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# Itelcond

ALUMINIUM ELECTROLYTIC CAPACITORS



[www.atd-elektronik.cz](http://www.atd-elektronik.cz)



## Data Book

Dear Partner,

Let us introduce ourselves.

Itelcond has over 40 years of experience in the design and production of aluminium electrolytic capacitors.

Our production range covers any application where a high quality capacitor is required. Our products are found in industrial products, such as UPS, inverter, solar, wind, e-mobility, automation, railways, welders, drives and medical.

An electrolytic capacitor represents many trade-offs in performance, price and lifetime. It is only through experienced understanding that the full benefits can be harnessed to deliver a long service life. At Itelcond, we have that experienced understanding along with state of the art manufacturing facility using European sourced materials in order to specify and deliver a long life product.

Please find the latest updates on our website.

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# SCREW TERMINAL SERIES

Series	Voltage Range [V]	Temperature Range [°C]	Case DxH [mm]	Expected Lifetime [hrs]	Applications
<b>AR</b> COMPACT	40 - 450	-40° +85° Self extinguishing construction and electrolyte	35x56 76x147	5.000 hrs	Industrial applications
<b>AY-HR</b> STANDARD APPLICATION	40 - 500	-40° +85° Self extinguishing construction and electrolyte	51x105 90x220	10.000 hrs	High reliability
<b>AD</b> LOW ESR	160 - 450	-40° +85°	51x80 90x240	15.000 hrs	High reliability Heavy transient Energy storage
<b>AP</b> PROFESSIONAL APPLICATION	40 - 450	-40° +85° Self extinguishing construction and electrolyte	64x105 90x240	15.000 hrs	Medical Heavy transient Energy storage Solar and wind application
<b>AS</b> PROFESSIONAL APPLICATION	40 - 500	-40° +85° Self extinguishing construction and electrolyte	35x56 90x220	15.000 hrs	DC-BUS Medical High reliability Telecom, Railways applications
<b>AF</b> EXTRA LONG LIFE	200 - 450	-40° +85°	64x105 90x240	20.000 hrs	Extra Long life Energy storage Railways applications Medical
<b>AZ</b> PROFESSIONAL	160 - 450	-40° +105°	51x105 90x240	5.000 hrs	Wide temperature range Long life High reliability LOW ESR
<b>AT</b> VERY LOW ESR	350 - 450	-55° +105°	64x105 90x220	8.000 hrs	Wide temperature range Very High reliability Very Long Life



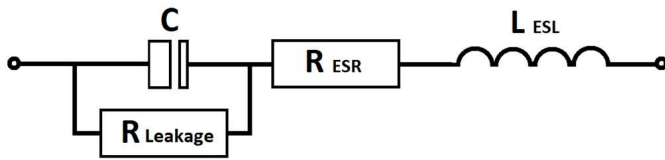
# SOLDER PIN SERIES

Series	Voltage Range [V]	Temperature Range [°C]	Case $\Phi \times H$ [mm]	Expected Lifetime [hrs]	Applications
<b>ARC/S</b> STANDARD	200	-40° +85° Self extinguishing construction and electrolyte	30x40 45x100	2.000 hrs	Solder pin mounting Industrial application High reliability 2-4 pins configuration
<b>AKS</b> 4/5 pins	40 - 450	-40° +85° Self extinguishing construction and electrolyte	30x40 40x100	5.000 hrs	Solder pin mounting Industrial applications
<b>ACC ACS</b> STANDARD APPLICATIONS	25 - 500	-40° +85° Self extinguishing construction and electrolyte	30x40 45x100	5.000 hrs	Snap-in type, Industrial application High reliability 2-4 pins configuration
<b>AZK</b> 4/5 pins	200 - 450	-40° +105°	30x40 40x100	5.000 hrs	Solder pin mounting Solar and wind application Energy Storage
<b>AZC AZS</b> STANDARD APPLICATIONS	200 - 450	-40° +105°	30x40 40x100	5.000 hrs	Solder pin mounting Industrial applications
<b>ATK</b> 4/5 pins	160 - 450	-55° +105°	30x40 40x100	8.000 hrs	Long life Low ESR Solar and wind application
<b>ATC ATS</b> PROFESSIONAL APPLICATIONS	200 - 450	-55° +105°	30x40 40x100	8.000 hrs	Very Long life Low ESR Solar and wind application



## Capacitance

The DC equivalent circuit of an aluminium electrolytic capacitor is shown in Figure 3.



Where:

- $R_{Leakage}$  is DC leakage current  $I_L$
- $C$  is the capacitance
- $R_{ESR}$  is the equivalent series resistance
- $L_{ESL}$  is the equivalent series inductance

Figure 3

The capacitance of a capacitor is the number of Coulomb/Volt that a capacitor can store. This value is normally expressed in microfarads ( $1\mu F = 10^{-6} F$ ) and the rated value is marked on the capacitor. The capacitance value depends on the ambient temperature in which the capacitor shall operate: the possible variations for every ITELCOND type are indicated in the graphs of individual data sheets: the largest deviations are at low temperature while at high temperature they are negligible.

It should be mentioned that the capacitance varies not only according to the temperature and frequency but even to the operational life of the capacitor: during the service life of the capacitor capacitance shows a regular decay determined by a series of simultaneous causes; such drift is less marked if the operational voltage decreases.

The percent values of capacitance drift for ITELCOND capacitors, after life tests of 2000/5000/10000hrs according to the type, are largely within the tolerance limits indicated in our catalogue and they are definitely lower than stated by DIN or CECC specifications.

Measurement shall be made at frequency of 100Hz and at a temperature of  $25^{\circ}C \pm 2^{\circ}C$ .

## Equivalent Series Resistance (ESR)

The equivalent series resistance of a capacitor is the resistance seen by the alternating current and it is this  $I^2 R$  that causes a capacitor to warm up. Figure 4 shows a set of ESR curves for a typical electrolytic capacitor.

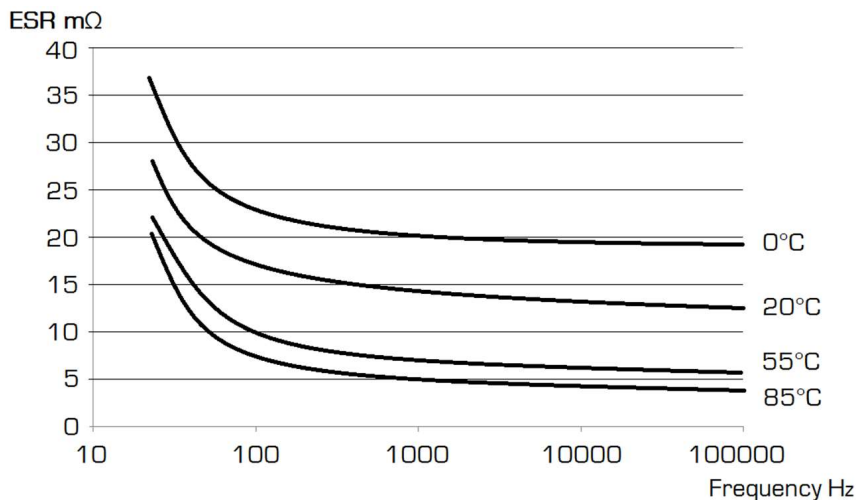


Figure 4

### Dissipation Factor (DF)

Dissipation factor ( $\tan \delta$ ) or DF is the ratio of the equivalent series resistance (ESR) to the capacitive reactance ( $X_c$ ):

$$DF = \tan \delta = ESR/X_c$$

The capacitive reactance ( $X_c$ ) can be expressed in terms of frequency ( $f$ ) and capacitance ( $C$ ):

$$X_c = 1/(2*\pi*f*C)$$

Combining the two equations expresses dissipation factor ( $\tan \delta$ ) or DF in terms of frequency ( $f$ ), capacitance ( $C$ ) and equivalent series resistance (ESR):  $DF = \tan \delta = 2*\pi*f*C*ESR$

Measurements are made at frequency of 100Hz and at a temperature of 25°C±2°C

### Equivalent Series Inductance (ESL)

Equivalent series inductance (ESL) is the inductance seen by the alternating current. Generally, the larger the physical size of a capacitor, the larger the ESL. ESL is made up of the physical aspects of the capacitor such as leads and terminals, are deemed parasitic inductances, and are not ideal, but they have to be taken into account as inductive reactance ( $X_l$ ). The inductive reactance can be expressed in terms of frequency ( $f$ ) and equivalent series inductance (ESL):  $X_l = 2*\pi*f*ESL$

### Impedance (Z)

Impedance ( $Z$ ) is the total resistance to the alternating currents and includes both resistive and inductive components.

The impedance of an electrolytic capacitor depends on the equivalent series resistance (ESR), the capacitive reactance ( $X_c$ ) and inductive reactance ( $X_l$ ):

$$Z = \sqrt{(ESR^2 + (X_c - X_l)^2)}$$

### Self-Resonant Frequency (Fr)

When the inductive reactance ( $X_l$ ) and the capacitive reactance ( $X_c$ ) are equal the self-resonant frequency ( $F_r$ ) of the capacitor is reached and can be expressed in terms of equivalent series inductance (ESL) and capacitance ( $C$ ):

$F_r = 1/(2*\pi*\sqrt{ESL*C})$ . Figure 5 shows the relationship between the equivalent series resistance (ESR), capacitive reactance ( $X_c$ ), inductive reactance ( $X_l$ ) and impedance ( $Z$ ).

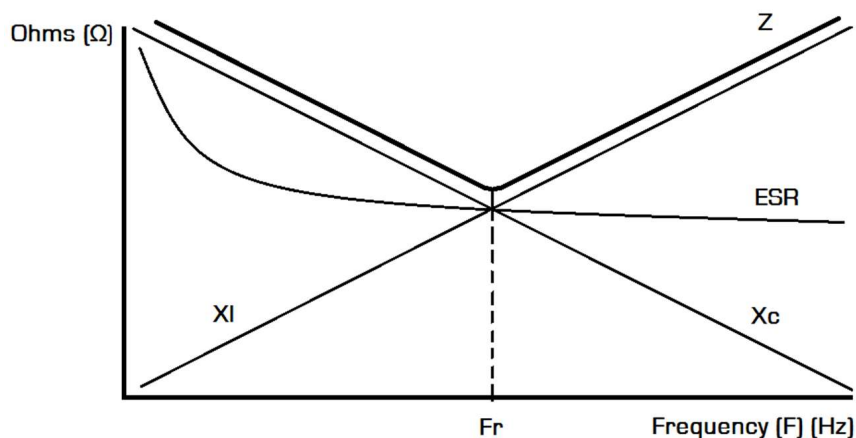


Figure 5

As can be seen from figure 5, the self-resonant frequency ( $F_r$ ) is when the inductive reactance ( $X_l$ ) and the capacitive reactance ( $X_c$ ) are equal. At this point, the impedance ( $Z$ ) and equivalent series resistance (ESR) converge. Below the self-resonant point ( $F_r$ ) the capacitive



reactance ( $X_c$ ) is the strongest aspect and the capacitor performs like a capacitor. Above the self-resonant point ( $F_r$ ) the inductive reactance ( $X_l$ ) is the strongest aspect and the capacitor performs like an inductor.

## Voltage

The various voltage terminologies are shown in figure 6.

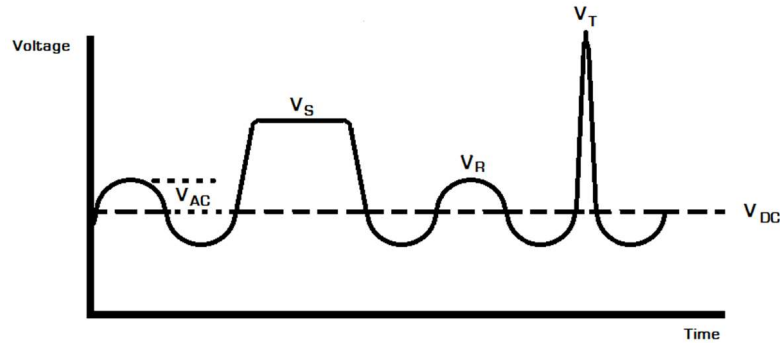


Figure 6

$V_R$  is the rated voltage of the capacitor. The maximum peak voltage of any ripple voltage component must not exceed the rated voltage.

$V_{DC}$  is the mean value of the applied DC voltage.

$V_{AC}$  is the maximum superimposed ripple voltage.

$V_S$  is the surge voltage. A surge voltage is caused by disturbances, such as switching and the values are stated for each capacitor range. The limitations are a maximum of 1000 random occurrences during the life of the capacitor with a load period of 30s and no load period of 330s. The RC time constant equals 0.1s.

$V_T$  is the transient voltage. Transients are application specific and there are no stated values. However, a typical transient could have a rise time ranging from a few hundred  $\mu$ s to several ms. Contact Itelcond if your application involves transients.

Reverse voltage not exceeding 1.5 Volts may be applied to the capacitors without significant change in normal performance characteristics.

## Leakage Current and Shelf Life

Figure 3 described the  $R_{Leakage}$  component as the DC Leakage current  $I_L$ . Leakage current is the residual current that flows once a capacitor has been fully charged. During the manufacture of an electrolytic capacitor the leakage current is managed down to the level specified in the range data. Figure 7 shows this process. Leakage current is specified at 20°C temperature.

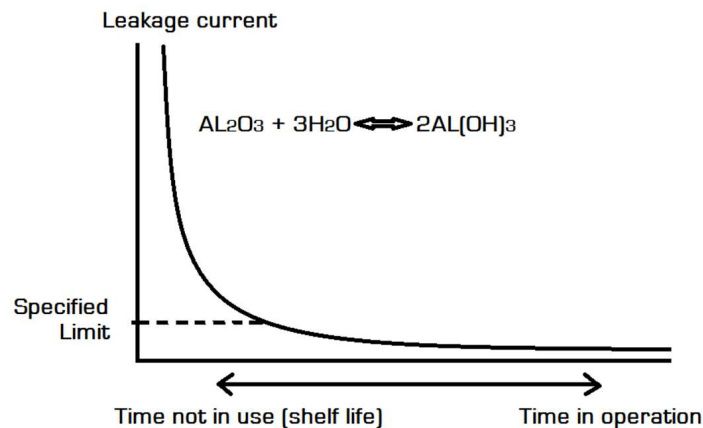


Figure 7

In operation, the leakage current will continue to gradually reduce and settle to a level somewhat less than the specified level. The time to settle will vary depending on the size of the capacitor but can typically take several hundred hours for a screw terminal capacitor.

### Leakage Current Multipliers

The leakage current value of an aluminium electrolytic capacitor is influenced by ambient temperature and by ratio of working voltage to rated voltage. Figure 8 give some indication of the multipliers that can be generally applied to each series.

Tamb [°C]	AR-AY-AKS-ACC-ACS	AS	AP	AZ	AT
25	1	1	1	1	1
35	1.2	1.2	1.2	1.2	1.2
45	1.4	1.4	1.2	1.4	1.4
55	1.8	1.8	1.6	1.8	1.8
65	2.5	2.4	2.2	2.4	2.4
75	3.5	3.0	2.8	3.0	3.0
85	5.0	4.0	3.9	4.5	4.5
95	N.A.	N.A.	N.A.	6.8	6.2
105	N.A.	N.A.	N.A.	9.0	8.3

Figure 8

### Leakage current decrease Vs. Voltage derating

If the voltage applied to the capacitor is lower than the rated voltage, the leakage current decreases accordingly and the approximate reduction factor is shown in Figure 9

Vapplied/Vrated	1	0,9	0,8	0,7	0,6	0,5	0,4
Multiplier	1	0,75	0,70	0,55	0,45	0,30	0,20

Figure 9

### Shelf life

Shelf life is where the electrolytic capacitor is stored dormant, either within equipment, or individually. Time, humidity and temperature will have an effect on a dormant capacitor where the leakage current will slowly increase over time without voltage present. A reversal of the aging process will occur as a chemical change will occur. As such, re-aging will be required before use. For how long you can leave a capacitor on the shelf at what temperature is shown in figure 10.

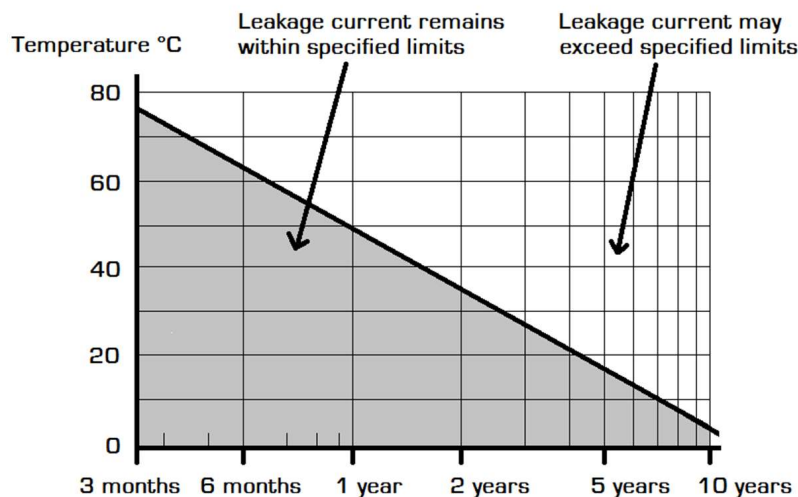


Figure 10

In a typical warehouse, the shelf life should be a minimum of 2 years. Beyond this, the leakage current may exceed the limits. If re-aging is required then this needs to be completed at room temperature. Connect a voltage supply equal to the rated voltage, but current limited to a value equal to the specified leakage limit of the capacitor. Anything from 1 to 4 hours may be required to re-age depending on the initial condition. Care should be taken when re-aging with high voltages.

## Voltage Deration

Voltage deration is the operation of an electrolytic capacitor below its rated voltage. This may occur through personal choice based on 'best practise' or through mandated requirements of the end market. How voltage deration works is shown in Figure II.

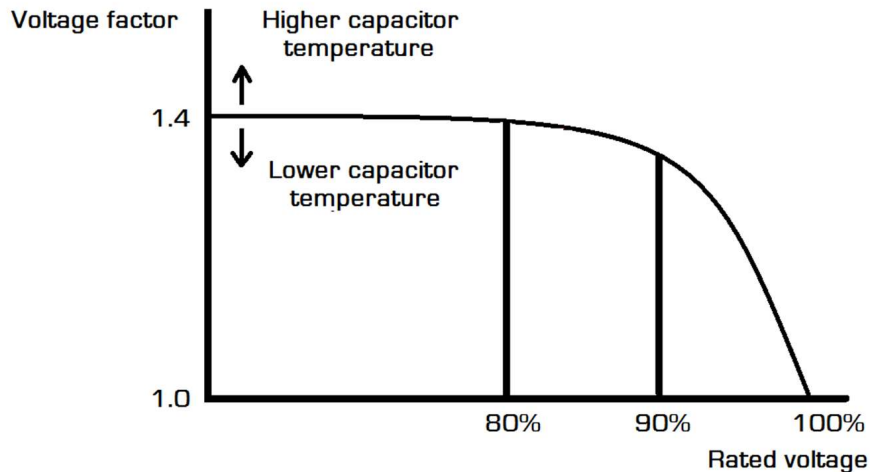


Figure II

From the figure II, you can see that you do not gain any further benefit from derating the capacitor below 80% of the rated voltage. Voltage factor has more effect at higher capacitor temperatures and is a parameter that is included in an expected life calculation. The 1.4 value represents a 40% increase in expected life.

## Useful Life Calculation

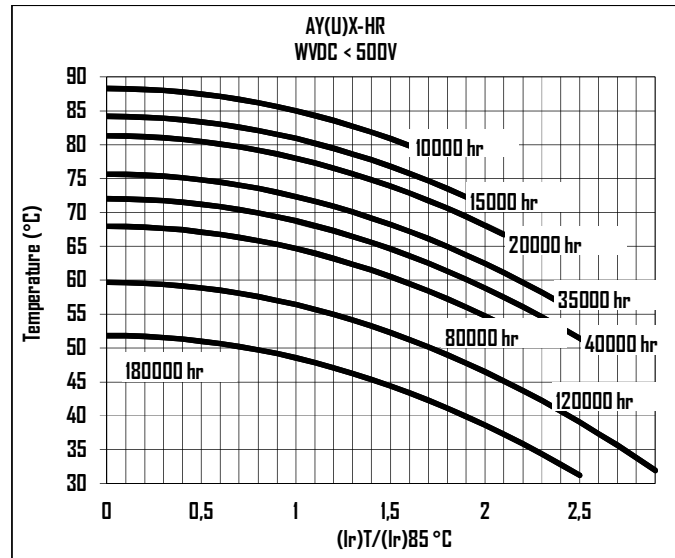
The useful life of a capacitor is calculated in accordance with the tables of expected life per each series.

The rated ripple current at upper category is listed in the data sheets, while the ripple current at different temperature can be calculated using the tables shown on each series.

To know the useful life proceed as follows:

- calculate the ratio  $(I_R) / (I_{R@185^\circ\text{C}})$  or  $(I_R) / (I_{R@105^\circ\text{C}})$
- find on to the table the crossing between the working temperature and the calculated ratio
- on top of the table it appears the useful life in hours

The example does not consider the frequency dependence of ripple current: the corresponding factor listed on each type must be used as an additional factor.


**Example 1:**

- Capacitor AY(U)X-HR472M350DFI
- Working conditions:  $I_{Ripple} = 25A@100Hz$
- Ambient temperature =  $70^{\circ}C$

**VN=350V**

Capacitance [ $\mu F$ ]@100Hz	Case	Tan $\delta$ [%]@100Hz	ESRmax/typ		Zmax [m $\Omega$ ]@10KHz	Iripple55°C/85°C		Ordering Code (U) for mounting stud
			[m $\Omega$ ]@100Hz			[A]@100Hz	[A]@100Hz	
4700	DF	0,08	27	22	20	22,8	16,3	AF(U)X-HR472M350DFI

$$1. \frac{I_{Ripple}}{I_{Ripple@85^{\circ}C}} = \frac{25}{16,3} = 1,53$$

a. Crossing 1,53 and  $T=70^{\circ}C$  expected life is about 30.000 hours

**Example 2:**

- Capacitor AY(U)X-HR472M350DFI
- Working conditions:  $I_{Ripple} = 25A@500Hz$
- Ambient temperature =  $70^{\circ}C$

**VN=350V**

Capacitance [ $\mu F$ ]@100Hz	Case	Tan $\delta$ [%]@100Hz	ESRmax/typ		Zmax [m $\Omega$ ]@10KHz	Iripple55°C/85°C		Ordering Code (U) for mounting stud
			[m $\Omega$ ]@100Hz			[A]@100Hz	[A]@100Hz	
4700	DF	0,08	27	22	20	24,5	16,3	AF(U)X-HR472M350DFI

$$1. I_{Ripple} = \frac{25}{1,32} = 18,9$$

$$2. \frac{I_{Ripple}}{I_{Ripple@85^{\circ}C}} = \frac{18,9}{16,3} = 1,16$$

a. Crossing 1,16 and  $T = 70^{\circ}C$  expected life is about 36000 hours

**Example 3:**

- Capacitor AY(U)X-HR472M3500F1
- Working conditions:  $I_{Ripple} = 25A @ 500Hz$
- Ambient temperature  $= 60^{\circ}C$

**VN=350V**

Capacitance	Case	Tanδ	ESRmax/typ		Zmax	I <sub>ripple</sub> 55°C/85°C		Ordering Code
[μF]@100Hz		[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@100Hz	[A]@100Hz	(U) for mounting stud
4700	DF	0,08	27	20	17	23,9	17,1	AY(U)X-HR472M3500F1

$$3. I_{Ripple} = \frac{25}{1,32} = 18,9$$

$$4. \frac{I_{Ripple}}{I_{Ripple@85^{\circ}C}} = \frac{18,9}{16,3} = 1,16$$

- a. Crossing 1,10 and  $T = 60^{\circ}C$  expected life is about 120000 hours

### Waveforms

All of the above examples assume a sine wave ripple current profile. Variations to a sine wave are shown in figure 12 along with the formula to calculate the equivalent sine wave ripple current.

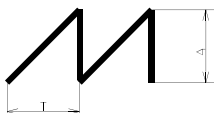

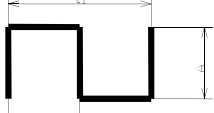
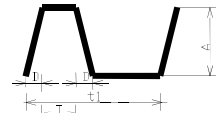
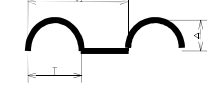
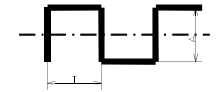
Waveform	r.m.s. value	Waveform	r.m.s. value
	$A \cdot \sqrt{\frac{T}{3}}$		$A \cdot \sqrt{\frac{t1}{3 \cdot T}}$
	$A \cdot \sqrt{\frac{T}{t1}}$		$A \cdot \sqrt{\frac{(2 \cdot D + 3 \cdot T)}{t1}}$
	$A \cdot \sqrt{\frac{T}{2 \cdot t1}}$		A

Figure 12

### Capacitors in Series – Balancing Resistors

When aluminium electrolytic capacitors are connected as a bank of capacitors where there are multiple parallel branches of series capacitors, the need for balancing resistors is diminished due to the averaging effect of the number of capacitors where individual leakage current values become less critical. However, in the case of just two capacitors connected in series it is advisable to use balancing resistors in order to control the voltage sharing across each device due to imbalances in individual capacitor leakage currents. Figure 13 shows two capacitors in series along with balancing resistors.

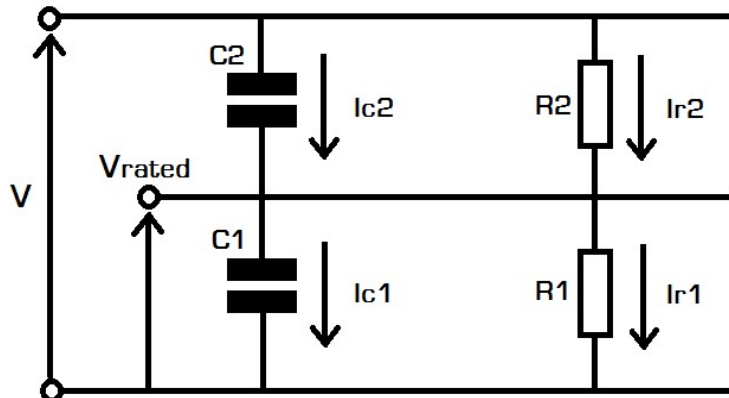


Figure 13

Trying to calculate individual leakage current values is impractical in a production environment and so an estimation based on experience can be made in order to calculate the differences in leakage currents between two capacitors in series. In figure 12 the individual leakage currents are  $I_{c1}$  and  $I_{c2}$ .

The estimation for the leakage current difference between  $I_{c1}$  and  $I_{c2}$  is:

$$\text{Difference, mA} = (0.0015 * C * V) / 2000$$

where  $C$  is the value of the individual capacitors in  $\mu\text{F}$  and  $V$  is the voltage across both capacitors in series.

Next, to calculate the value for balancing resistors, the equation is:

$$R \Omega = ((2 * V_{\text{rated}}) - V) / I_{\text{difference}}$$

where  $V_{\text{rated}}$  is the individual capacitor rated voltage and  $V$  is the voltage across both capacitors in series.

Next to calculate the power rating of the resistors, we firstly require the current through the balancing resistor and then the power. The current through the balancing resistor is:

$$I, \text{ mA} = (V/2)/R$$

where  $V$  is the voltage across both capacitors in series and  $R$  is the value of a balancing resistor.

The power,  $P$ ,  $W = I^2 R$ .

Example:  $V = 940\text{v}$ ,  $V_{\text{rated}} = 500\text{v}$ ,  $C = 1800\mu\text{F}$

$I_{\text{difference}} = 2.538\text{mA}$

$R = 23.64\text{k} \Omega$

$I = 19.881\text{mA} = 0.019881\text{A}$

$P = 9.34\text{W}$

## Altitude

Itelcond electrolytic capacitors can be operated at altitude or in a vacuum. The safety vents in electrolytic capacitors will operate at approximately 110 psi/760kPa/7.5bar. At altitude in a vacuum, these values will be reduced by 14.7psi/101kPa/1bar. So, at altitude, the capacitor must be operated in a less demanding arrangement.

Another factor is that there will be no natural convection to carry heat away in a vacuum. As such, there must be further derating of the demands on the capacitor.

### Screw Terminal

The terminals on a screw terminal capacitor are 99.9% aluminium. The layout is shown in figure 14.

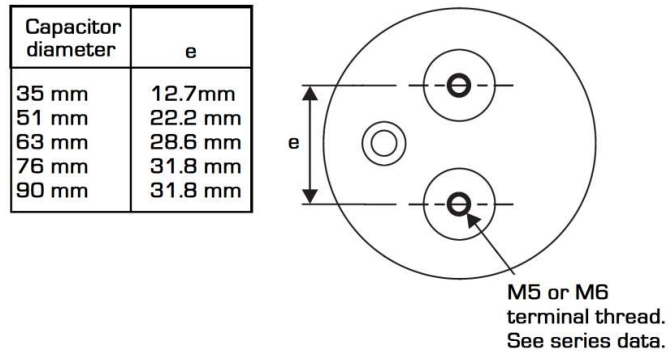


Figure 14

### Snap in and DIN pin

The terminals on a snap-in or DIN pin capacitor are base steel, flashed with copper, then plated in tin. So the terminal finish is tin.

Snap in pin layout is shown in figure 15.

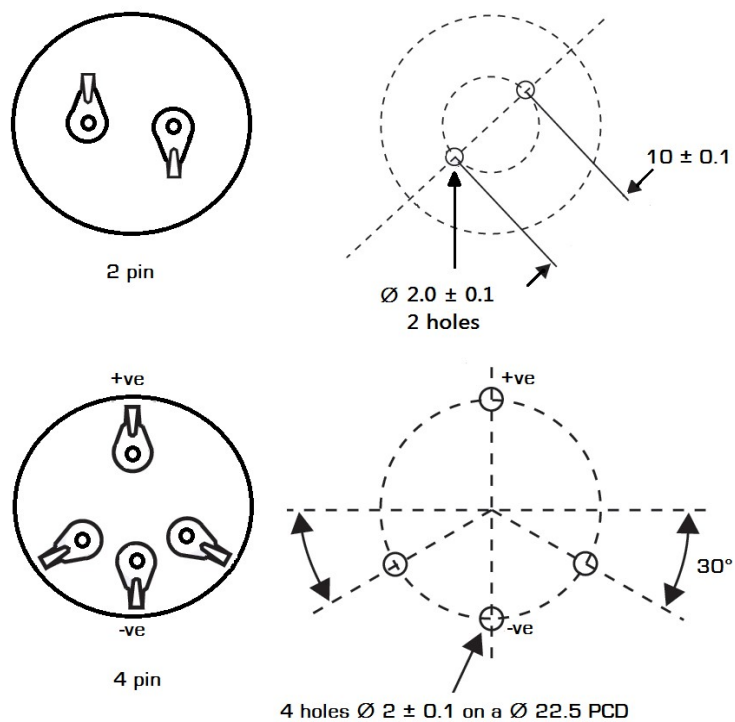
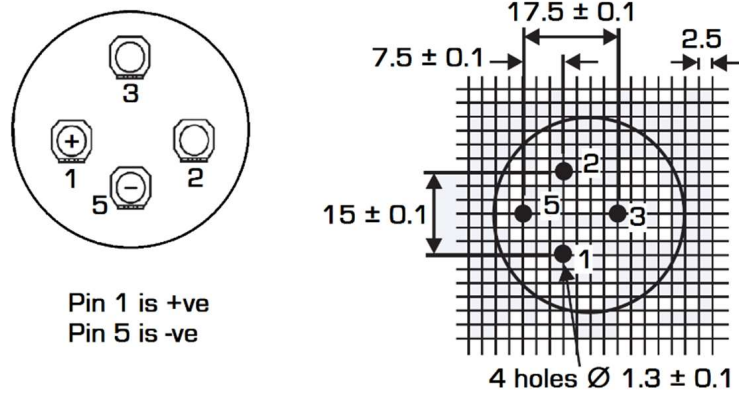


Figure 15

With a 4 pin snap in, two of the pins are unassigned. They are intended for mechanical stability. It is recommended that they are soldered to the printed circuit board. These unassigned pins are at the negative potential but they must not be used in place of the negative connection. As such they should be connected to the same potential as the negative pin or left electrically isolated.

DIN pin layout is shown in figure 16.

35mm diameter 4 pin



40mm and 45mm diameter 5 pin

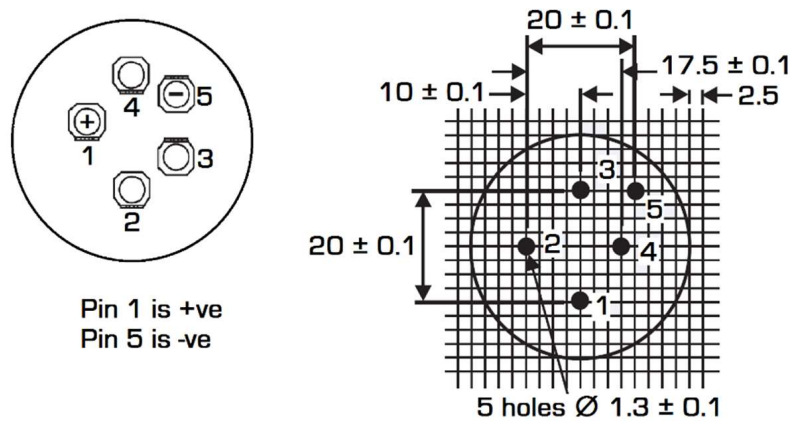


Figure 16

With the DIN pin layout, pin 1 is the positive connection and pin 5 is the negative connection. The spare pins are unassigned. They are intended for mechanical stability. It is recommended that they are soldered to the printed circuit board. These unassigned pins are at the negative potential but they must not be used in place of the negative connection. As such they should be connected to the same potential as the negative pin or left electrically isolated.

**IEC – Climatic Category**

The permissible climatic stress on an aluminium electrolytic capacitor is given by the respective IEC climatic category. Following IEC 60068-1, the climatic category is composed by 3 groups of numbers, separated by slashes.

Example 40/85/56.

1st group: Lower category temperature (temperature limit) denoting the test temperature for test A (cold) to IEC 60068-2-1

2nd group: Upper category temperature (temperature limit) denoting the test temperature for test B (dry heat) to IEC 60068-2-2

3rd group: Number of days, the duration of test C (damp heat, steady state) at a relative humidity of 93 +2/-3% and an ambient temperature of 40°C, to IEC 60068-2-78.



Given an operating condition and expected life, the reliability of an Itelcond capacitor can be defined as the probability that it will operate correctly. The expected life is the period of time in which a capacitor reaches the maximum accepted values of modification of its electrical parameters.

Naturally it is impossible to predict exactly when a capacitor will fail and so probability theory is used. To forecast the probability that a capacitor will operate correctly, MIL-STD-883C specifications with a "confidence level" of 60% is utilised. Reliability is linked to capacitor temperature, applied voltage and time in use.

Reliability as a function of time,  $Rel(t) = e^{-\lambda t}$  where  $Rel(t)$  is the probability that the capacitor will work correctly and  $\lambda$  is the failure rate.

The failure rate of many electronic components follows a characteristic 'bath tub' pattern as shown in figure 17.

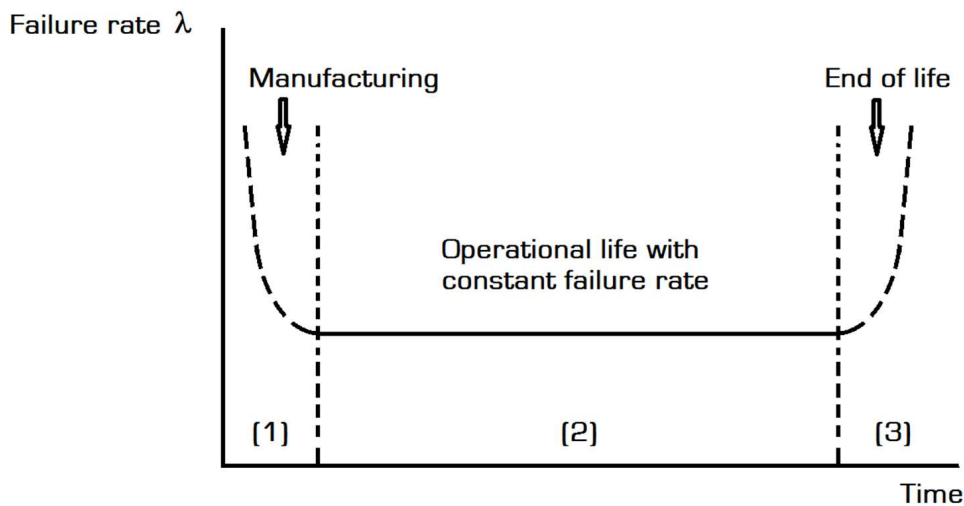


Figure 17

- (1) is the period during manufacturing.
- (2) is the operational life, where the failure rate is invariably constant.
- (3) is where the end of life has been reached. The failure rate will rapidly increase.

The failure rate,  $\lambda$ , is defined as  $1 \times 10^{-9}$  failures per hour, and is also known as Failure in Time, or FIT, and is also expressed as a percentage of failures per 1000 hours.

For example,  $10 \text{ FIT} = 1 \times 10^{-8}$  failures per hour = 0.01%/1000 hours.

Years of experience have shown that values in **Errore. L'origine riferimento non è stata trovata.** can be considered, during the intrinsic failure period of a typical bathtub statistical curve. The values of FIT are typical at 60°C.

ITELCOND series	Voltage	FIT	ITELCOND series	Voltage	FIT
AR,AY	<150 Vdc	40	AZK	<150 Vdc	50
	≥150 Vdc	70		≥150 Vdc	80
AS	<150 Vdc	45	ATK	<150 Vdc	40
	≥150 Vdc	45		≥150 Vdc	70
AP	ALL VOLTAGES	45	ACC	ALL VOLTAGES	50
AF	ALL VOLTAGES	45	AZC	<150 Vdc	50
AT	ALL VOLTAGES	20		≥150 Vdc	80
			ATC	<150 Vdc	40
AKS	<150 Vdc	50		≥150 Vdc	70

Figure 18

Figure 19 shows a typical FIT vs temperature graph.

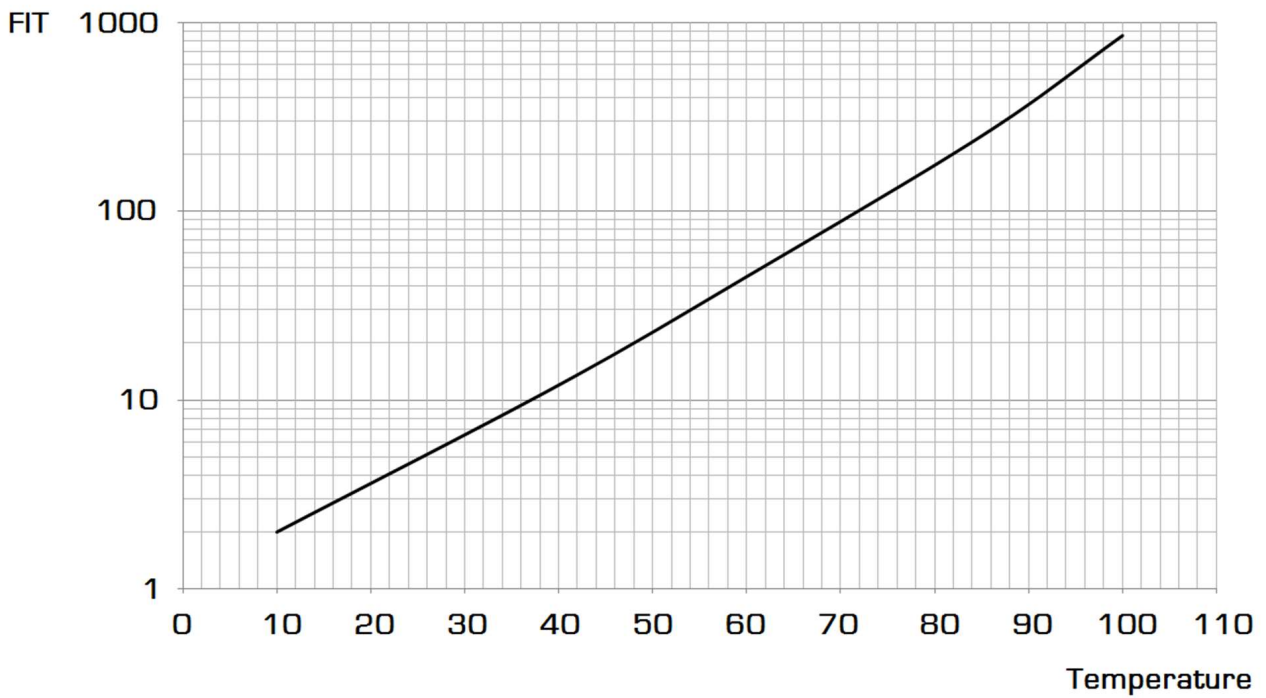


Figure 19

Applied voltage in relation to the capacitor rated voltage also has an effect on reliability. Figure 20 shows the effect of having the applied voltage less than the rated voltage as a percentage.

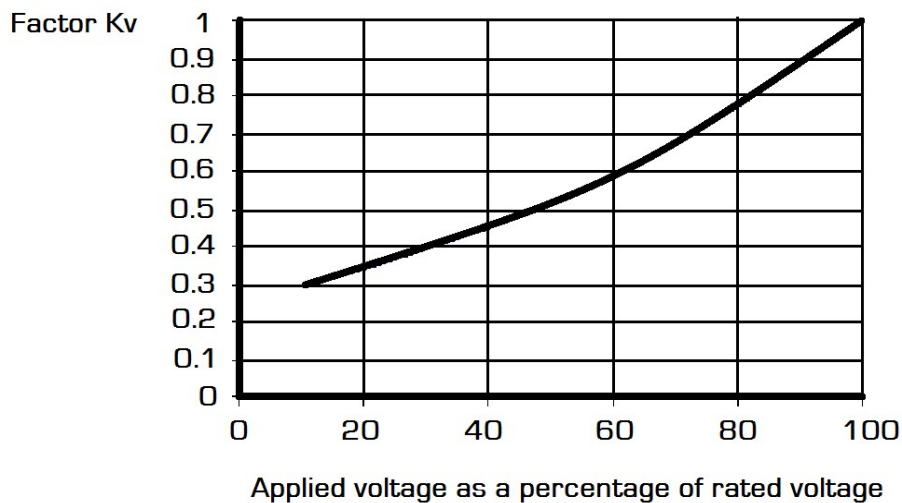


Figure 20

The failure rate during the operational life,  $\lambda_{op}$ , is the FIT value from figure 17 multiplied by the Kv value from figure 20:

$$\lambda_{op} = FIT \times K_v$$

The mean time before failures (MTBF) is the inverse of the failure rate:  $MTBF = 1 / \lambda_{op}$

## Vibration Test

### Screw Terminals

To IEC 60068-1:

Frequency range 10 Hz / 55 Hz, displacement amplitude 0.75 mm, acceleration max 10 *g*, duration 3 x 2 h.

Capacitor mounted by its body which is rigidly clamped to the work surface.

### Solder pins

To IEC 60068-2-6, test Fc:

Frequency range 10 Hz / 55 Hz, displacement amplitude 0.35 mm, acceleration max 5 *g*, duration 3 x 2 h.

Capacitor mounted by its body which is rigidly clamped to the work surface.

### Sealing Test

The capacitors shall be tested for seal tightness in accordance with IEC 68-2-17.

## Insulation Strength

-Insulation resistance @100V, 60°C between terminals and mounting hardware >100 MΩ.

-Dielectric strength of the sleeve >2500Voc.

## Self-recharging ( Dielectric Absorption)

It is important to take note that Aluminium Electrolytic Capacitors undergo to the phenomenon known as self-recharging or dielectric absorption.

It is a phenomenon that is impossible to predict. A capacitor, which has been charged and then completely discharged, may appear to re-charge itself, if left open circuit. Itelcond has observed a maximum of 30 Volts across the terminals but sometimes the value could be higher. It is therefore suggested to discharge the capacitors before touching or connecting the terminals.

## Cleaning Agents

Halogenated solvents are not recommended for use in cleaning capacitors, while many solvents such as alcohol are suitable. It must be remembered that many solvents given, as chemically stable in the most varied conditions may on the contrary be electrochemically dissociated, producing chemical products extremely dangerous to the capacitor life. The following list contains critical halogenated solvents (unsafe) used as cleaning agents in electrical industry: Trichloroethane (ex. Chlorotene)

- Freon
- Trichloroethylene
- Tetrachloroethylene
- Chloroform
- Methylene chloride
- Methyl ethyl Ketone
- Acetone

In case of wetting capacitors with those solvents, a safe cleaning agent must be used to eliminate residues of non-safe agents.

List of solvents without halogen (safe):

Methanol

Propanol

Isobutanol

## Electrolytes

Electrolytes used in aluminium capacitors manufacturing are produced in accordance with Itelcond internal specifications.

*Since its foundation ITELCOND has never used in its electrolytes formulations that are dangerous or potentially poisonous chemicals. So all electrolytes are free from:*

- Dimethylformamide (DMF)*
- Dimethylacetamide (DMAC)*
- Polychlorinated biphenyl (PCB)*

## Materials

The aluminium electrolytic capacitors manufactured by Itelcond comply with:

- Directive 2002/95/EC -January 2003
- Directive 2003/11/EC -February 2003
- Amendment of Directive 2002/95/EC -August 2005
- Directive 2006/122/EC -December 2006

Itelcond certifies that during designing and manufacturing of aluminium electrolytic capacitors there is no :

- Asbestos
- Lead (Pb)
- Polychlorinated Triphenyl (PCT)
- Polybrominated Biphenyl (PBB)
- Mercury (Hg),
- Dimethylacetamide (DMAC)
- Dimethylformamide (DMF)
- Polychlorinated Biphenyl (PCB)
- Polybrominated Diphenyl (PBD)
- Chromium VI (Cr<sup>VI</sup>)
- Polybrominated Diphenyl Ethers(PBDE)
- PentaBDE / OctaBDE / DecaBDE

Materials currently listed as carcinogenic / mutagenic / teratogenic are not intentionally added or used.

Itelcond has written assurance from suppliers that they do not use the above chemicals or substances in the manufacture of materials Itelcond are currently employs to produce its own capacitors.

## Non Flammable Materials

ITELCOND capacitors are manufactured with raw materials that meet UL specifications. This is shown in figures 21 and 22.

### Raw Materials for Screw Terminal

Component	Material	UL rating
Cover / deck	Thermosetting	VO
Plastic sleeve	PVC	VO
Bottom insulating disk	PVC	VO
Plastic washers	Thermoplastic	VO
Hex nut	Thermoplastic	VO

*Figure 21*

### Raw Materials for Solder Pin Types

Component	Material	UL rating
Cover	Rubber-Bakelite	HB
Plastic sleeve	PVC	VO
Bottom insulating disk	PVC	VO

Figure 22

### Precautions

When using aluminium electrolytic capacitors a number of precautions must be taken:

- Operating temperature, ripple current and working voltage must be within the specified limits.
- Do not exceed 1.5V reverse voltage.
- Do not apply an AC only voltage. Any AC voltage must be superimposed onto a DC voltage that is of a greater value than the AC voltage swing, so to avoid any reverse voltage conditions.
- The DC voltage plus AC component cannot exceed the working voltage of the capacitor.
- Capacitors used in areas where harmful gases are present may undergo a reduced lifetime due to diffusion through the sealing gasket into the inside of the capacitor, causing damage.
- When a capacitor is used in a highly dusty area check that the level of dust powders on the top of the capacitor does not reach the terminals to avoid possible short circuit.
- Moisture or salt spray can penetrate into the capacitor and cause short circuit.
- When mounting snap in capacitor with a solder iron, the hot tip cannot come into contact with the can, deck or insulating sleeve.
- When units are mounted in series – parallel combinations use homogeneous date codes.
- Take care when handling capacitors. Any physical damage could render the capacitor bad and it should not be used.
- Capacitors should not be stored under direct sun light.
- Be aware of the risk posed by dielectric absorption.
- When a capacitor is operated at a low voltage for a prolonged time and is then operated at a higher voltage an increase in temperature must be expected.
- When a snap in capacitor is fixed to the printed circuit board by means of a fixing material be sure that the fixing compound does not contain chloride or chemicals that can deliver chlorine.
- Cleaning the printed circuit board must be achieved with non-hazardous chemicals.
- A hazardous voltage, especially on very high capacitance units, is present for up to 60 minutes after removal of power.
- Do not use capacitors having a standard design in circuits where the charge and discharge cycles have a high repetition rate; specific capacitors can be designed for this application.
- When the safety vent operates a gas at high temperature is emitted: the gas may contain electrolyte that could damage the printed circuit board or connecting bars if not properly insulated from chemical attack.
- When a capacitor in bank fails replace all the capacitors: do not replace the failed capacitor only.

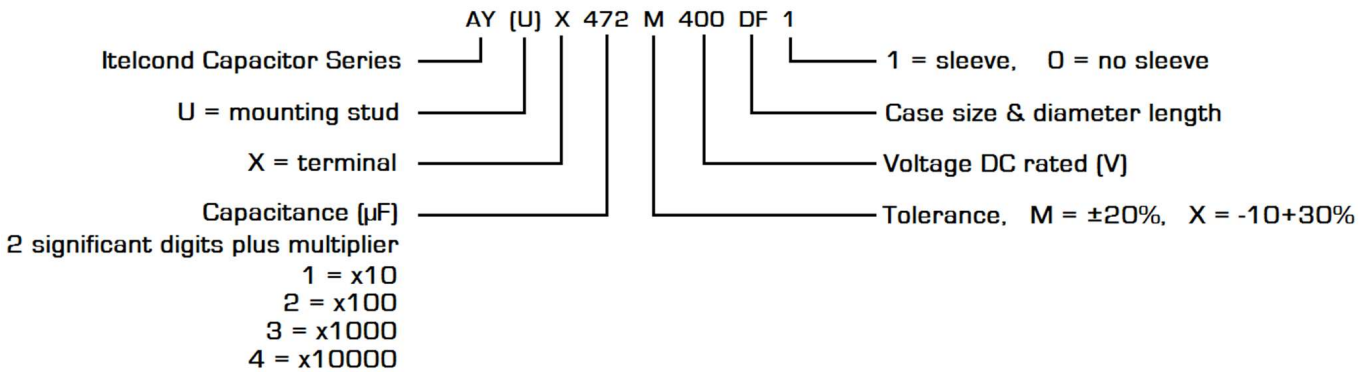
### Marking

ITELCOND capacitors shall be marked as shown in figure 23.

ITELCOND
Series
Rated Capacitance ( $\mu\text{F}$ )
Rated DC working voltage (V)
Part Number
Date code of manufacture

Figure 23

### Capacitor Ordering Code



### Packaging

Units are packed in carton boxes and the number of units per box is shown in figure 24. Carton boxes for larger shipments are packed onto Euro dimensioned wooden pallets (plastic on request).

Series	Diameter	Length	Pcs/Box	Weight/Box [kg]
Screw terminal	A 35mm	A=55mm	50/100	4-7
		B=80mm	50	4-6
		C=105mm	50	6-8
	B 51mm	B=80mm	30	5-7
		C=105mm	30	6-9
	C 63mm	C=105mm	20	6-8
		F=145mm	20	9-10
		C=105mm	12	5-7
	D 76mm	F=145mm	12	6-14
		K=165mm	12	6-14
		J=222mm	8	9-11
		C=105mm	6	7-9
E 90mm	F=145mm	6	9-11	
	J=222mm	6	8-12	
	L=240mm	6	9-13	

Series	Diameter	Length	Pcs/Box	Weight/Box [kg]
Solder pins	M 30mm	B=40mm	254	6-15
		C=50mm	254	6-15
	N 35mm	B=40mm	100	6-8
		C=50mm	100	6-8
		N=60mm	50	5-7
	P 40mm	E=75mm	50	6-8
		B=40mm	126	9-10
		C=50mm	126	9-10
		E=75mm	63	10-11
	Q 45mm	G=100mm	63	10-11
		C=50mm	96	18-21
		E=75mm	48	13-18
G=100mm		48	16-20	
		N=60mm	48	16-20

Figure 24

The shown weight values depend on the type of unit packed into the box : the weight of capacitors is a function of the capacitance value of the capacitor (e.g. into the same can size a capacitor having a capacitance of 2200 µF differs substantially from one having a capacitance of 10000 µF).

## Terms and Conditions

1. The general conditions presently in force are applicable to all purchases effected by the Client (Buyer) from Itelcond S.r.l. (Seller). These general conditions must not be exceeded, modified, deferred or, in any other way, altered, except if an official document is underwritten and signed by the Seller. Under no circumstances the general conditions adopted by the Buyer, printed on his purchase orders or any other document, will be deemed applicable to none of the purchase orders placed with the Seller. The execution, also partial, of the Buyer's order, or any other fulfillment from the Seller's side towards the Buyer, will not be valid and therefore not interpreted as tacit or implicit acceptance of any general condition decided by the Buyer, unless specifically agreed upon the Seller's legal representative.
2. The products manufactured or sold by the Seller are not designed to be used into devices or equipments to be inserted surgically into the human body or, in other words, suitable to examine or preserve the human life, or used in devices or systems for the nuclear applications. If the Buyer intends to utilise the Seller's products for its application in medical, nuclear, military and/or aerospace fields, he may do so only with prior request and receipt of a document signed by the Seller's managing director, certifying that these products are suitable to be applied in the above fields.
3. The Seller will accept purchase orders only after written confirmation of the order, sent to the Buyer.
4. Delivery dates shown in the confirmation order are only indicative and not binding. The Seller will do his utmost in order to respect the confirmed delivery date but, at the same time, does not take any responsibility for the eventual non-observance of the date. The delivery is linked to the payment of eventual amounts which are due and are related to previous supplies. Likewise also prices indicated in the confirmation order might vary according to increases in the energy or raw materials prices or changes in currency rates.
5. In absence of written agreements, orders are considered fulfilled with a tolerance of plus/minus 3% or plus/minus 5 pieces.
6. The technical specifications of the Seller's products are those contained in his last "Data Book" and are also traceable on his Web Site: [www.itelcond.it](http://www.itelcond.it). The technical specifications may also be those agreed upon between Seller and Buyer.
7. Seller's products will be free from vices and will be guaranteed for a period of 12 months from delivery date to the Buyer. The law decree No.24 of 02.02.2002 will not be enforced as these products are not considered as consumer goods. The warranty is effective exclusively towards the Seller's direct Buyer. Damages claimed by third parties, although if requested by Seller's direct Buyer, will be turned down.
8. The warranty does not cover products which are used incorrectly. Certain types of electric products, designed and manufactured to be used as basic components to be inserted in other electric devices, are anyway such that their performance is widely related to the way they are integrated in the final product and by its general characteristics. In the range of these basic components are included both active and passive components and notably the electrolytic capacitors.
9. Eventual defects or vices of goods will be promptly notified in writing and anyhow not after 8 days from the date of receipt of goods. In case of hidden defects, the above timing will start from the date of the discovery of these defects. In case of vices ascertained and reported in due time, defects or lack in quantity or quality of products, the Seller is entitled to the sole substitution of such products, repair or writing back of such products at his choice. In line with the most ample applicability of the law, any different and further responsibility is excluded for damages occurring to the buyer or third parties with regard to the utilization of the Seller's products. Samples, prototypes and products in development, will be delivered as they are and uncovered from warranty.
10. In case of missed and damaged products and units considered not in line with the technical specifications, the Buyer is entitled to inform immediately the Seller, who will decide how to proceed about the matter. No rejected goods will be accepted, unless previously authorized by the Seller. If an authorization number for the rejection (RMA) has been notified to the Buyer, such a number must be reported both on packaging and on documents accompanying the units rejected to the Seller. Products, travelling at Buyer's risk and danger, must be returned complete, not tampered with, non-welded, with their eventual accessories and adequately packed and delivered free factory of Seller. The assignment of the authorization number for rejection does not allow the Buyer to obtain the substitution of products, the credit of their value, and whatsoever responsibility on the Seller's side is not admitted. The Buyer is obliged to comply with the rules related to the re-exportation of the products to clients or countries, if the Italian law forbids export and sale towards them.
11. Goods are sold free factory of Seller and therefore the transportation risk is at total Buyer's charge. The delivery of products will be considered in every respect accomplished once the products are collected by the carrier or by the same Buyer at the Seller's warehouse.
12. The sold products will remain property of the Seller until totally paid by the Buyer. In case of delayed or missed payment the Seller may, at his discretion, request to re-enter into possession of unpaid products.
13. The Seller will not be liable if events, not due to his will, will prevent him to accomplish, partially or totally, the contractual obligations undertaken. The Seller will not assume responsibility for his products after the same are assembled on Buyer's equipments. The Seller will not be liable, no limitations admitted, for damages caused by the loss of warranty, contracts, or other legal matters, including loss of value, profit, capital, or expenses for the substitution of equipments.
14. Any dispute will be submitted to the law-court of Milan (Italy). Under any circumstance the contract will be exclusively governed by the Italian law.







## Series AR(U)- 85°C 5.000h

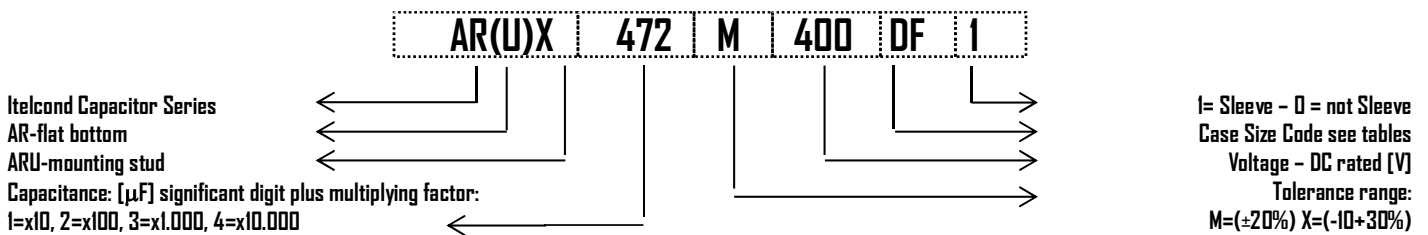
### Capacitors screw terminal type - Standard 85°C

- AR- Flat Bottom
- ARU- Mounting Stud
- Capacitance Tolerance: - 20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/85/56
- Case: 35x59 - 76x145
- Temperature - 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Amperes, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85C}$$

Where:

- $I_{\text{Ripple}@85°C}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	2.10	1.80	1.60	1.30	1.00

Table 1- $K_t$  Values

$V_n$ /Hz	$K_f$			
	50<V=300		V>300	
	Diameter Code A,B		Diameter Code C,D,E	
50	0.79	0.76	0.78	0.72
100	1.00	1.00	1.00	1.00
120	1.04	1.04	1.02	1.03
200	1.12	1.17	1.06	1.14
300	1.16	1.28	1.08	1.24
400	1.20	1.35	1.09	1.29
500	1.22	1.39	1.09	1.32
>1000	1.25	1.45	1.09	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 15\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

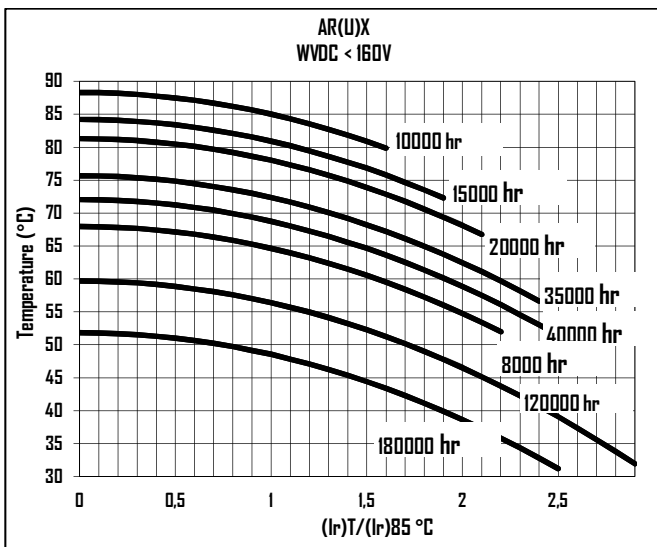


Table 3

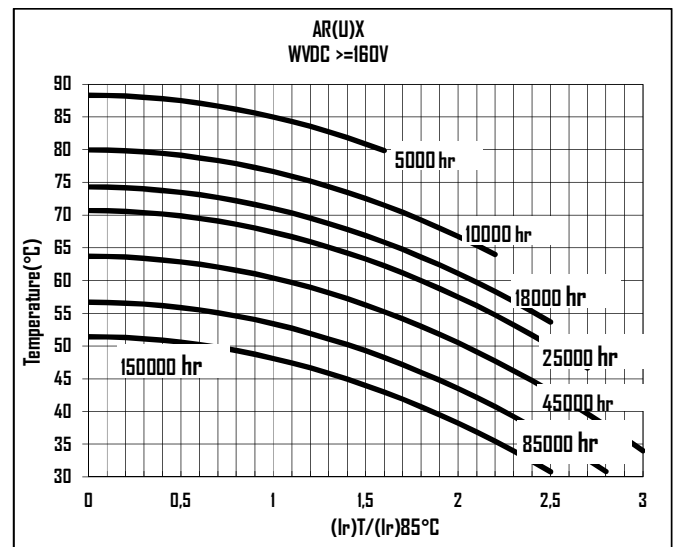


Table 4

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

### Surge Voltage

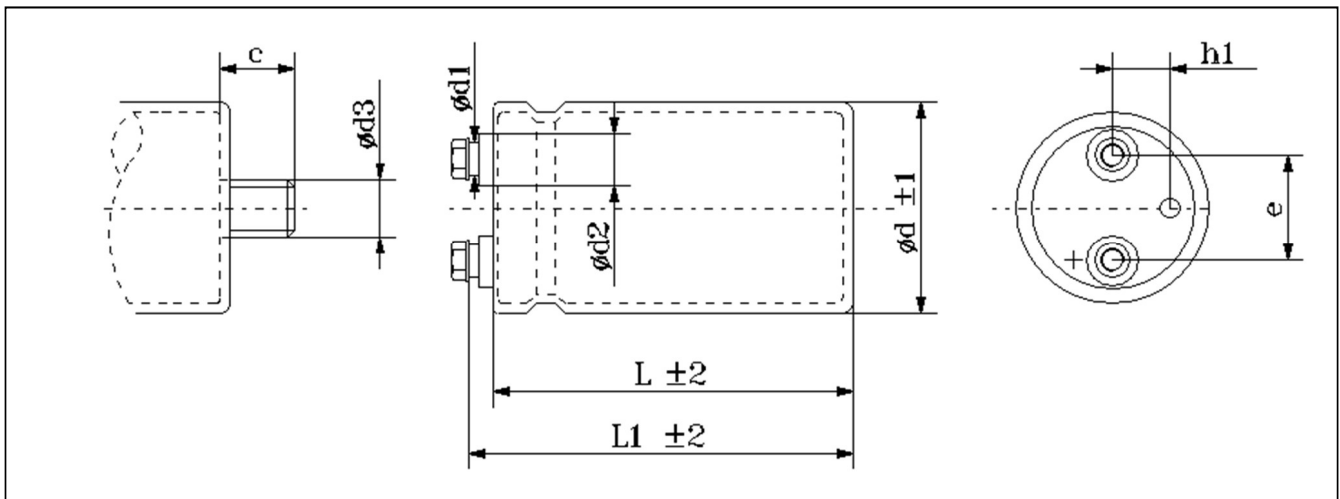
Working Voltage	40	50	63	75	100	160	200	250	350	400	420	450
Surge Voltage	46	58	73	86	115	185	230	290	385	440	460	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
40	15000	AB	35	83	0,35	33	27	25	10,5	6,1	AR(U)X153M040AB1
	22000	AC	35	105	0,42	27	22	18	13,2	7,7	AR(U)X223M040AC1
		BB	51	83	0,42	30	24	23	14,6	8,1	AR(U)X223M040BB1
	33000	BB	51	83	0,45	20	16	18	16,9	9,8	AR(U)X333M040BB1
	47000	BB	51	83	0,48	15	12	18	16,9	11,4	AR(U)X473M040BB1
		BC	51	105	0,51	16	12	14	21,4	13,3	AR(U)X473M040BC1
	68000	CC	63	105	0,63	15	12	11	26,3	14,6	AR(U)X683M040CC1
	100000	CC	63	105	0,70	10	8	9	30,0	17,5	AR(U)X104M040CC1
150000	DC	76	105	0,90	9	7	8	36,1	21,1	AR(U)X154M040DC1	
220000	DF	76	145	1,30	8	7	7	41,6	24,3	AR(U)X224M040DF1	
63	6800	AB	35	83	0,20	42	34	27	9,3	5,2	AR(U)X682M063AB1
	10000	AB	35	83	0,22	32	25	21	10,8	6,0	AR(U)X103M063AB1
	15000	AC	35	105	0,25	24	19	18	14,1	7,8	AR(U)X153M063AC1
	22000	BB	51	83	0,33	21	17	17	16,1	8,9	AR(U)X223M063BB1
		BC	51	105	0,33	24	19	18	18,2	10,1	AR(U)X223M063BC1
	33000	BC	51	105	0,38	17	13	14	20,8	11,6	AR(U)X333M063BC1
	47000	CC	63	105	0,33	10	8	9	30,0	16,7	AR(U)X473M063CC1
	68000	DC	76	105	0,39	8	7	7	36,9	20,5	AR(U)X683M063DC1
100000	DF	76	145	0,45	6	5	6	47,7	26,5	AR(U)X104M063DF1	
100	3300	AB	35	83	0,12	52	42	34	8,4	4,7	AR(U)X332M100AB1
	4700	AB	35	83	0,12	37	29	27	9,7	5,4	AR(U)X472M100AB1
		BB	51	83	0,12	41	33	30	12,6	7,0	AR(U)X472M100BB1
	6800	AC	35	105	0,12	25	20	20	13,2	7,3	AR(U)X682M100AC1
	10000	BB	51	83	0,12	17	14	17	15,6	8,7	AR(U)X103M100BB1
		BC	51	105	0,12	19	15	14	20,4	11,3	AR(U)X103M100BC1
	15000	BC	51	105	0,12	11	9	13	21,6	12	AR(U)X153M100BC1
	22000	CC	63	105	0,12	8	6	9	27,8	15,4	AR(U)X223M100CC1
33000	DC	76	105	0,12	5	4	8	35,9	20	AR(U)X333M100DC1	
47000	DF	76	145	0,12	4	3	7	46,7	26	AR(U)X473M100DF1	
160	1500	AB	35	83	0,12	115	92	62	6,2	3,4	AR(U)X152M160AB1
	2200	AC	35	105	0,12	78	63	41	8,5	4,7	AR(U)X222M160AC1
	3300	BB	51	83	0,12	52	42	29	11,3	6,3	AR(U)X332M160BB1
	4700	BC	51	105	0,12	37	29	25	14,0	7,8	AR(U)X472M160BC1
	6800	CC	63	105	0,12	25	20	20	18,9	10,5	AR(U)X682M160CC1
	10000	CC	63	105	0,12	17	14	18	20,5	11,4	AR(U)X103M160CC1
		DC	76	105	0,12	19	15	14	25,8	14,3	AR(U)X103M160DC1
	15000	DF	76	145	0,12	13	10	10	36,2	20,1	AR(U)X153M160DF1
22000	DF	76	145	0,12	8	6	8	36,4	20,2	AR(U)X223M160DF1	
200	680	AA	35	59	0,12	253	202	111	3,8	2,1	AR(U)X681M200AA1
	1000	AB	35	83	0,12	172	138	78	5,6	3,1	AR(U)X102M200AB1
	1500	AC	35	105	0,12	115	92	51	7,9	4,4	AR(U)X152M200AC1
	2200	BB	51	83	0,12	78	63	36	10,3	5,7	AR(U)X222M200BB1

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
<b>200</b>	2200	CC	63	105	0,12	65	57	30	11,6	6,0	AR(U)X222M200CC1
	3300	BC	51	105	0,12	52	42	30	12,8	7,1	AR(U)X332M200BC1
	4700	CC	63	105	0,12	37	29	21	17,2	9,6	AR(U)X472M200CC1
	6800	CC	63	105	0,12	24	20	17	22,5	11,2	AR(U)X682M200CC1
	10000	DC	76	105	0,12	17	14	14	25,5	14,2	AR(U)X103M200DC1
	15000	DF	76	145	0,12	11	9	12	32,0	17,8	AR(U)X153M200DF1
<b>250</b>	470	AA	35	59	0,12	366	293	155	3,2	1,8	AR(U)X471M250AA1
	680	AB	35	83	0,12	253	202	107	4,7	2,6	AR(U)X681M250AB1
	1000	AC	35	105	0,12	172	138	86	6,1	3,4	AR(U)X102M250AC1
	1500	BB	51	83	0,12	115	92	59	8,0	4,5	AR(U)X152M250BB1
	2200	BC	51	105	0,12	78	63	44	10,5	5,8	AR(U)X222M250BC1
		CC	63	105	0,12	69	58	55	10,9	6,3	AR(U)X222M250CC1
	3300	BC	51	105	0,12	52	42	30	12,8	7,1	AR(U)X332M250BC1
	4700	CC	63	105	0,12	37	29	23	17,2	9,6	AR(U)X472M250CC1
	6800	DC	76	105	0,12	25	20	20	21,1	11,7	AR(U)X682M250DC1
10000	DF	76	145	0,12	17	14	17	26,1	14,5	AR(U)X103M250DF1	
<b>350</b>	330	AA	35	59	0,12	521	417	217	2,7	1,5	AR(U)X331M350AA1
	470	AB	35	83	0,12	366	293	155	3,9	2,2	AR(U)X471M350AB1
	680	AC	35	105	0,12	253	202	107	5,3	2,9	AR(U)X681M350AC1
	1000	AC	35	105	0,12	172	138	78	6,4	3,6	AR(U)X102M350AC1
	1500	BB	51	83	0,12	115	92	51	8,6	4,8	AR(U)X152M350BB1
	2200	BC	51	105	0,12	78	63	35	11,7	6,5	AR(U)X222M350BC1
	3300	CC	63	105	0,12	52	42	25	16,1	9	AR(U)X332M350CC1
		DC	76	105	0,12	47	35	24	16,9	10	AR(U)X332M350DC1
	4700	DC	76	105	0,12	37	29	22	19,2	10,7	AR(U)X472M350DC1
		DF	76	145	0,12	33	27	20	20,3	11,9	AR(U)X472M350DF1
6800	DF	76	145	0,12	25	20	18	26,4	14,6	AR(U)X682M350DF1	
<b>400</b>	330	AA	35	59	0,12	521	417	221	2,7	1,5	AR(U)X331M400AA1
	470	AB	35	83	0,12	366	293	155	3,9	2,2	AR(U)X471M400AB1
	680	AC	35	105	0,12	253	202	111	5,3	2,9	AR(U)X681M400AC1
	1000	BB	51	83	0,12	172	138	78	7,0	3,9	AR(U)X102M400BB1
	1500	BB	51	83	0,12	115	92	78	8,0	4,5	AR(U)X152M400BB1
	1500	BC	51	105	0,12	115	92	50	9,7	5,4	AR(U)X152M400BC1
	2200	CC	51	105	0,12	78	63	40	12,4	6,9	AR(U)X222M400CC1
	3300	DC	76	105	0,12	52	42	29	16,5	9,2	AR(U)X332M400DC1
	4700	DF	76	145	0,12	37	29	21	22,5	12,5	AR(U)X472M400DF1
<b>450</b>	220	AA	35	59	0,12	782	625	480	1,8	1,0	AR(U)X221M450AA1
	330	AB	35	83	0,12	521	417	323	2,6	1,5	AR(U)X331M450AB1
	470	AC	35	105	0,12	366	293	237	4,6	2,5	AR(U)X471M450AC1
	680	BB	51	83	0,12	253	202	166	4,7	2,6	AR(U)X681M450BB1
	1000	BC	51	105	0,12	172	138	112	6,4	3,6	AR(U)X102M450BC1
	1500	BC	51	105	0,12	162	118	92	7,3	3,9	AR(U)X152M450BC1

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
450	1500	CC	63	105	0,12	115	92	75	8,9	4,9	AR(U)X152M450CC1
	2200	CC	63	105	0,12	78	63	56	12,0	6,7	AR(U)X222M450CC1
	2200	DC	76	105	0,12	68	54	46	13,2	7,3	AR(U)X222M450DC1
	2200	DF	76	145	0,12	60	47	39	14,0	7,9	AR(U)X222M450DF1
	3300	DF	76	145	0,12	52	39	32	16,0	8,9	AR(U)X332M450DC1
	4700	DF	76	145	0,12	37	29	28	20,0	11,1	AR(U)X472M450DF1

### Dimension, Quantity and Weight for box



Case				Connections						Mounting Stud			Packaging	
Code	DxL	Ll	hl	d1	d2	e	Screw			Screw			Pcs/Box	Weight/box
							Thread	Torque	Lenght	d3	c	Torque		
AA	35X59	64	8	8	12	12.7	M5	2.0	10	M8	12	10	100	4-7
AB	35X83	89	8	8	12	12.7	M5	2.0	10	M8	12	10	50	4-6
AC	35X105	109	8	8	12	12.7	M5	2.0	10	M8	12	10	50	6-8
BB	51x83	89	13	8	13	22.2	M5	2.0	10	M12	16	10	30	6-9
BC	51x105	109	13	8	13	22.2	M5	2,0	10	M12	16	10	30	6-9
CC	63x105	111	16	8	13	28.6	M5	2,0	10	M12	16	10	20	6-8
DC	76x105	111	19	8	13	31.8	M5	2,0	10	M12	16	10	12	5-7
DF	76x145	150	19	8	13	31.8	M5	2,0	10	M12	16	10	12	6-14

All dimensions in mm, torque in Nm, weight in kg



## Series AY(U)- 85°C 10.000 h

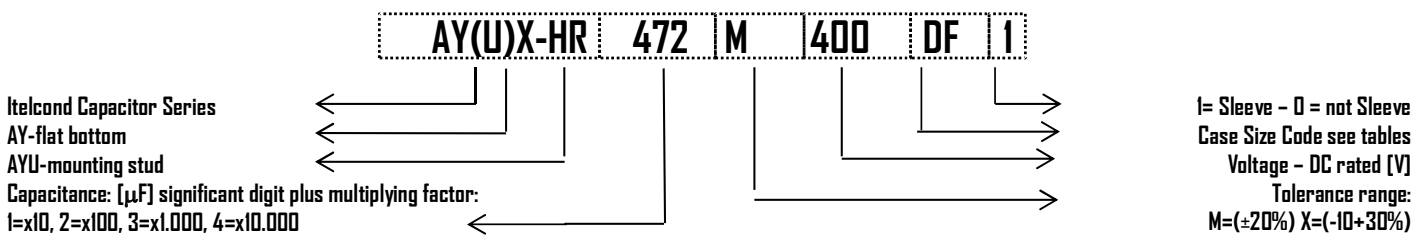
### Capacitors screw terminal type - Long Useful Life

- AY- Flat Bottom
- AYU- Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/85/56
- Case: 51x105 - 90 x 222
- Temperature - 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@85^\circ\text{C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note. Superimposed alternating voltage summed to DC voltage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	1.65	1.50	1.40	1.20	1.00

Table 1- $K_t$  Values

$V_n$ /Hz	$K_f$			
	50<V=300		V>300	
	Diameter Code A,B		Diameter Code C,D,E	
50	0.79	0.76	0.78	0.72
100	1.00	1.00	1.00	1.00
120	1.04	1.04	1.02	1.03
200	1.12	1.17	1.06	1.14
300	1.16	1.28	1.08	1.24
400	1.20	1.35	1.09	1.29
500	1.22	1.39	1.09	1.32
>1000	1.25	1.45	1.09	1.37

Table 2- $K_f$  Values



### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 15\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

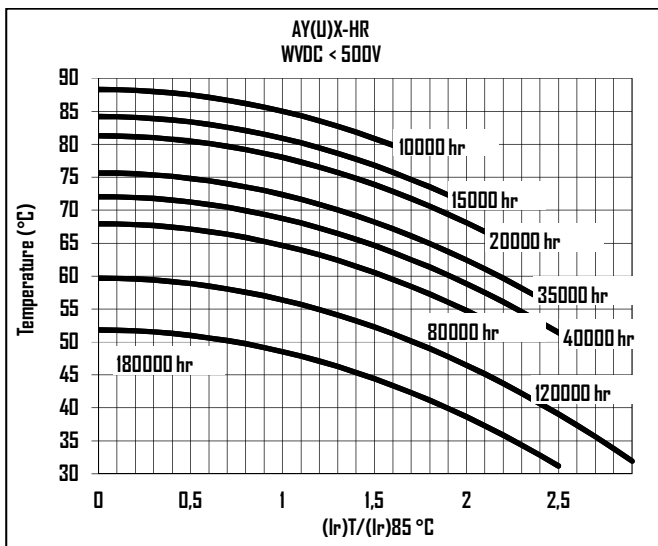


Table 3

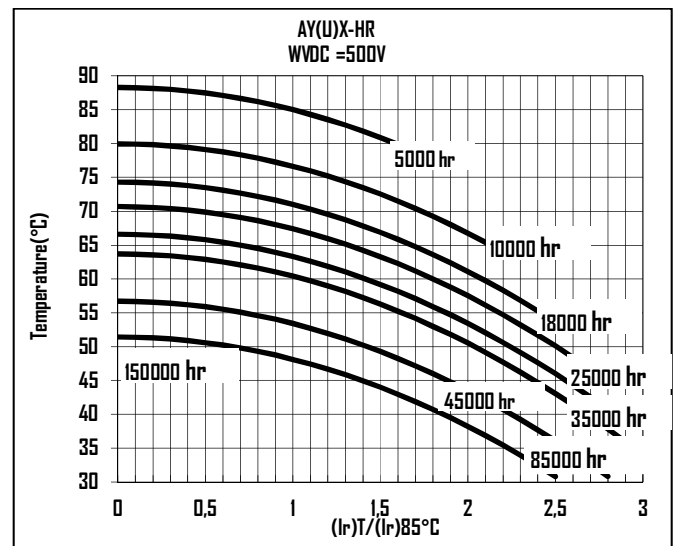


Table 4

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

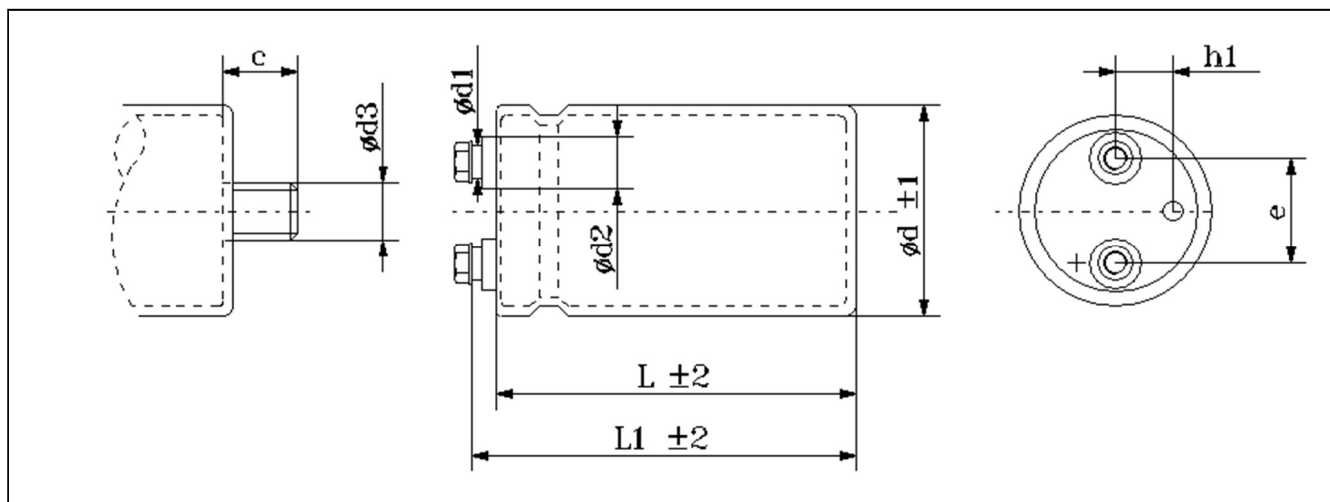
### Surge Voltage

Working Voltage	40	63	75	100	160	200	250	350	400	420	450	500
Surge Voltage	46	73	86	115	185	230	290	385	440	460	495	525

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
40	10000	AA	35	50	0,27	43	34	32	7,3	5,2	AY(U)X-HR103M040AAI
	15000	AB	35	83	0,35	37	30	28	13,4	9,6	AY(U)X-HR153M040ABI
	22000	AC	35	105	0,42	30	24	23	16,6	11,8	AY(U)X-HR223M040ACI
	33000	BB	51	83	0,45	22	17	16	21,7	15,5	AY(U)X-HR333M040BBI
		BB	51	83	0,48	16	13	12	25,1	17,9	AY(U)X-HR473M040BBI
	47000	BC	51	105	0,51	17	14	13	27,0	19,3	AY(U)X-HR473M040BCI
		CC	63	107	0,70	11	9	8	38,1	27,2	AY(U)X-HR104M040CCI
150000	DC	76	107	0,90	10	8	7	45,8	32,7	AY(U)X-HR154M040DCI	
63	22200	BB	51	83	0,26	19	15	14	17,1	12,2	AY(U)X-HR223M063BBI
		BC	51	105	0,24	17	14	13	19,7	14,1	AY(U)X-HR223M063BCI
	33000	BC	51	105	0,28	14	11	10	22,3	15,9	AY(U)X-HR333M063BCI
		CC	63	105	0,27	13	10	10	25,8	18,4	AY(U)X-HR333M063CCI
	47000	CC	63	105	0,30	10	8	8	29,2	20,9	AY(U)X-HR473M063CCI
	68000	DC	76	105	0,36	8	7	6	35,4	25,3	AY(U)X-HR683M063DCI
100000	DF	76	145	0,40	6	5	5	47,1	33,7	AY(U)X-HR104M063DFI	
100	10000	BB	51	83	0,12	19	15	14	16,9	12,1	AY(U)X-HR103M100BBI
		BC	51	105	0,1	16	13	12	20,6	14,7	AY(U)X-HR103M100BCI
	15000	BC	51	105	0,11	12	9	9	24,0	17,1	AY(U)X-HR153M100BCI
	22200	CC	63	105	0,15	11	9	8	28,3	20,2	AY(U)X-HR223M100CCI
		DC	76	105	0,14	10	8	8	32,5	23,2	AY(U)X-HR223M100DCI
	33000	DC	76	105	0,18	9	7	7	35,2	25,1	AY(U)X-HR333M100DCI
		DF	76	145	0,16	8	6	6	42,8	30,6	AY(U)X-HR333M100DFI
47000	DF	76	145	0,18	6	5	5	48,1	34,4	AY(U)X-HR473M100DFI	
160	4700	BC	51	105	0,1	34	27	25	14,1	10,1	AY(U)X-HR472M160BCI
		CC	63	105	0,09	30	24	23	16,9	12,0	AY(U)X-HR472M160CCI
	6800	DC	76	105	0,1	23	19	18	21,4	15,3	AY(U)X-HR682M160DCI
	10000	DC	76	105	0,11	18	14	13	24,8	17,7	AY(U)X-HR103M160DCI
	15000	DF	76	145	0,12	13	10	10	33,3	23,8	AY(U)X-HR153M160DFI
	22200	DF	76	145	0,15	11	9	8	36,1	25,8	AY(U)X-HR223M160DFI
EF		90	222	0,14	10	8	8	49,1	35,1	AY(U)X-HR223M160EFI	
200	3300	BC	51	105	0,10	48	39	36	11,8	8,4	AY(U)X-HR332M200BCI
	4700	CC	63	105	0,10	34	27	25	16,0	11,4	AY(U)X-HR472M200CCI
		DC	76	105	0,09	30	24	23	18,8	13,4	AY(U)X-HR472M200DCI
	6800	DC	76	105	0,10	23	19	18	21,4	15,3	AY(U)X-HR682M200DCI
	10000	DF	76	145	0,11	18	14	13	28,4	20,3	AY(U)X-HR103M200DFI
	15000	DF	76	145	0,12	13	10	10	33,3	23,8	AY(U)X-HR153M200DFI
	22200	DF	76	145	0,12	9	7	7	40,3	28,8	AY(U)X-HR223M200DFI
DK		76	165	0,12	9	7	7	42,7	30,5	AY(U)X-HR223M200DKI	
33000	DK	76	165	0,12	6	5	4	52,3	37,4	AY(U)X-HR333M200DKI	
250	2220	BB	51	83	0,09	65	52	49	9,2	6,5	AY(U)X-HR222M250BBI
		BC	51	105	0,08	58	46	43	10,8	7,7	AY(U)X-HR222M250BCI
	3300	BC	51	105	0,10	48	39	36	11,8	8,4	AY(U)X-HR332M250BCI

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
<b>250</b>	3300	CC	63	105	0,09	43	35	33	14,1	10,1	AY(U)X-HR332M250CC1
	4700	DC	76	105	0,10	34	27	25	17,8	12,7	AY(U)X-HR472M250DC1
	6800	DC	76	105	0,10	23	19	18	21,4	15,3	AY(U)X-HR682M250DC1
	10000	DF	76	145	0,10	16	13	12	29,8	21,3	AY(U)X-HR103M250DF1
		EC	90	105	0,10	16	13	12	28,6	20,5	AY(U)X-HR103M250EC1
15000	DF	76	145	0,10	11	8	8	36,5	26,1	AY(U)X-HR153M250DF1	
<b>350</b>	2220	BC	51	105	0,09	65	52	49	10,2	7,3	AY(U)X-HR222M350BC1
	3300	CC	63	105	0,09	43	35	33	14,1	10,1	AY(U)X-HR332M350CC1
		DC	76	105	0,08	39	31	29	16,7	11,9	AY(U)X-HR332M350DC1
	4700	DC	76	105	0,09	30	24	23	18,8	13,4	AY(U)X-HR472M350DC1
		DF	76	145	0,08	27	22	20	22,8	16,3	AY(U)X-HR472M350DF1
	6800	DF	76	145	0,08	19	15	14	27,5	19,6	AY(U)X-HR682M350DF1
		DJ	76	222	0,09	21	17	16	31,2	22,3	AY(U)X-HR682M350DJ1
		EC	90	105	0,11	26	21	19	22,5	16,1	AY(U)X-HR682M350EC1
	10000	DF	76	145	0,11	18	14	13	28,4	20,3	AY(U)X-HR103M350DF1
		DJ	76	222	0,10	16	13	12	35,9	25,6	AY(U)X-HR103M350DJ1
		EC	90	105	0,10	16	13	12	28,6	20,5	AY(U)X-HR103M350EC1
	15000	DF	76	145	0,10	11	8	8	36,5	26,1	AY(U)X-HR153M350DF1
		DJ	76	222	0,10	11	8	8	44,0	31,4	AY(U)X-HR153M350DJ1
		EF	90	145	0,12	13	10	10	36,6	26,2	AY(U)X-HR153M350EF1
		EJ	90	222	0,12	13	10	10	44,0	31,4	AY(U)X-HR153M350EJ1
18000	EF	90	145	0,12	11	8	8	40,1	28,7	AY(U)X-HR183M350EF1	
22200	EJ	90	222	0,12	9	7	7	53,3	38,1	AY(U)X-HR223M350EJ1	
27000	EJ	90	222	0,12	7	6	5	59,0	42,2	AY(U)X-HR273M350EJ1	
<b>400</b>	1500	BB	51	83	0,10	106	85	80	7,2	5,1	AY(U)X-HR152M400BB1
		BC	51	105	0,10	106	85	80	8,0	5,7	AY(U)X-HR152M400BC1
	2220	BC	51	105	0,10	72	58	54	9,6	6,9	AY(U)X-HR222M400BC1
		CC	63	105	0,09	65	52	49	11,5	8,2	AY(U)X-HR222M400CC1
		DC	76	105	0,08	58	46	43	13,6	9,7	AY(U)X-HR222M400DC1
	3300	CC	63	105	0,09	43	35	33	14,1	10,1	AY(U)X-HR332M400CC1
		DC	76	105	0,09	43	35	33	15,7	11,2	AY(U)X-HR332M400DC1
		DF	76	145	0,09	43	35	33	18,0	12,9	AY(U)X-HR332M400DF1
	4700	DC	76	105	0,10	34	27	25	17,8	12,7	AY(U)X-HR472M400DC1
		DF	76	145	0,09	30	24	23	21,5	15,4	AY(U)X-HR472M400DF1
	6800	DF	76	145	0,08	19	15	14	27,5	19,6	AY(U)X-HR682M400DF1
	10000	DJ	76	222	0,11	18	14	13	34,2	24,5	AY(U)X-HR103M400DJ1
		EF	90	145	0,11	18	14	13	31,2	22,3	AY(U)X-HR103M400EF1
15000	EJ	90	222	0,08	8	7	6	53,9	38,5	AY(U)X-HR153M400EJ1	
18000	EJ	90	222	0,08	7	6	5	59,0	42,2	AY(U)X-HR183M400EJ1	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud	
<b>450</b>	1000	BB	51	83	0,12	191	153	143	5,4	3,8	AY(U)X-HR102M450BB1
	1500	BB	51	83	0,11	117	93	88	6,8	4,9	AY(U)X-HR152M450BB1
		BC	51	105	0,10	106	85	80	8,0	5,7	AY(U)X-HR152M450BC1
	2220	CC	63	105	0,12	87	69	65	10,0	7,1	AY(U)X-HR222M450CC1
		DC	76	105	0,11	80	64	60	11,6	8,3	AY(U)X-HR222M450DC1
	3300	DC	76	105	0,12	58	46	43	13,6	9,7	AY(U)X-HR332M450DC1
		DF	76	145	0,1	48	39	36	17,1	12,2	AY(U)X-HR332M450DF1
	4700	DF	76	145	0,12	41	33	30	18,6	13,3	AY(U)X-HR472M450DF1
		EC	90	105	0,11	37	30	28	18,7	13,4	AY(U)X-HR472M450EC1
	6800	DF	76	145	0,13	30	24	23	21,6	15,4	AY(U)X-HR682M450DF1
		DJ	76	222	0,12	28	22	21	27,0	19,3	AY(U)X-HR682M450DJ1
	10000	DJ	76	222	0,12	19	15	14	32,8	23,4	AY(U)X-HR103M450DJ1
EJ		90	222	0,12	19	15	14	35,9	25,7	AY(U)X-HR103M450EJ1	
15000	EJ	90	222	0,13	14	11	10	42,3	30,2	AY(U)X-HR153M450EJ1	
<b>500</b>	1000	BC	51	105	0,13	207	166	155	5,7	4,1	AY(U)X-HR102M500BC1
	1500	DC	76	105	0,13	138	110	104	8,8	6,3	AY(U)X-HR152M500DC1
	2220	CC	63	105	0,13	94	75	71	9,6	6,9	AY(U)X-HR222M500CC1
		DC	76	105	0,13	94	75	71	10,7	7,6	AY(U)X-HR222M500DC1
		DF	76	145	0,13	94	75	71	12,3	8,8	AY(U)X-HR222M500DF1
	3300	DF	76	145	0,12	58	46	43	15,6	11,2	AY(U)X-HR332M500DF1
	3900	DF	76	145	0,12	49	39	37	17,0	12,1	AY(U)X-HR392M500DF1
	4400	DF	76	145	0,12	43	35	33	18,0	12,9	AY(U)X-HR442M500DF1
	4700	DF	76	145	0,12	41	33	30	18,6	13,3	AY(U)X-HR472M500DF1
	5600	DF	76	145	0,12	34	27	26	20,4	14,5	AY(U)X-HR562M500DF1
	6800	DJ	76	222	0,12	28	22	21	26,9	19,2	AY(U)X-HR682M500DJ1
10000	EJ	90	222	0,12	19	15	14	35,8	25,6	AY(U)X-HR103M500EJ1	

**Dimension, Quantity and Weight for box**


Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x81	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	8	18	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	151	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	8-12

*All dimensions in mm, torque in Nm, weight in kg*

## Series AD(U) – 85°C 15.000 h

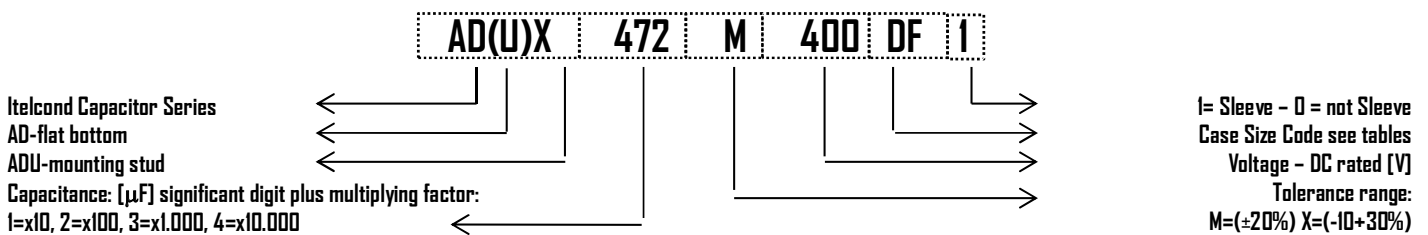
### Capacitors screw terminal type – Low ESR

- AD- Flat Bottom
- ADU- Mounting Stud
- Capacitance Tolerance: -20 + 20% – standard (M)
- Capacitance Tolerance: -10 + 30% – on request (X)
- Climatic category: 40/85/56
- Case: 51x83 – 90x240
- Temperature – 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@85^\circ\text{C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	1.55	1.40	1.20	1.10	1.00

Table 1- $K_t$  Values

Hz	$K_f$
50	0.78
100	1.00
120	1.02
200	1.06
300	1.08
400	1.09
500	1.32
>1000	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 15\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

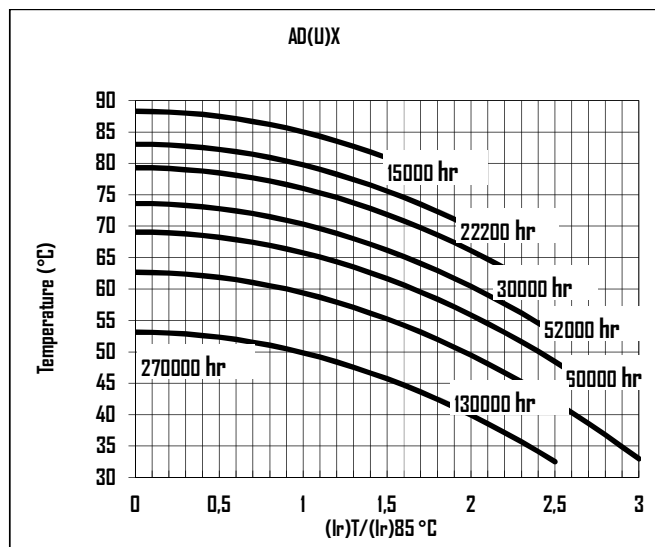


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

### Surge Voltage

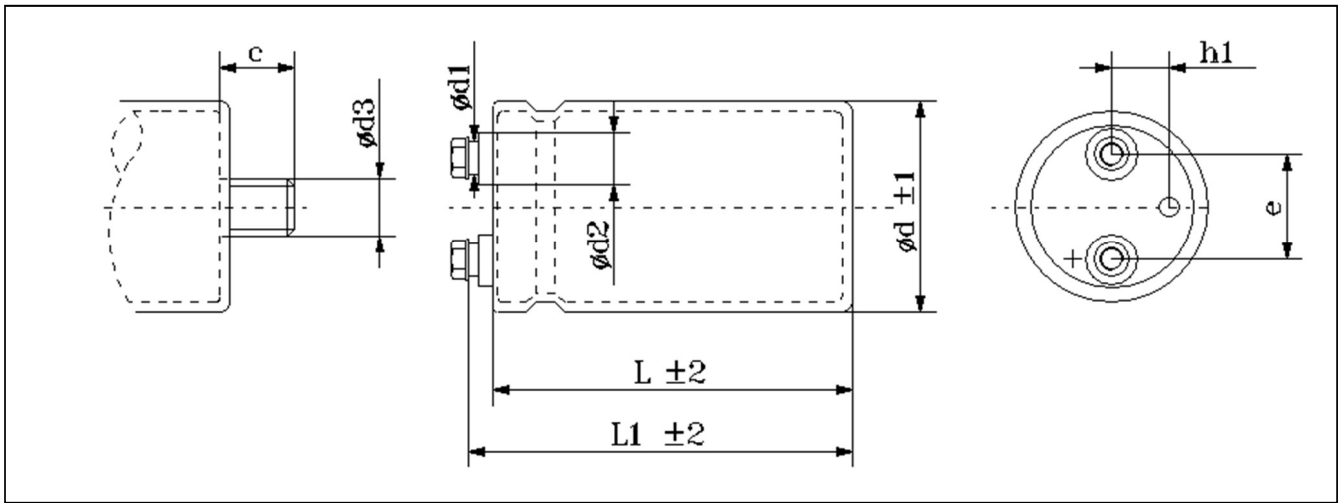
Working Voltage	160	200	250	350	400	420	450
Surge Voltage	185	230	290	385	440	460	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
160	4700	BC	51	105	0,09	30	24	23	14,9	10,6	AD(U)X472M160BCI
		CC	63	107	0,09	30	24	23	16,9	12,0	AD(U)X472M160CCI
	6800	DC	76	107	0,09	21	17	16	22,6	16,1	AD(U)X682M160DCI
	10000	DC	76	107	0,09	14	11	11	27,4	19,5	AD(U)X103M160DCI
	15000	DF	76	147	0,09	10	8	7	38,5	27,5	AD(U)X153M160DFI
		DF	76	147	0,09	7	5	5	46,6	33,3	AD(U)X223M160DFI
	22000	EF	90	220	0,09	7	5	5	61,3	43,8	AD(U)X223M160EFI
200	3300	BC	51	105	0,08	39	31	29	13,2	9,4	AD(U)X332M200BCI
	4700	CC	63	107	0,08	27	22	20	17,9	12,8	AD(U)X472M200CCI
		DC	76	107	0,08	27	22	20	19,9	14,2	AD(U)X472M200DCI
	6800	DC	76	107	0,08	19	15	14	23,9	17,1	AD(U)X682M200DCI
	10000	DF	76	147	0,08	13	10	10	33,3	23,8	AD(U)X103M200DFI
	15000	DF	76	147	0,08	8	7	6	40,8	29,1	AD(U)X153M200DFI
		DF	76	147	0,08	6	5	4	49,4	35,3	AD(U)X223M200DFI
	33000	DK	76	167	0,08	6	5	4	52,3	37,4	AD(U)X223M200DKI
250	2200	BB	51	83	0,07	51	41	38	10,4	7,4	AD(U)X222M250BBI
		BC	51	105	0,07	51	41	38	11,5	8,2	AD(U)X222M250BCI
	3300	BC	51	105	0,07	34	27	25	14,1	10,1	AD(U)X332M250BCI
		CC	63	107	0,07	34	27	25	16,0	11,4	AD(U)X332M250CCI
	4700	DC	76	107	0,07	24	19	18	21,3	15,2	AD(U)X472M250DCI
	6800	DC	76	107	0,07	16	13	12	25,6	18,3	AD(U)X682M250DCI
	10000	DF	76	147	0,07	11	9	8	35,6	25,4	AD(U)X103M250DFI
		EC	90	107	0,07	11	9	8	34,2	24,5	AD(U)X103M250ECI
	15000	DF	76	147	0,07	7	6	6	43,6	31,2	AD(U)X153M250DFI
		EJ	90	222	0,07	7	6	6	57,6	41,1	AD(U)X153M250EJI
350	4700	DC	76	107	0,06	20	16	15	23,0	16,4	AD(U)X472M350DCI
		DF	76	147	0,06	20	16	15	26,4	18,8	AD(U)X472M350DFI
	6800	DF	76	147	0,06	14	11	11	31,7	22,7	AD(U)X682M350DFI
		EC	90	107	0,06	14	11	11	30,5	21,8	AD(U)X682M350ECI
	10000	DF	76	147	0,06	10	8	7	38,5	27,5	AD(U)X103M350DFI
		DJ	76	222	0,06	10	8	7	46,4	33,1	AD(U)X103M350DJI
		EC	90	107	0,06	10	8	7	37,0	26,4	AD(U)X103M350ECI
	15000	DJ	76	222	0,06	6	5	5	56,8	40,5	AD(U)X153M350DJI
		EF	90	147	0,06	6	5	5	51,8	37,0	AD(U)X153M350EFI
		EJ	90	222	0,06	6	5	5	62,2	44,4	AD(U)X153M350EJI
22000	EJ	90	222	0,06	4	3	3	75,4	53,8	AD(U)X223M350EJI	
25000	EL	90	240	0,06	4	3	3	83,2	59,5	AD(U)X253M350ELI	



	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
<b>400</b>	3300	DC	76	107	0,06	29	23	22	19,3	13,8	AD(U)X332M400DCI
	4700	DC	76	107	0,06	20	16	15	23,0	16,4	AD(U)X472M400DCI
	4700	DF	76	147	0,06	20	16	15	26,4	18,8	AD(U)X472M400DFI
	6800	DF	76	147	0,06	14	11	11	31,7	22,7	AD(U)X682M400DFI
	10000	DJ	76	222	0,06	10	8	7	46,4	33,1	AD(U)X103M400DJI
		EF	90	147	0,06	10	8	7	42,3	30,2	AD(U)X103M400EFI
	15000	EJ	90	222	0,06	6	5	5	62,2	44,4	AD(U)X153M400EJI
20000	EL	90	240	0,06	5	4	4	74,4	53,2	AD(U)X203M400ELI	
<b>450</b>	2200	CC	63	107	0,07	51	41	38	13,1	9,3	AD(U)X222M450CCI
		DC	76	107	0,07	51	41	38	14,6	10,4	AD(U)X222M450DCI
	3300	DC	76	107	0,07	34	27	25	17,8	12,7	AD(U)X332M450DCI
		DF	76	147	0,07	34	27	25	20,5	14,6	AD(U)X332M450DFI
	4700	DF	76	147	0,07	24	19	18	24,4	17,4	AD(U)X472M450DFI
		EC	90	107	0,07	24	19	18	23,5	16,8	AD(U)X472M450ECI
	6800	DF	76	147	0,07	16	13	12	29,4	21,0	AD(U)X682M450DFI
		DJ	76	222	0,07	16	13	12	35,4	25,3	AD(U)X682M450DJI
	10000	DJ	76	222	0,07	11	9	8	42,9	30,7	AD(U)X103M450DJI
		EJ	90	222	0,07	11	9	8	47,0	33,6	AD(U)X103M450EJI
	15000	EJ	90	222	0,07	7	6	6	57,6	41,1	AD(U)X153M450EJI
18000	EL	90	240	0,07	6	5	5	65,4	46,7	AD(U)X183M450ELI	

**Dimension, Quantity and Weight for box**



Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x83	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BB	51x83	85	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	151	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	8-12
EL	90x240	245	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-13

*All dimensions in mm, torque in Nm, weight in kg*



## Series AP(U)X 85°C 15.000 h

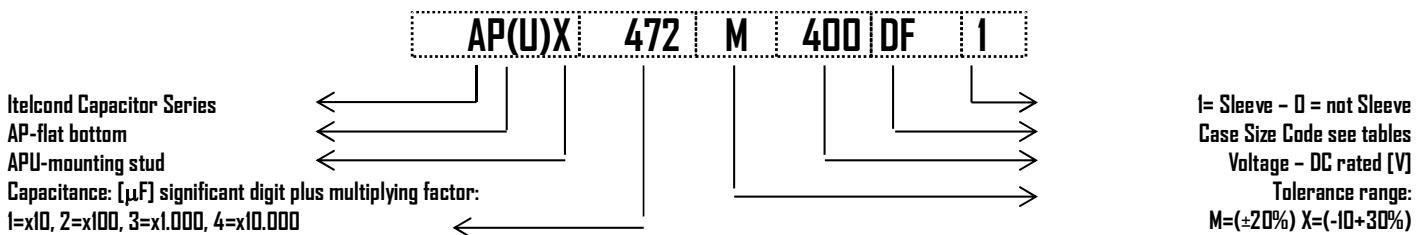
### Capacitors screw terminal type -Heavy Transient

- AP- Flat Bottom
- APU- Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/85/56
- Case: 51x83 - 90x240
- Temperature - 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85C}$$

Where:

- $I_{\text{Ripple}@85°C}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC voltage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	1.65	1.50	1.40	1.20	1.00

Table 1- $K_t$  Values

$V_n/Hz$	$K_f$
	$V > 300$ Diameter Code C, D, E
50	0.72
100	1.00
120	1.03
200	1.14
300	1.24
400	1.29
500	1.32
>1000	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

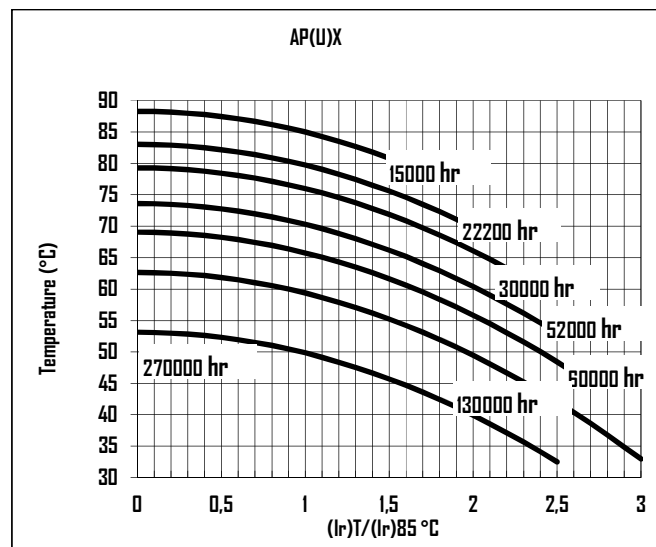


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,001 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,0005 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F],  
V=rated voltage [V]

### Surge Voltage

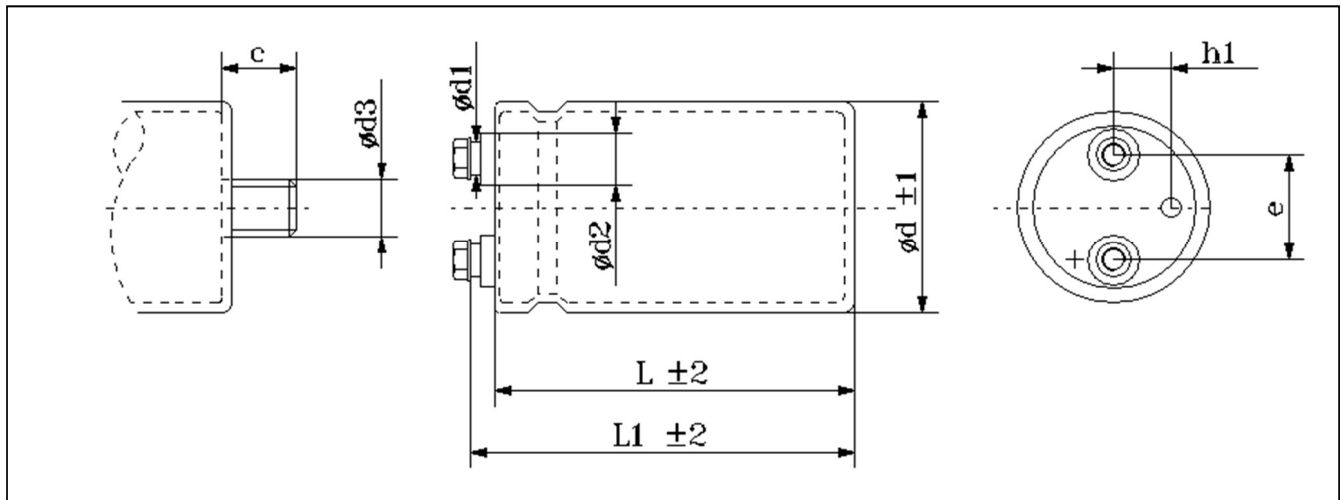
Working Voltage	63	75	100	160	200	250	350	400	420	450
Surge Voltage	73	86	115	185	230	290	385	440	460	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
40	10000	AA	35	50	0,27	43	34	32	7,8	5,2	AP(U)X103M040AAI
	15000	AB	35	83	0,35	37	30	28	10,5	7,0	AP(U)X153M040ABI
	22000	AC	35	105	0,42	30	24	23	13,0	8,7	AP(U)X223M040ACI
	33000	BB	51	83	0,45	22	17	16	17,0	11,3	AP(U)X333M040BBI
	47000	BB	51	83	0,48	16	13	12	19,7	13,1	AP(U)X473M040BBI
		BC	51	105	0,51	17	14	13	21,1	14,1	AP(U)X473M040BCI
	100000	CC	63	107	0,70	11	9	8	29,9	19,9	AP(U)X104M040CCI
	150000	DC	76	107	0,90	10	8	7	35,9	23,9	AP(U)X154M040DCI
220000	DF	76	147	1,30	9	8	7	41,5	27,7	AP(U)X224M040DFI	
63	22000	BB	51	83	0,26	19	15	14	18,8	12,5	AP(U)X223M063BBI
		BC	51	105	0,24	17	14	13	21,7	14,5	AP(U)X223M063BCI
	33000	BC	51	105	0,28	14	11	10	24,6	16,4	AP(U)X333M063BCI
		CC	63	107	0,27	13	10	10	28,5	19,0	AP(U)X333M063CCI
	47000	CC	63	107	0,30	10	8	8	32,2	21,5	AP(U)X473M063CCI
	68000	DC	76	105	0,36	8	7	6	39,0	26,0	AP(U)X683M063DCI
	100000	DF	76	147	0,40	6	5	5	52,0	34,6	AP(U)X103M063DFI
100	10000	BB	51	83	0,12	19	15	14	18,7	12,4	AP(U)X103M100BBI
		BC	51	105	0,1	16	13	12	22,7	15,1	AP(U)X103M100BCI
	15000	BC	51	105	0,11	12	9	9	26,5	17,7	AP(U)X153M100BCI
	22000	CC	63	107	0,15	11	9	8	31,2	20,8	AP(U)X223M100CCI
		DC	76	107	0,14	10	8	8	35,9	23,9	AP(U)X223M100DCI
	33000	DC	76	107	0,18	9	7	7	38,8	25,8	AP(U)X333M100DCI
		DF	76	147	0,16	8	6	6	47,2	31,5	AP(U)X333M100DFI
47000	DF	76	147	0,18	6	5	5	53,1	35,4	AP(U)X473M100DFI	
160	4700	BC	51	105	0,1	34	27	25	15,5	10,4	AP(U)X472M160BCI
		CC	63	107	0,09	30	24	23	18,6	12,4	AP(U)X472M160CCI
	6800	DC	76	107	0,1	23	19	18	23,6	15,7	AP(U)X682M160DCI
	10000	DC	76	107	0,11	18	14	13	27,3	18,2	AP(U)X103M160DCI
	15000	DF	76	147	0,12	13	10	10	36,7	24,5	AP(U)X153M160DFI
	22000	DF	76	147	0,15	11	9	8	39,8	26,5	AP(U)X223M160DFI
EF		90	220	0,14	10	8	8	54,2	36,1	AP(U)X223M160EFI	
200	3300	BC	51	105	0,10	48	39	36	13,0	8,7	AP(U)X332M200BCI
	4700	CC	63	107	0,10	34	27	25	17,6	11,8	AP(U)X472M200CCI
		DC	76	107	0,09	30	24	23	20,7	13,8	AP(U)X472M200DCI
	6800	DC	76	107	0,10	23	19	18	23,6	15,7	AP(U)X682M200DCI
	10000	DF	76	147	0,11	18	14	13	31,3	20,9	AP(U)X103M200DFI
	15000	DF	76	147	0,12	13	10	10	36,7	24,5	AP(U)X153M200DFI
	22000	DF	76	147	0,12	9	7	7	44,5	29,7	AP(U)X223M200DFI
DK		76	167	0,12	9	7	7	47,1	31,4	AP(U)X223M200DKI	
33000	DK	76	167	0,12	6	5	4	57,7	38,5	AP(U)X333M200DKI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud	
<b>250</b>	2200	BB	51	83	0,09	65	52	49	10,1	6,7	AP(U)X222M250BB1
	3300	BC	51	105	0,10	48	39	36	13,0	8,7	AP(U)X332M250BC1
	3300	CC	63	107	0,09	43	35	33	15,6	10,4	AP(U)X332M250CC1
	4700	DC	76	107	0,10	34	27	25	19,6	13,1	AP(U)X472M250DC1
	6800	DC	76	107	0,10	23	19	18	23,6	15,7	AP(U)X682M250DC1
	10000	DF	76	147	0,10	16	13	12	32,9	21,9	AP(U)X103M250DF1
	10000	EC	90	107	0,10	16	13	12	31,6	21,1	AP(U)X103M250EC1
	15000	DF	76	147	0,10	11	8	8	40,3	26,8	AP(U)X153M250DF1
	15000	EJ	90	222	0,10	11	8	8	53,2	35,4	AP(U)X153M250EJ1
<b>350</b>	2200	BC	51	105	0,09	65	52	49	11,2	7,5	AP(U)X222M350BC1
	3300	CC	63	107	0,09	43	35	33	15,6	10,4	AP(U)X332M350CC1
		DC	76	107	0,08	39	31	29	18,4	12,3	AP(U)X332M350DC1
	4700	DC	76	107	0,09	30	24	23	20,7	13,8	AP(U)X472M350DC1
		DF	76	147	0,08	27	22	20	25,2	16,8	AP(U)X472M350DF1
	6800	DF	76	147	0,08	19	15	14	30,3	20,2	AP(U)X682M350DF1
		DJ	76	222	0,09	21	17	16	34,4	23,0	AP(U)X682M350DJ1
		EC	90	107	0,11	26	21	19	24,8	16,6	AP(U)X682M350EC1
	10000	DF	76	147	0,11	18	14	13	31,3	20,9	AP(U)X103M350DF1
		DJ	76	222	0,10	16	13	12	39,6	26,4	AP(U)X103M350DJ1
		EC	90	107	0,10	16	13	12	31,6	21,1	AP(U)X103M350EC1
	15000	DF	76	147	0,10	11	8	8	40,3	26,8	AP(U)X153M350DF1
		DJ	76	222	0,10	11	8	8	48,5	32,3	AP(U)X153M350DJ1
		EF	90	147	0,12	13	10	10	40,4	26,9	AP(U)X153M350EF1
		EJ	90	222	0,12	13	10	10	48,5	32,4	AP(U)X153M350EJ1
	18000	EF	90	147	0,12	11	8	8	44,3	29,5	AP(U)X183M350EF1
22000	EJ	90	222	0,12	9	7	7	58,8	39,2	AP(U)X223M350EJ1	
27000	EJ	90	222	0,12	7	6	5	65,1	43,4	AP(U)X273M350EJ1	
25000	EL	90	240	0,12	8	6	6	54,9	43,3	AP(U)X253M350EL1	
<b>400</b>	1500	BB	51	83	0,10	106	85	80	7,9	5,3	AP(U)X152M400BB1
		BC	51	105	0,10	106	85	80	8,8	5,9	AP(U)X152M400BC1
	2200	BC	51	105	0,10	72	58	54	10,6	7,1	AP(U)X222M400BC1
		CC	63	107	0,09	65	52	49	12,7	8,5	AP(U)X222M400CC1
		DC	76	107	0,08	58	46	43	15,0	10,0	AP(U)X222M400DC1
	3300	CC	63	107	0,09	43	35	33	15,6	10,4	AP(U)X332M400CC1
		DC	76	107	0,09	43	35	33	17,3	11,6	AP(U)X332M400DC1
		DF	76	147	0,09	43	35	33	19,9	13,3	AP(U)X332M400DF1
	4700	DC	76	107	0,10	34	27	25	19,6	13,1	AP(U)X472M400DC1
		DF	76	147	0,09	30	24	23	23,8	15,8	AP(U)X472M400DF1
	6800	DF	76	147	0,08	19	15	14	30,3	20,2	AP(U)X682M400DF1
	10000	DJ	76	222	0,11	18	14	13	37,8	25,2	AP(U)X103M400DJ1
		EF	90	147	0,11	18	14	13	34,5	23,0	AP(U)X103M400EF1
15000	EJ	90	222	0,08	8	7	6	59,4	39,6	AP(U)X153M400EJ1	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
<b>400</b>	15000	EJ	90	222	0,08	8	7	6	59,4	39,6	AP(U)X153M400EJ1
	18000	EJ	90	222	0,08	7	6	5	65,1	43,4	AP(U)X183M400EJ1
	20000	EL	90	240	0,08	6	5	5	71,4	47,4	AP(U)X203M400EL1
<b>450</b>	1000	BB	51	83	0,12	191	153	143	5,9	3,9	AP(U)X102M450BB1
	1500	BB	51	83	0,11	117	93	88	7,6	5,0	AP(U)X152M450BB1
		BC	51	105	0,10	106	85	80	8,8	5,9	AP(U)X152M450BC1
	2200	CC	63	107	0,12	87	69	65	11,0	7,3	AP(U)X222M450CC1
		DC	76	107	0,11	80	64	60	12,8	8,5	AP(U)X222M450DC1
	3300	DC	76	107	0,12	58	46	43	15,0	10,0	AP(U)X332M450DC1
		DF	76	147	0,1	48	39	36	18,9	12,6	AP(U)X332M450DF1
	4700	DF	76	147	0,12	41	33	30	20,6	13,7	AP(U)X472M450DF1
		EC	90	107	0,11	37	30	28	20,7	13,8	AP(U)X472M450EC1
	6800	DF	76	147	0,13	30	24	23	23,8	15,8	AP(U)X682M450DF1
		DJ	76	222	0,12	28	22	21	29,8	19,9	AP(U)X682M450DJ1
	10000	DJ	76	222	0,12	19	15	14	36,2	24,1	AP(U)X103M450DJ1
		EJ	90	222	0,12	19	15	14	39,6	26,4	AP(U)X103M450EJ1
	15000	EJ	90	222	0,13	14	11	10	46,6	31,1	AP(U)X153M450EJ1
	18000	EL	90	240	0,13	12	9	9	52,9	35,3	AP(U)X183M450EL1



**Dimension, Quantity and Weight for box**


Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x83	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BB	51x83	85	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	153	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	8-12
EL	90x240	245	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-13

All dimensions in mm, torque in Nm, weight in kg

## Series AS(U) - 85°C 15.000 h

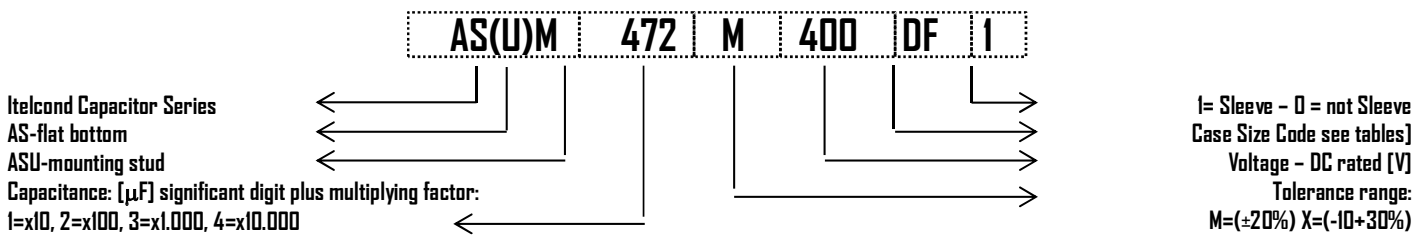
### Capacitors screw terminal type – Compact Size -High Ripple Current

- AS - Flat Bottom
- ASU - Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/85/56
- Case: 51x105 - 90 x 222
- Temperature - 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@85^\circ\text{C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	2.10	1.80	1.60	1.30	1.00

Table 1-Kt Value

$V_n / \text{Hz}$	$K_f$			
	$50 < V = 300$		$V > 300$	
	Diameter Code A,B		Diameter Code C,D,E	
50	0.79	0.76	0.78	0.72
100	1.00	1.00	1.00	1.00
120	1.04	1.04	1.02	1.03
200	1.12	1.17	1.06	1.14
300	1.16	1.28	1.08	1.24
400	1.20	1.35	1.09	1.29
500	1.22	1.39	1.09	1.32
>1000	1.25	1.45	1.09	1.37

Table 2-Kf Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

Voltage Endurance Test are one of the basys for Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

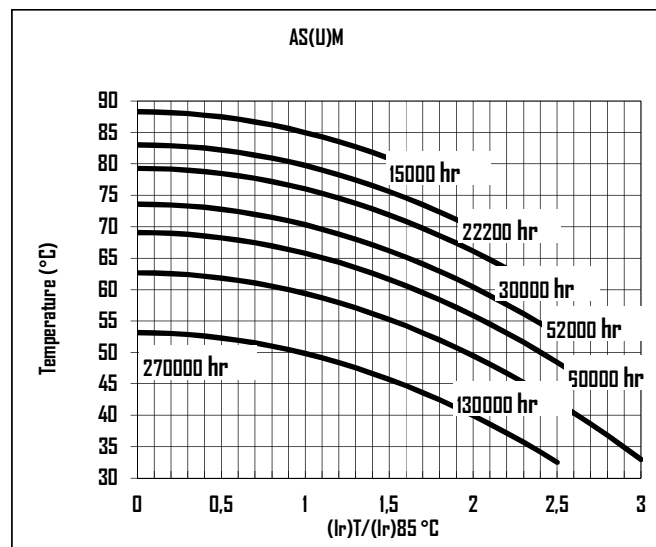


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

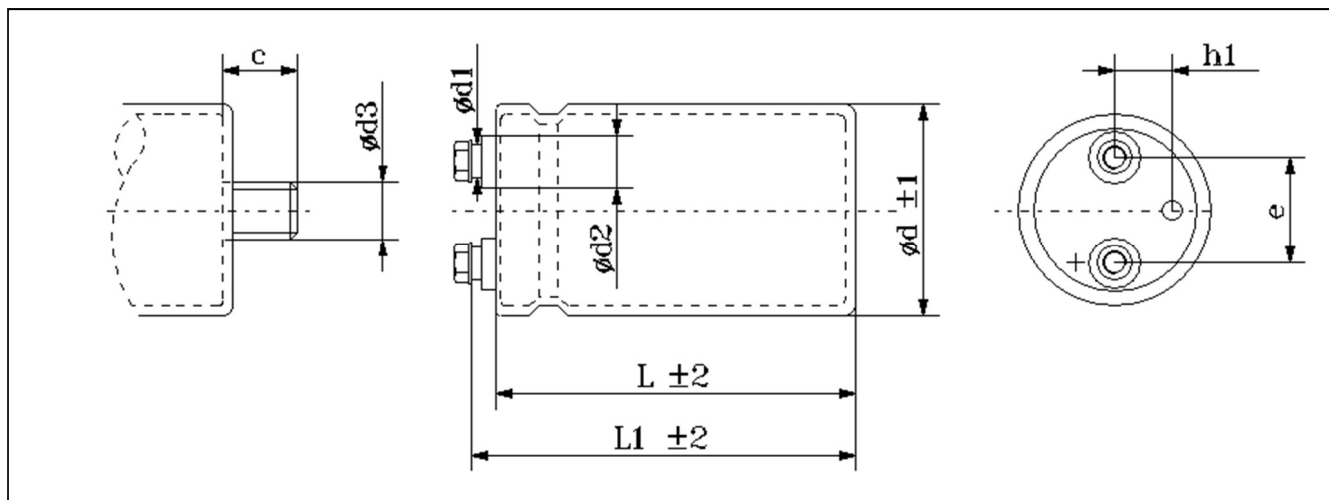
Maximum limit	@25°C	$I_f \leq 1..5 \cdot \sqrt{C \cdot V}$
Operating limit	@25°C	$I_f \leq 1..5 \cdot \sqrt{C \cdot V}$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F], V=rated voltage [V]

### Surge Voltage

Working Voltage	350	400	450	500
Surge Voltage	425	475	525	550

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
350	680	BC	51	105	0,07	164	131	124	8,0	4,4	AS(U)M681M350BCI
	1000	BC	51	105	0,07	108	87	85	10,0	5,4	AS(U)M102M350BCI
	1500	CC	63	105	0,08	81	65	66	13,0	7,0	AS(U)M152M350CCI
	2220	DC	76	105	0,09	62	50	51	16,0	8,9	AS(U)M222M350DCI
	3300	DF	76	145	0,09	41	33	35	22,0	12,5	AS(U)M332M350DFI
	4700	DF	76	145	0,07	24	19	24	27,0	14,9	AS(U)M472M350DFI
	6800	DJ	76	222	0,10	23	19	20	39,0	21,7	AS(U)M682M350DJI
400	680	BC	51	105	0,10	234	187	151	7,0	4,0	AS(U)M681M400BCI
	1000	CC	63	105	0,10	159	127	105	10,0	5,4	AS(U)M102M400CCI
	1500	DC	76	105	0,10	106	85	72	13,0	7,4	AS(U)M152M400DCI
	2220	DC	76	105	0,11	80	64	51	15,0	8,5	AS(U)M222M400DCI
	2220	DF	76	145	0,10	72	58	51	18,0	10,2	AS(U)M222M400DFI
	3300	DF	76	145	0,12	58	46	35	21,0	11,4	AS(U)M332M400DFI
	4700	DF	76	145	0,12	41	33	35	24,8	13,5	AS(U)M472M400DFI
	6800	DJ	76	222	0,12	28	22	26	30,0	16,4	AS(U)M682M400DJI
450	1500	CC	63	105	0,10	106	80	60	9,5	6,8	AS(U)M152M450CCI
	2220	CC	63	105	0,12	87	65	49	10,5	7,5	AS(U)M222M450CCI
	3300	DC	76	105	0,12	58	43	36	14,3	10,2	AS(U)M332M450DCI
		DF	76	145	0,10	48	36	28	17,9	12,8	AS(U)M332M450DFI
	4700	DF	76	145	0,12	41	30	24	19,5	13,9	AS(U)M472M450DFI
		EC	90	105	0,12	41	30	25	21,8	15,6	AS(U)M472M450ECI
	5600	DF	76	145	0,12	34	27	29	30,0	16,4	AS(U)M562M450DFI
		DJ	76	222	0,13	37	30	28	31,0	17,2	AS(U)M562M450DJI
	6800	DJ	76	222	0,12	28	21	17	28,3	20,2	AS(U)M682M450DJI
		EF	90	145	0,12	28	21	17	26,2	18,7	AS(U)M682M450EFI
10000	DJ	76	222	0,12	19	14	20	32,5	22,8	AS(U)M103M450DJI	
	EJ	90	222	0,12	19	14	12	37,7	26,9	AS(U)M103M450EJI	
500	470	BB	51	83	0,10	339	271	254	5,2	2,9	AS(U)M471M500BBI
		BC	51	105	0,10	339	271	254	5,8	3,2	AS(U)M471M500BCI
	1000	BC	51	105	0,10	159	127	98	8,0	4,2	AS(U)M102M500BCI
	1500	DC	76	105	0,10	106	85	74	11,0	6,0	AS(U)M152M500DCI
	2220	DC	76	105	0,10	72	58	54	13,4	7,6	AS(U)M222M500DCI
		DF	76	145	0,10	72	58	47	15,0	8,3	AS(U)M222M500DFI
	3300	DF	76	145	0,10	48	39	27	16,0	9,1	AS(U)M332M500DFI
	3900	DF	76	145	0,10	41	32	22	18,3	11,2	AS(U)M392M500DFI
	4400	DF	76	145	0,10	35	28	2	23,7	13,5	AS(U)M442M500DFI
	4700	DF	76	145	0,08	27	22	18	27,0	15,4	AS(U)M472M500DFI
		EF	90	145	0,08	27	22	18	30,1	17,2	AS(U)M472M500EFI
	5600	EF	90	145	0,12	34	27	26	34,1	18,9	AS(U)M562M500EFI
	6800	EF	90	145	0,12	28	22	21	37,5	20,8	AS(U)M682M500EFI
10000	EJ	90	222	0,12	19	15	14	54,4	30,2	AS(U)M103M500EJI	

**Dimension, Quantity and Weight for box**


Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x83	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BB	51x83	85	13	13	18	22.2	M	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	M	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	M	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DC	76x105	111	19	13	18	31.8	M	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	M	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	M	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	13	18	31.8	M	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	153	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	8-12

All dimensions in mm, torque in Nm, weight in kg

## Series AF(U) - 85°C 20.000 h

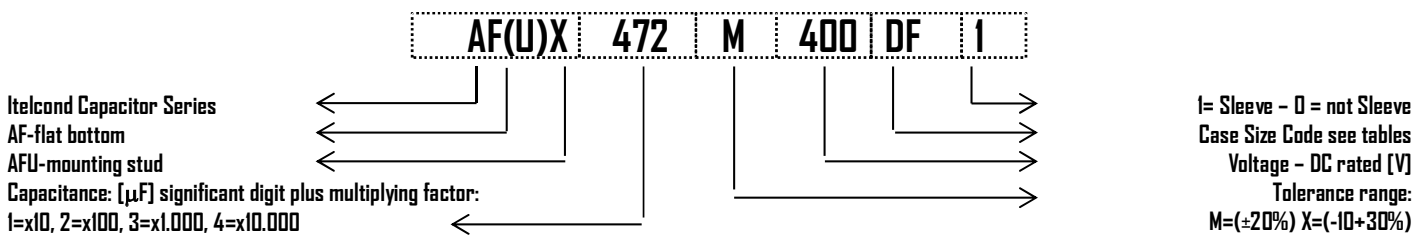
### Capacitors screw terminal type - High Ripple - Extra Long Useful Life

- AF - Flat Bottom
- AFU - Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/85/56
- Case: 51x105 - 90x240
- Temperature - 40°C + 85°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@85^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@85^\circ\text{C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	1.65	1.50	1.40	1.20	1.00

Table 1- $K_t$  Values

$V_n/\text{Hz}$	$K_f$
	V>300 Diameter Code C, D, E
50	0.72
100	1.00
120	1.03
200	1.14
300	1.24
400	1.29
500	1.32
>1000	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

Voltage Endurance Test are one of the basys for Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

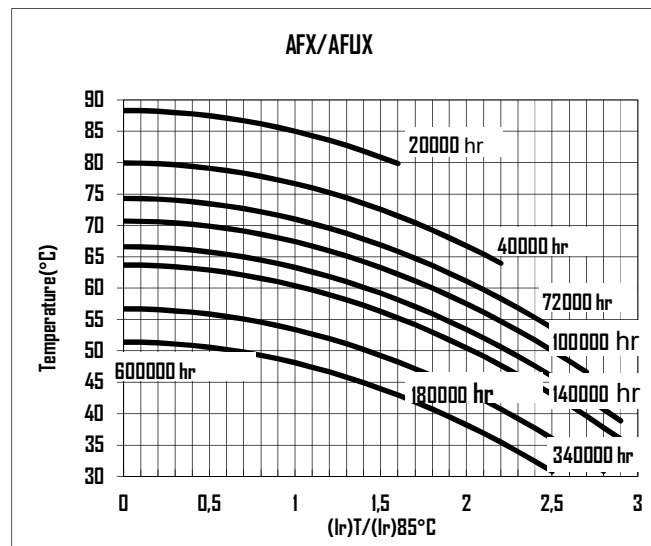


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,001 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,0005 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F], V=rated voltage [V]

### Surge Voltage

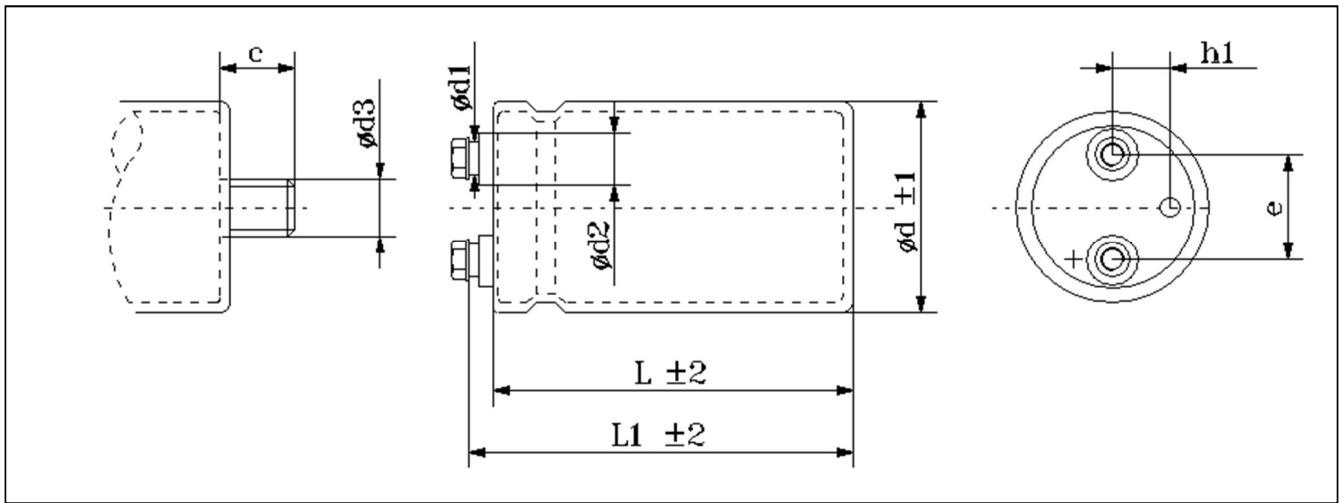
Working Voltage	160	200	250	350	400	450
Surge Voltage	185	230	290	385	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code	
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud	
160	4700	BC	51	105	0,09	30	24	23	15,9	10,6	AF(U)X472M160BCI	
		CC	63	107	0,09	30	24	23	18,1	12,0	AF(U)X472M160CCI	
	6800	DC	76	107	0,09	21	17	16	24,2	16,1	AF(U)X682M160DCI	
	10000	DC	76	107	0,09	14	11	11	29,3	19,5	AF(U)X103M160DCI	
	15000	DF	76	147	0,09	10	8	7	41,2	27,5	AF(U)X153M160DFI	
		22000	DF	76	147	0,09	7	5	5	49,9	33,3	AF(U)X223M160DFI
			EF	90	220	0,09	7	5	5	65,7	43,8	AF(U)X223M160EFI
200	3300	BC	51	105	0,09	43	35	33	13,3	8,9	AF(U)X332M200BCI	
	4700	CC	63	107	0,09	30	24	23	18,1	12,0	AF(U)X472M200CCI	
		DC	76	107	0,09	30	24	23	20,1	13,4	AF(U)X472M200DCI	
	6800	DC	76	107	0,09	21	17	16	24,2	16,1	AF(U)X682M200DCI	
	10000	DF	76	147	0,09	14	11	11	33,7	22,4	AF(U)X103M200DFI	
	15000	DF	76	147	0,09	10	8	7	41,2	27,5	AF(U)X153M200DFI	
		22000	DF	76	147	0,09	7	5	5	49,9	33,3	AF(U)X223M200DFI
	DK		76	167	0,09	7	5	5	52,8	35,2	AF(U)X223M200DKI	
33000	DK	76	167	0,09	4	3	3	64,7	43,1	AF(U)X333M200DKI		
350	2200	CC	63	105	0,08	58	46	43	13,1	8,7	AF(U)X222M350CCI	
	3300	DF	76	145	0,08	39	31	29	20,5	13,7	AF(U)X332M350DFI	
	4700	DF	76	145	0,08	27	22	20	24,5	16,3	AF(U)X472M350DFI	
	6800	DF	76	145	0,08	19	15	14	29,4	19,6	AF(U)X682M350DFI	
		DJ	76	222	0,08	19	15	14	35,5	23,6	AF(U)X682M350DJI	
	10000	DJ	76	222	0,08	13	10	10	43,0	28,7	AF(U)X103M350DJI	
		EF	90	145	0,08	13	10	10	39,3	26,2	AF(U)X103M350EFI	
15000	EJ	90	222	0,08	8	7	6	57,7	38,5	AF(U)X153M350EJI		
400	1500	DC	76	105	0,08	85	68	64	12,0	8,0	AF(U)X152M400DCI	
	2220	DC	76	105	0,08	58	46	43	14,6	9,7	AF(U)X222M400DCI	
	3300	DC	76	105	0,08	39	31	29	17,9	11,9	AF(U)X332M400DCI	
		DF	76	145	0,08	39	31	29	20,5	13,7	AF(U)X332M400DFI	
	4700	DF	76	145	0,08	27	22	20	24,5	16,3	AF(U)X472M400DFI	
		6800	DF	76	145	0,08	19	15	14	29,4	19,6	AF(U)X682M400DFI
	DJ		76	222	0,08	19	15	14	35,5	23,6	AF(U)X682M400DJI	
	10000	DJ	76	222	0,08	13	10	10	43,0	28,7	AF(U)X103M400DJI	
		EF	90	145	0,08	13	10	10	39,3	26,2	AF(U)X103M400EFI	
15000	EJ	90	222	0,08	8	7	6	57,7	38,5	AF(U)X153M400EJI		
450	1500	CC	63	105	0,08	85	68	64	10,8	7,2	AF(U)X152M450CCI	
	2220	CC	63	105	0,08	58	46	43	13,1	8,7	AF(U)X222M450CCI	
	3300	DC	76	105	0,08	39	31	29	17,9	11,9	AF(U)X332M450DCI	
		DF	76	145	0,08	39	31	29	20,5	13,7	AF(U)X332M450DFI	
	4700	DF	76	145	0,08	27	22	20	24,5	16,3	AF(U)X472M450DFI	
	5600	DF	76	145	0,08	23	18	17	26,7	17,8	AF(U)X562M450DFI	
6800	EF	90	145	0,08	19	15	14	32,4	21,6	AF(U)X682M450EFI		



	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	(U) for mounting stud
<b>450</b>		DJ	76	222	0,08	19	15	14	35,5	23,6	AF(U)X682M4500J1
	10000	EJ	90	222	0,08	13	10	10	47,1	31,4	AF(U)X103M450EJ1

### Dimension, Quantity and Weight for box



Case				Connections						Mounting Stud			Packaging		
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DC	76x105	111	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	8	13	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	153	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	8-12
EL	90x240	245	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-13

*All dimensions in mm, torque in Nm, weight in kg*



## Series AZ(U) – 105°C - 5.000 h

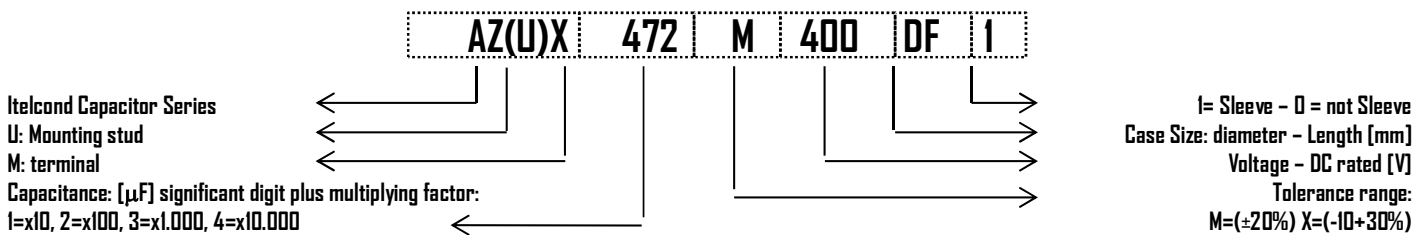
### Capacitors screw terminal type –High Reliability

- AZX Flat Bottom
- AZUX Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 40/105/86
- Case: 51x83 – 90 x 222
- Temperature - 40°C + 105°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@105^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@105^\circ\text{C}}$  is the limit given by tables, @ 105°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85	95	105
$K_t$	2.50	2.40	2.20	2.00	1.80	1.30	1.00

Table 1- $K_t$  Values

Hz	$K_f$
50	0.78
100	1.00
120	1.02
200	1.06
300	1.08
400	1.09
500	1.32
>1000	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_0 \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 20\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_0 \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

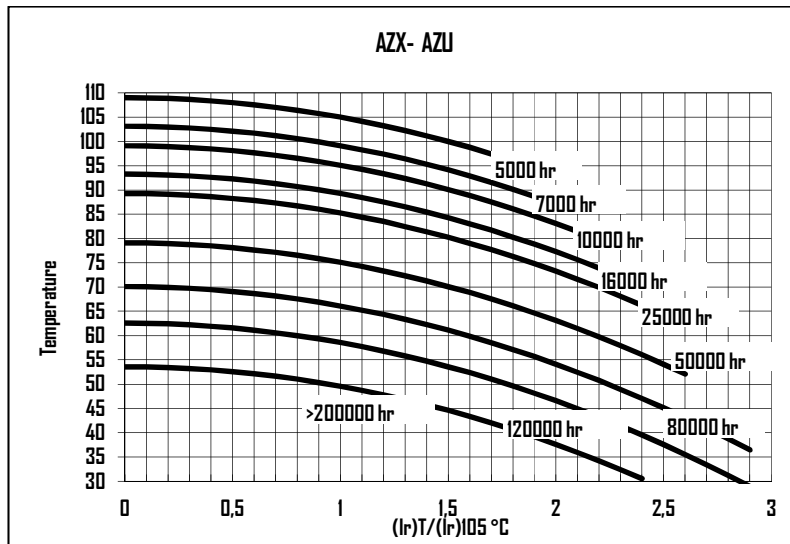


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu\text{A}$ ],  $C$ =capacitance [ $\mu\text{F}$ ],  
 $V$ =rated voltage [V]

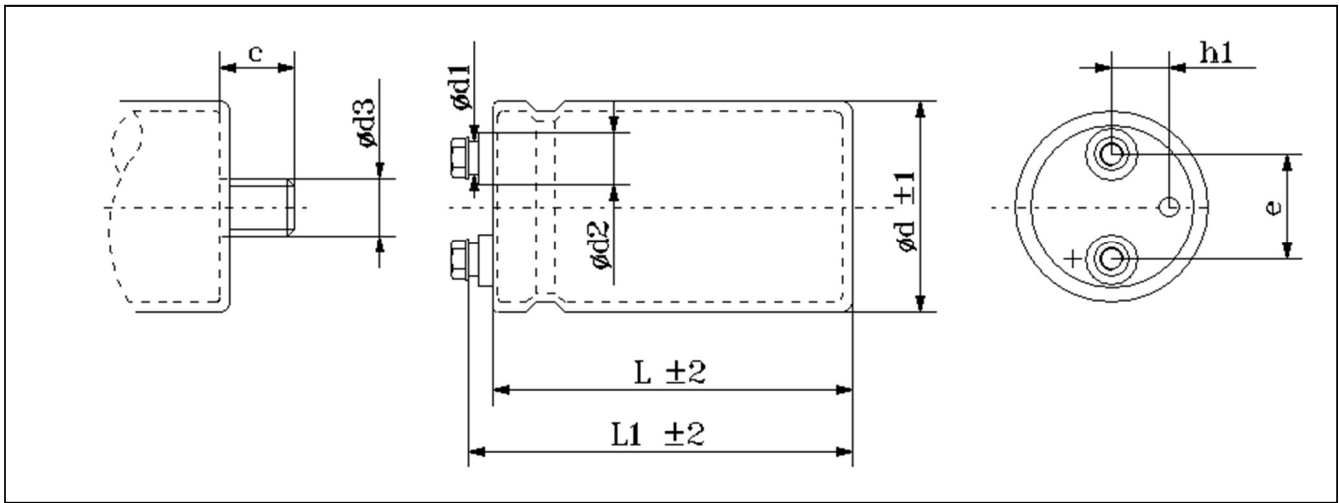
### Surge Voltage

Working Voltage	200	250	350	400	450
Surge Voltage	230	290	385	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@105°C	(U) for mounting stud
200	2220	BC	51	105	0,09	65	49	61	10,0	5,4	AZ(U)X222M200BCI
	3300	CC	63	105	0,09	43	33	40	13,0	7,5	AZ(U)X332M200CCI
	4700	DC	76	105	0,09	30	23	28	18,0	10,0	AZ(U)X472M200DCI
	6800	DF	76	145	0,09	21	16	18	25,0	13,7	AZ(U)X682M200DFI
	10000	DF	76	145	0,09	14	11	13	30,0	16,6	AZ(U)X103M200DFI
250	2220	BC	51	105	0,09	65	52	49	10,8	6,0	AZ(U)X222M250BCI
	3300	BC	51	105	0,09	43	35	33	13,2	7,3	AZ(U)X332M250BCI
		CC	63	105	0,09	43	35	33	15,0	8,3	AZ(U)X332M250CCI
	4700	DC	76	105	0,09	30	24	23	19,9	11,0	AZ(U)X472M250DCI
		DF	76	145	0,09	30	24	23	22,8	12,7	AZ(U)X472M250DFI
	6800	DF	76	145	0,09	21	17	16	27,4	15,2	AZ(U)X682M250DFI
	10000	DF	76	145	0,09	14	11	11	33,3	18,5	AZ(U)X103M250DFI
		DJ	76	222	0,09	14	11	11	40,1	22,3	AZ(U)X103M250DJI
	15000	DJ	76	222	0,09	10	8	7	49,1	27,3	AZ(U)X153M250DJI
EF		90	145	0,09	10	8	7	44,8	24,9	AZ(U)X153M250EFI	
22200	EJ	90	222	0,09	7	5	5	65,2	36,2	AZ(U)X223M250EJI	
350	1500	BC	51	105	0,07	74	59	56	10,1	5,6	AZ(U)X152M350BCI
	2220	CC	63	105	0,07	51	41	38	13,9	7,7	AZ(U)X222M350CCI
	3300	CC	63	105	0,07	34	27	25	17,0	9,4	AZ(U)X332M350CCI
		DC	76	105	0,07	34	27	25	18,9	10,5	AZ(U)X332M350DCI
	3900	DC	76	105	0,07	29	23	21	20,5	11,4	AZ(U)X392M350DCI
	4700	DC	76	105	0,07	24	19	18	22,5	12,5	AZ(U)X472M350DCI
		DF	76	145	0,07	24	19	18	25,9	14,4	AZ(U)X472M350DFI
	5600	DF	76	145	0,07	20	16	15	28,2	15,7	AZ(U)X562M350DFI
	6800	DF	76	145	0,07	16	13	12	31,1	17,3	AZ(U)X682M350DFI
		DJ	76	222	0,07	16	13	12	37,5	20,8	AZ(U)X682M350DJI
	8200	DF	76	145	0,07	0	0	0	0,0	0,0	AZ(U)X822M350DFI
10000	DJ	76	222	0,07	11	9	8	45,4	25,2	AZ(U)X103M350DJI	
	EF	90	145	0,07	11	9	8	41,5	23,0	AZ(U)X103M350EFI	
15000	EJ	90	222	0,07	7	6	6	61,0	33,9	AZ(U)X153M350EJI	
400	680	BC	51	105	0,07	164	131	123	6,8	3,8	AZ(U)X682M400BCI
	1000	BC	51	105	0,07	111	89	84	8,2	4,6	AZ(U)X102M400BCI
	1500	BC	51	105	0,07	74	59	56	10,1	5,6	AZ(U)X152M400BCI
	2220	CC	63	105	0,07	51	41	38	13,9	7,7	AZ(U)X222M400CCI
		DC	76	105	0,07	51	41	38	15,4	8,6	AZ(U)X222M400DCI
	3300	DC	76	105	0,07	34	27	25	18,9	10,5	AZ(U)X332M400DCI
		DF	76	145	0,07	34	27	25	21,7	12,0	AZ(U)X332M400DFI
	3900	DF	76	145	0,07	29	23	21	23,6	13,1	AZ(U)X392M400DFI
	4700	DF	76	145	0,07	24	19	18	25,9	14,4	AZ(U)X472M400DFI
	5600	DF	76	145	0,07	20	16	15	28,2	15,7	AZ(U)X562M400DFI
6800	DF	76	145	0,07	16	13	12	31,1	17,3	AZ(U)X682M400DFI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@105°C	(U) for mounting stud
<b>400</b>	6800	DJ	76	222	0,07	16	13	12	37,5	20,8	AZ(U)X682M400DJ
	10000	EF	90	145	0,07	11	9	8	41,5	23,0	AZ(U)X103M400EF
		DJ	76	222	0,07	11	9	8	45,4	25,2	AZ(U)X103M400DJ
	15000	EJ	90	222	0,07	7	6	6	61,0	33,9	AZ(U)X153M400EJ
<b>450</b>	1000	BC	51	105	0,08	127	102	96	7,7	4,3	AZ(U)X102M450BC
	1500	CC	63	105	0,08	85	68	64	10,7	5,9	AZ(U)X152M450CC
	2220	DC	76	105	0,08	58	46	43	14,4	8,0	AZ(U)X222M450DC
		DF	76	145	0,08	58	46	43	16,5	9,2	AZ(U)X222M450DF
	3300	DF	76	145	0,08	39	31	29	20,3	11,3	AZ(U)X332M450DF
	3900	DF	76	145	0,08	33	26	24	22,0	12,2	AZ(U)X392M450DF
	4700	DF	76	145	0,08	27	22	20	24,2	13,4	AZ(U)X472M450DF
	5600	DF	76	145	0,08	23	18	17	26,4	14,7	AZ(U)X562M450DF
	6800	DJ	76	222	0,08	19	15	14	35,1	19,5	AZ(U)X682M450DJ
		EF	90	145	0,08	19	15	14	32,0	17,8	AZ(U)X682M450EF
	10000	DJ	76	222	0,08	13	10	10	42,5	23,6	AZ(U)X103M450DJ
	10000	EJ	90	222	0,08	13	10	10	46,6	25,9	AZ(U)X103M450EJ

### Dimension, Quantity and Weight for box



Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x83	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BB	51x83	85	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	153	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31.8	G	M6	2,5	10	M12	16	10Nm	6	8-12

All dimensions in mm, torque in Nm, weight in kg





## Series AT(U) – 105°C 8.000 h

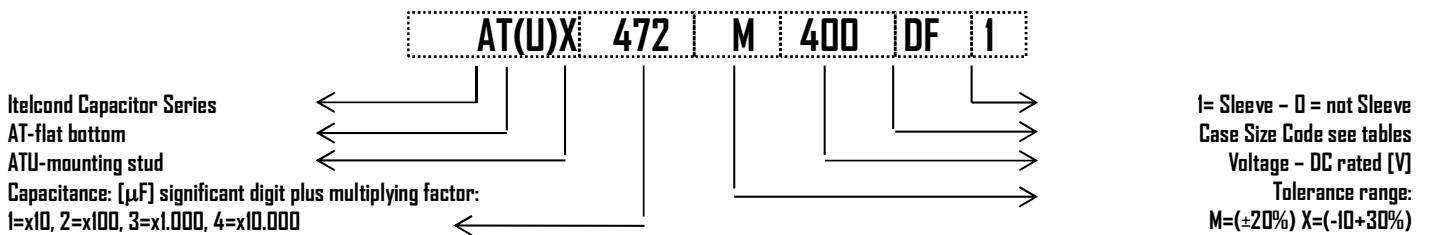
### Capacitors screw terminal type – High Ripple – High Reliability – Extra Useful Life

- AT- Flat Bottom
- ATU- Mounting Stud
- Capacitance Tolerance: -20 + 20% - standard (M)
- Capacitance Tolerance: -10 + 30% - on request (X)
- Climatic category: 55/105/56
- Case: 51x83 – 90 x 222
- Temperature – 55°C + 105°C
- All welded construction reliable electrical contact

### Mechanical Outlines

- Case: aluminium made
- Terminals: screw
- Sealing: hermetic by EPR gasket, on a resin cover
- Pressure Release Vent: silicone-rubber
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- Mounting Hardware: see hardware section
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@105^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@105^\circ\text{C}}$  is the limit given by tables, @ 105°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85	95	105
$K_t$	2.50	2.40	2.20	2.00	1.80	1.30	1.00

Table 1- $K_t$  Values

Hz	$K_f$
50	0.78
100	1.00
120	1.02
200	1.06
300	1.08
400	1.09
500	1.32
>1000	1.37

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 20\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

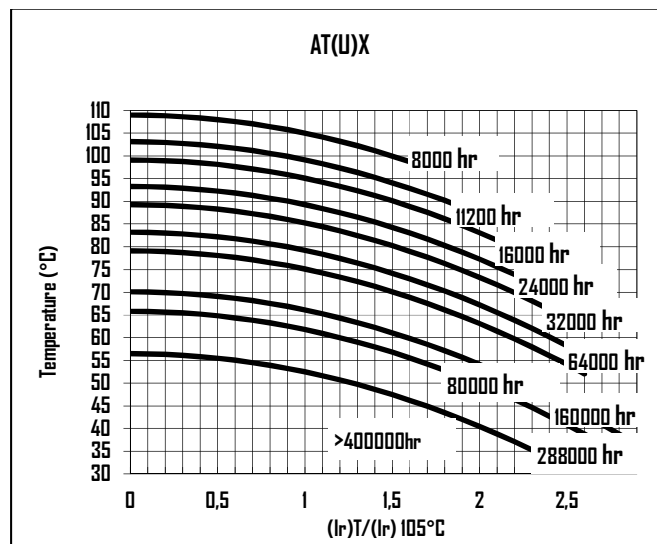


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

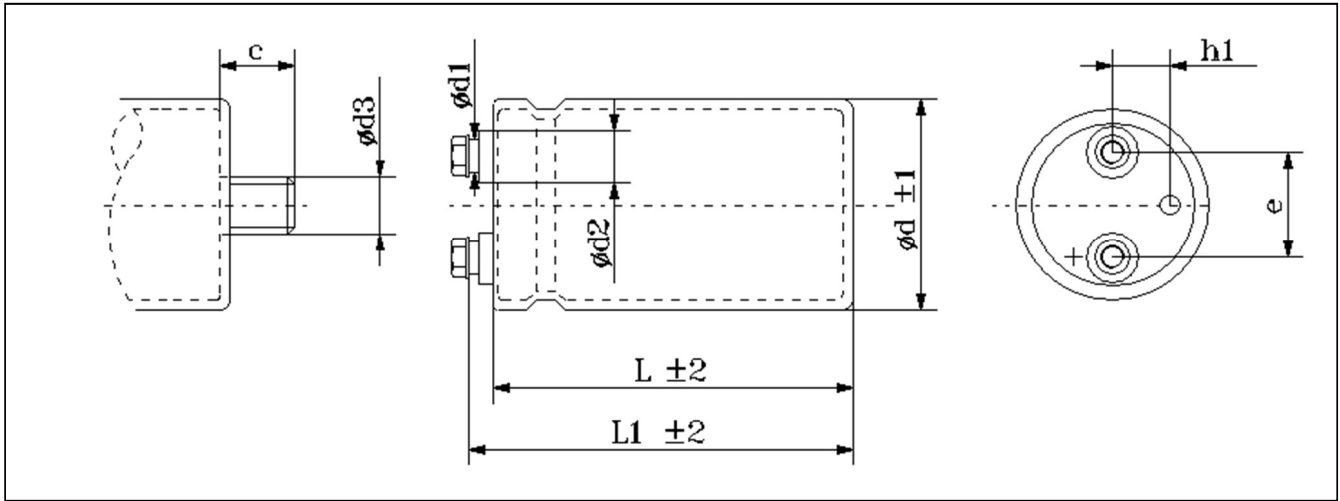
Maximum limit	@25°C	$I_f \leq 1.3 \cdot \sqrt{C \cdot V}$
Operating limit	@25°C	$I_f \leq 1.2 \cdot \sqrt{C \cdot V}$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F], V=rated voltage [V]

### Surge Voltage

Working Voltage	350	400	420	450
Surge Voltage	385	440	420	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@105°C	(U) for mounting stud
350	2200	CC	63	105	0,09	65	52	49	17,4	7,0	AT(U)X222M350CC1
	2700	CC	63	105	0,09	53	42	40	19,3	7,7	AT(U)X272M350CC1
	3300	CC	63	105	0,09	43	35	33	21,3	8,5	AT(U)X332M350CC1
	3900	DC	76	145	0,09	37	29	28	29,6	11,8	AT(U)X392M350DC1
	4700	DF	76	145	0,09	30	24	23	32,5	13,0	AT(U)X472M350DF1
	6800	DF	76	145	0,09	21	17	16	39,1	15,6	AT(U)X682M350DF1
	8200	DF	76	145	0,09	17	14	13	42,9	17,2	AT(U)X822M350DF1
	10000	DJ	76	222	0,09	14	11	11	56,9	22,8	AT(U)X103M350DJ1
	12000	DJ	76	222	0,09	12	10	9	62,3	24,9	AT(U)X123M350DJ1
	15000	EJ	90	222	0,09	10	8	7	76,7	30,7	AT(U)X153M350EJ1
18000	EJ	90	222	0,09	8	6	6	83,6	33,5	AT(U)X183M350EJ1	
400	1000	CC	63	105	0,09	143	115	105	11,7	4,7	AT(U)X102M400CC1
	1500	CC	63	105	0,09	96	76	72	14,4	5,7	AT(U)X152M400CC1
	2220	CC	63	105	0,09	65	52	49	17,4	7,0	AT(U)X222M400CC1
	3300	CC	63	105	0,09	43	35	33	21,3	8,5	AT(U)X332M400CC1
	3900	DC	76	145	0,09	37	29	28	29,6	11,8	AT(U)X392M400DC1
	4700	DC	76	145	0,09	30	24	23	32,5	13,0	AT(U)X472M400DC1
	5600	DF	76	145	0,09	26	20	19	35,5	14,2	AT(U)X562M400DF1
	6800	DF	76	145	0,09	21	17	16	39,1	15,6	AT(U)X682M400DF1
	8200	DJ	76	222	0,09	17	14	13	51,5	20,6	AT(U)X822M400DJ1
	10000	DJ	76	222	0,09	14	11	11	56,9	22,8	AT(U)X103M400DJ1
12000	EJ	90	222	0,09	12	10	9	68,3	27,3	AT(U)X123M400EJ1	
450	1000	CC	63	105	0,09	143	115	105	11,7	4,7	AT(U)X102M450CC1
	1500	CC	63	105	0,09	96	76	72	14,4	5,7	AT(U)X152M450CC1
	2220	CC	63	105	0,10	72	58	54	16,5	6,6	AT(U)X222M450CC1
	3300	CC	63	105	0,12	58	46	43	18,5	7,4	AT(U)X332M450CC1
	3900	DC	76	145	0,12	49	39	37	25,6	10,3	AT(U)X392M450DC1
	4700	DC	76	145	0,12	41	33	30	28,1	11,3	AT(U)X472M450DC1
	5600	DF	76	145	0,10	28	23	21	33,7	13,5	AT(U)X562M450DF1
	6800	DF	76	145	0,10	23	19	18	37,1	14,8	AT(U)X682M450DF1
	8200	DJ	76	222	0,12	23	19	17	44,6	17,8	AT(U)X822M450DJ1
10000	DJ	76	222	0,12	19	15	14	49,3	19,7	AT(U)X103M450DJ1	

**Dimension, Quantity and Weight for box**


Case				Connections							Mounting Stud			Packaging	
Code	DxL	L1	h1	d1	d2	e	Terminal	Screw			Screw			Pcs/Box	Weight/box
							Code	Thread	Torque	Lenght	d3	c	Torque		
BB	51x83	85	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BB	51x83	85	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	8	13	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
BC	51x105	109	13	13	18	22.2	X	M5	2,0	10	M12	16	10Nm	30	6-9
CC	63x105	111	16	8	13	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
CC	63x105	111	16	13	18	28.6	X	M5	2,0	10	M12	16	10Nm	20	6-8
DC	76x105	111	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	5-7
DF	76x145	151	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DK	76x165	173	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	12	6-14
				18	23		G	M6	2,5						
DJ	76x222	222	19	13	18	31.8	X	M5	2,0	10	M12	16	10Nm	8	9-11
				18	23		G	M6	2,5						
EC	90x105	112	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	7-9
EF	90x145	153	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	9-11
EJ	90x222	227	19	18	23	31,8	G	M6	2,5	10	M12	16	10Nm	6	8-12

*All dimensions in mm, torque in Nm, weight in kg*

## Series ARS/C - 85°C 2.000 h

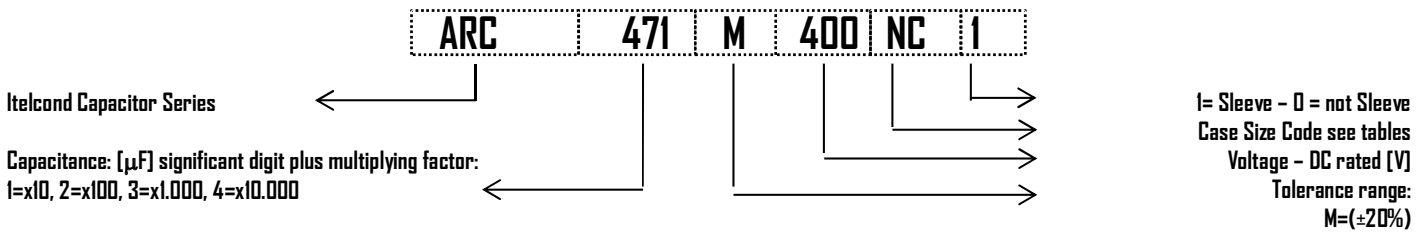
### Capacitors PCB type -

- ARC 2 pins - ARS - 4 pins
- Capacitance Tolerance: -20 + 20% - standard (M)
- Climatic category: 40/85/56
- Case: 30x40 - 45x100
- Temperature - 40°C + 85°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- No insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple@85C}}$$

Where:

- $I_{\text{Ripple@85°C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	2.30	1.90	1.70	1.40	1.00

Table 1- $K_t$  Values

$V_n/Hz$	$K_f$	
	$V < 50$	$V > 50$
50	0.90	0.88
100	1.00	1.00
300	1.14	1.20
400	1.18	1.25
500	1.20	1.35
>1000	1.25	1.40

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

Voltage Endurance Test are one of the basys for Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

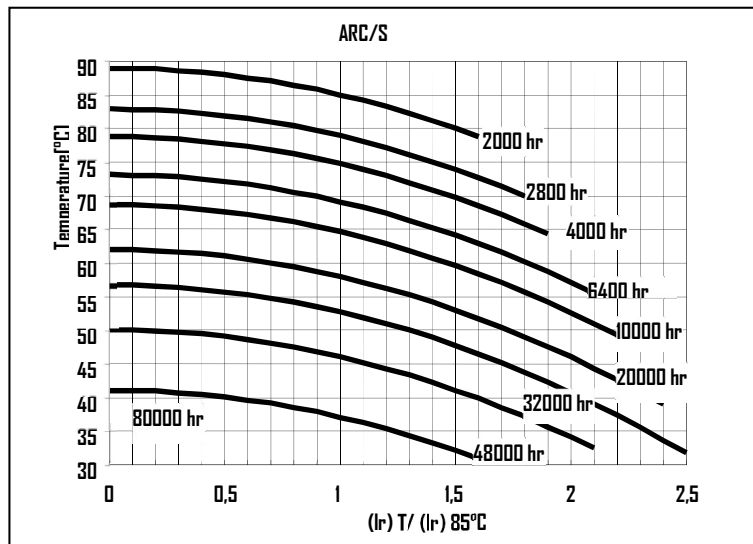


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,006 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,003 \times C \times V$

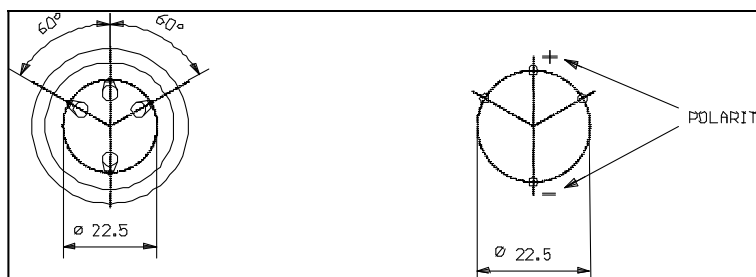
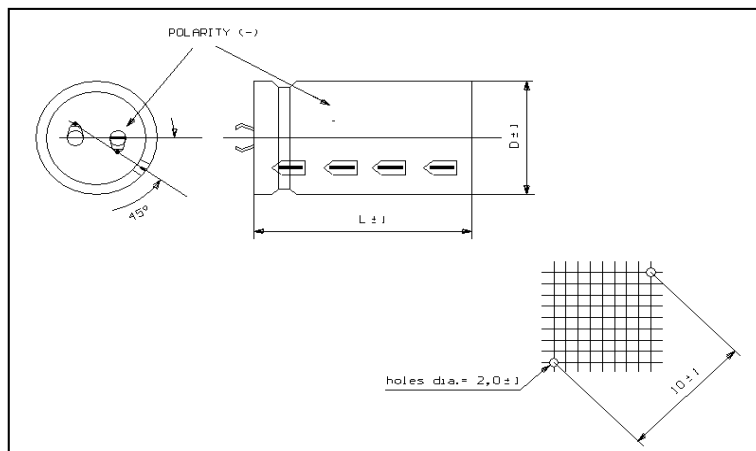
Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

### Surge Voltage

Working Voltage	200	250	350	400	450
Surge Voltage	230	290	385	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[A]@55°C	[A]@85°C		
200	470	MB	30	40	0,09	244	195	183	2,4	1,2	ARC471M200MBI
	680	MB	30	40	0,09	169	135	126	2,8	1,5	ARC681M200MBI
	1000	MC	30	50	0,09	115	92	86	3,8	2,0	ARC102M200MCI
		NB	35	40	0,09	115	92	86	3,8	2,0	ARC102M200NBI
	1200	NB	35	40	0,09	96	76	72	4,1	2,2	ARC122M200NBI
	1500	NC	35	50	0,09	76	61	57	5,1	2,7	ARC152M200NCI
1800	NC	35	50	0,09	64	51	48	5,5	2,9	ARC182M200NCI	
250	470	MB	30	40	0,09	244	195	183	2,4	1,2	ARC471M250MBI
	680	MC	30	50	0,09	169	135	126	3,1	1,6	ARC681M250MCI
		NB	35	40	0,09	169	135	126	3,1	1,6	ARC681M250NBI
	1000	NB	35	40	0,09	115	92	86	3,8	2,0	ARC102M250NBI
		NC	35	50	0,09	115	92	86	4,1	2,2	ARC102M250NCI
	1500	PC	40	50	0,09	76	61	57	5,5	2,9	ARC152M250PCI
2200	NE	35	75	0,09	52	42	39	7,3	3,8	ARC222M250NEI	
400	330	MC	30	50	0,10	386	309	290	2,1	1,1	ARC331M400MCI
	470	MC	30	50	0,10	271	217	203	2,5	1,3	ARC471M400MCI
		PB	40	40	0,10	271	217	203	2,6	1,4	ARC471M400PBI
	560	NC	35	50	0,10	227	182	171	2,9	1,5	ARC561M400NCI
	680	NC	35	50	0,10	187	150	141	3,2	1,7	ARC681M400NCI
		PC	40	50	0,10	187	150	141	3,5	1,8	ARC681M400PCI
1000	PE	40	75	0,10	127	102	96	5,0	2,7	ARC102M400PEI	
1200	PE	40	75	0,10	106	85	80	5,5	2,9	ARC122M400PEI	
450	330	MC	30	50	0,13	502	401	376	1,8	1,0	ARC331M450MCI
	470	NC	35	50	0,13	352	282	264	2,4	1,2	ARC471M450NCI
	680	NC	35	50	0,13	244	195	183	2,8	1,5	ARC681M450NCI
		NN	35	60	0,13	244	195	183	3,1	1,6	ARC681M450NNI
		PC	40	50	0,13	244	195	183	3,1	1,6	ARC681M450PCI
	820	NE	35	75	0,13	202	162	151	3,7	2,0	ARC821M450NEI
1000	PE	40	75	0,13	166	132	124	4,4	2,3	ARC102M450PEI	



**Dimension, Quantity and Weight for box**


Case		Connections			Packaging	
Code	DxL	PIN			Pcs/Box	Weight/box
		ARC	ARS	Lenght		
MB	30x40	2		6.3	100	4-6
MC	30x50	2		6.3	100	4-6
NB	35x40	2	4	6.3	100	6-8
NC	35x50	2	4	6.3	100	6-8
NN	35x60	2	4	6.3	100	5-7
NE	35x75	2	4	6.3	50	6-8
PB	40x40	2	4	6.3	126	9-11
PC	40x50	2	4	6.3	126	9-11
PN	40x60	2	4	6.3	126	9-11
PE	40x75	2	4	6.3	63	10-12
PG	40x100	2	4	6.3	63	7-9
QC	45x50		4	6.3	30	6-8
QN	45x60		4	6.3	30	6-8
QE	45x75		4	6.3	30	7-9
QG	45x100		4	6.3	30	8-10

*All dimensions in mm, torque in Nm, weight in kg*

## Series AKS- 85°C 5.000h

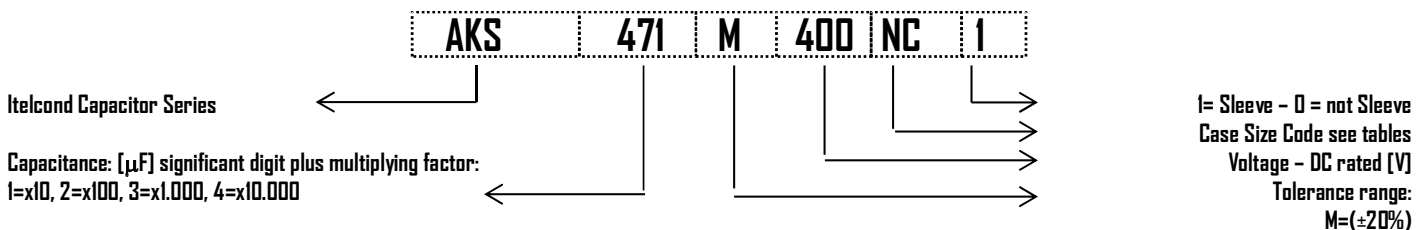
### Capacitors PCB type –DIN style Solder Pins

- AKS 4 pins – 5 pins
- Capacitance Tolerance: -20 + 20% – standard (M)
- Climatic category: 40/85/56
- Case: 35x40 – 45x100
- Temperature – 40°C + 85°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- Insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple@85C}}$$

Where:

- $I_{\text{Ripple@85°C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC voltage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	2.30	1.90	1.70	1.40	1.00

Table 1- $K_t$  Values

$V_n/Hz$	$K_f$	
	$V < 50$	$V > 50$
50	0.90	0.88
100	1.00	1.00
300	1.14	1.20
400	1.18	1.25
500	1.20	1.35
>1000	1.25	1.40

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

Voltage Endurance Test are one of the basys for Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

## Expected Lifetime Vs Temperature and Ripple Current

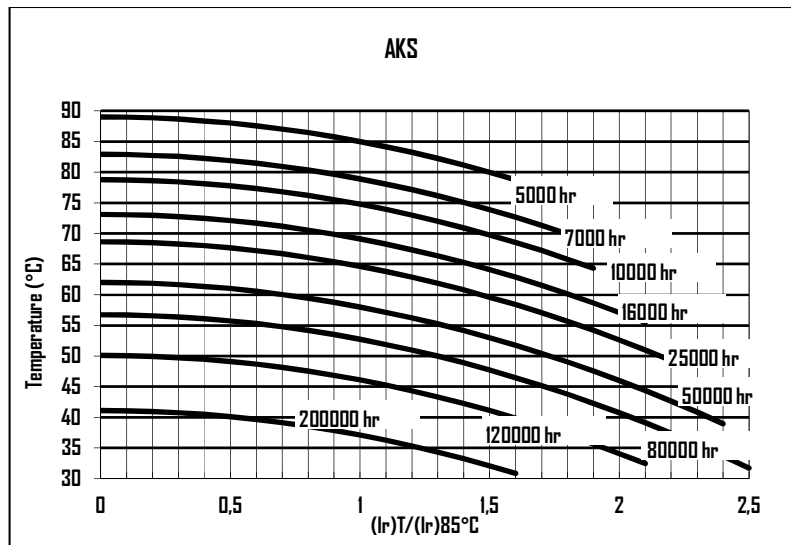


Table 3

## Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F],  
V=rated voltage [V]

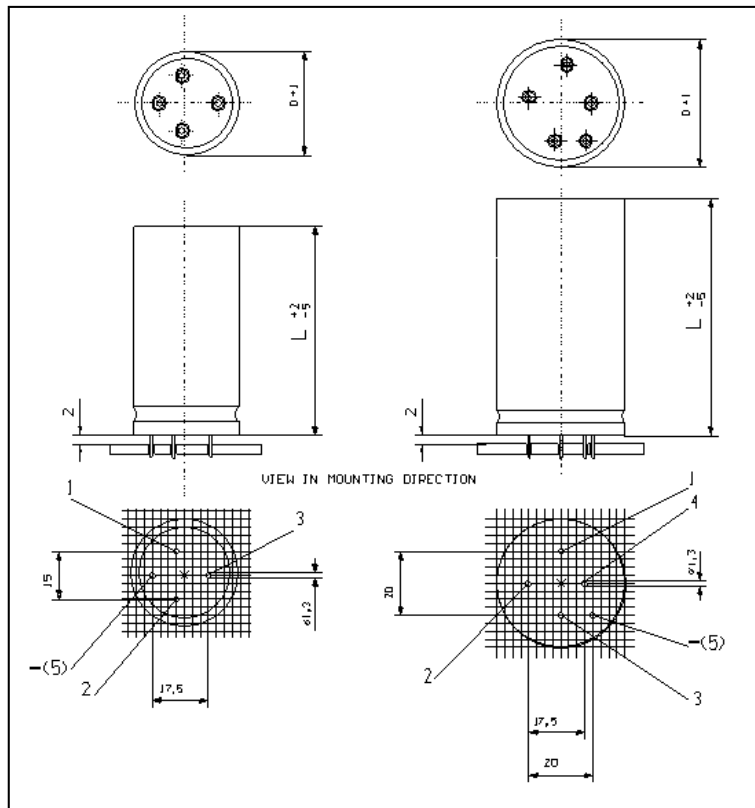
## Surge Voltage

Working Voltage	40	50	63	75	100	160	200	250	350	400	450	500
Surge Voltage	46	58	73	86	115	185	230	290	385	440	495	525

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	
40	15000	NC	35	50	0,34	29	23	22	13,7	7,2	AKS153M040NCI
	22000	PC	40	50	0,40	23	19	17	16,5	8,7	AKS223M040PCI
	33000	PE	40	75	0,46	18	14	13	22,5	11,8	AKS333M040PEI
	47000	PG	40	100	0,55	15	12	11	27,9	14,7	AKS473M040PGI
63	10000	NC	35	50	0,26	33	26	25	12,8	6,7	AKS103M063NCI
		PC	40	50	0,24	31	24	23	14,4	7,6	AKS103M063PCI
	15000	PE	40	75	0,29	25	20	18	19,1	10,1	AKS153M063PEI
	22000	PG	40	100	0,32	19	15	14	25,0	13,2	AKS223M063PGI
100	3300	NC	35	50	0,11	42	34	32	11,3	6,0	AKS332M100NCI
	4700	PC	40	50	0,13	35	28	26	13,4	7,1	AKS472M100PCI
	6800	PE	40	75	0,13	24	19	18	19,2	10,1	AKS682M100PEI
	10000	PG	40	100	0,13	17	13	12	26,5	13,9	AKS103M100PGI
200	1500	NC	35	50	0,09	76	61	57	8,4	4,4	AKS152M200NCI
	2200	PC	40	50	0,09	52	42	39	11,0	5,8	AKS222M200PCI
	2200	PE	40	75	0,09	52	42	39	13,1	6,9	AKS222M200PEI
	3300	PG	40	100	0,09	35	28	26	18,3	9,6	AKS332M200PGI
250	1000	NC	35	50	0,09	115	92	86	6,9	3,6	AKS101M250NCI
	1500	PC	40	50	0,09	76	61	57	9,1	4,8	AKS152M250PCI
	1500	PE	40	75	0,09	76	61	57	10,8	5,7	AKS152M250PEI
	2200	PG	40	100	0,09	52	42	39	14,9	7,9	AKS222M250PGI
400	330	NB	35	40	0,10	386	309	290	3,6	1,9	AKS331M400NBI
	470	NC	35	50	0,10	271	217	203	4,7	2,5	AKS471M400NCI
	680	NN	35	60	0,10	187	150	141	6,2	3,3	AKS681M400NNI
		NE	35	75	0,10	187	150	141	6,8	3,6	AKS681M400NEI
		PC	40	50	0,10	187	150	141	6,2	3,2	AKS681M400PCI
		PN	40	60	0,10	187	150	141	6,7	3,5	AKS681M400PNI
	1000	NN	35	60	0,10	127	102	96	7,5	3,9	AKS102M400NNI
		NE	35	75	0,10	127	102	96	8,3	4,4	AKS102M400NEI
		PE	40	75	0,10	127	102	96	8,9	4,7	AKS102M400PEI
		PG	40	100	0,10	127	102	96	10,1	5,3	AKS102M400PGI
	1200	PG	40	100	0,10	106	85	80	11,1	5,8	AKS122M400PGI
	1500	PE	40	75	0,10	85	68	64	10,9	5,7	AKS152M400PEI
QE		45	75	0,10	85	68	64	11,7	6,1	AKS152M400QEI	
450	220	NB	30	40	0,12	695	556	521	2,5	1,3	AKS221M450NBI
		NC	35	50	0,12	695	556	521	3,0	1,6	AKS221M450NCI
	330	NC	35	50	0,12	463	371	347	3,6	1,9	AKS331M450NCI
	470	NC	35	50	0,12	325	260	244	4,3	2,3	AKS471M450NCI
	680	PC	40	50	0,12	225	180	169	5,6	3,0	AKS681M450PCI
		NE	35	75	0,12	225	180	169	6,2	3,3	AKS681M450NEI
PE		40	75	0,12	225	180	169	6,7	3,5	AKS681M450PEI	

	Capacitance	Case	Diam	Height	Tan $\delta$	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[ $\mu$ F]@100Hz		[mm]	[mm]	[%]@100Hz	[m $\Omega$ ]@100Hz	[m $\Omega$ ]@10KHz	[A]@55°C	[A]@85°C		
	1000	NE	35	75	0,12	153	122	115	7,5	4,0	AKS102M450NEI
		PN	40	60	0,12	153	122	115	7,4	3,9	AKS102M450PNI
450	1000	PE	40	75	0,12	153	122	115	8,1	4,3	AKS102M450PEI
		PG	40	100	0,12	153	122	115	9,2	4,9	AKS102M450PGI
	1500	PG	40	100	0,12	102	82	76	11,3	6,0	AKS152M450PGI

### Dimension, Quantity and Weight for box



Case		Connections			Packaging	
Code	DxL	PIN		Pcs/Box	Weight/box	
		AKS	Lenght			
NB	35x40	4	6.3	100	6-8	
NC	35x50	4	6.3	100	6-8	
NN	35x60	4	6.3	100	5-7	
NE	35x75	4	6.3	50	6-8	
PB	40x40	5	6.3	126	9-10	
PC	40x50	5	6.3	126	9-10	
PN	40x60	5	6.3	126	9-10	
PE	40x75	5	6.3	63	7-9	
PG	40x100	5	6.3	63	9-10	
QC	45x50	5	6.3	30	6-8	
QN	45x60	5	6.3	30	6-8	
QE	45x75	5	6.3	30	7-9	
QG	45x100	5	6.3	30	8-10	

All dimensions in mm, torque in Nm, weight in kg



## Series ACS - ACC- 85°C 5.000h

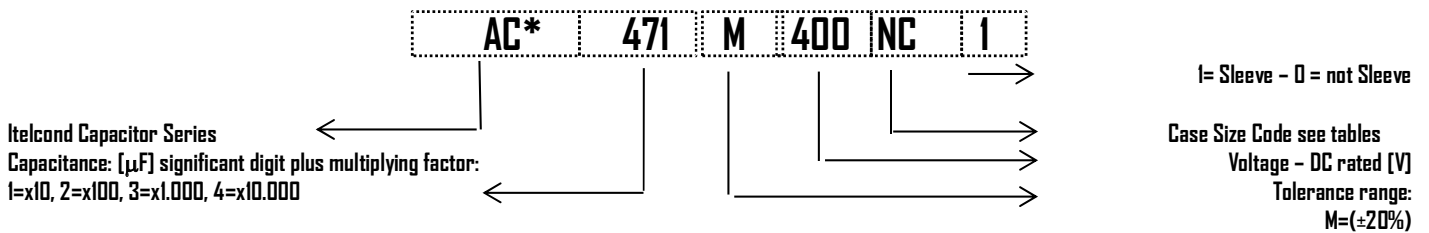
### Capacitors PCB type

- ACC 2 pins
- ACS 4 pins
- Capacitance Tolerance: -20 + 20% - standard (M)
- Climatic category: 40/85/56
- Case: 30x40 - 45x100
- Temperature - 40°C + 85°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- No insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple@85C}}$$

Where:

- $I_{\text{Ripple@85°C}}$  is the limit given by tables, @ 85°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	40	55	65	75	85
$K_t$	2.30	1.90	1.70	1.40	1.00

Table 1- $K_t$  Values

Vn/Hz	$K_f$	
	V<50	V>50
50	0.90	0.88
100	1.00	1.00
300	1.14	1.20
400	1.18	1.25
500	1.20	1.35
>1000	1.25	1.40

Table 2- $K_f$  Values



### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

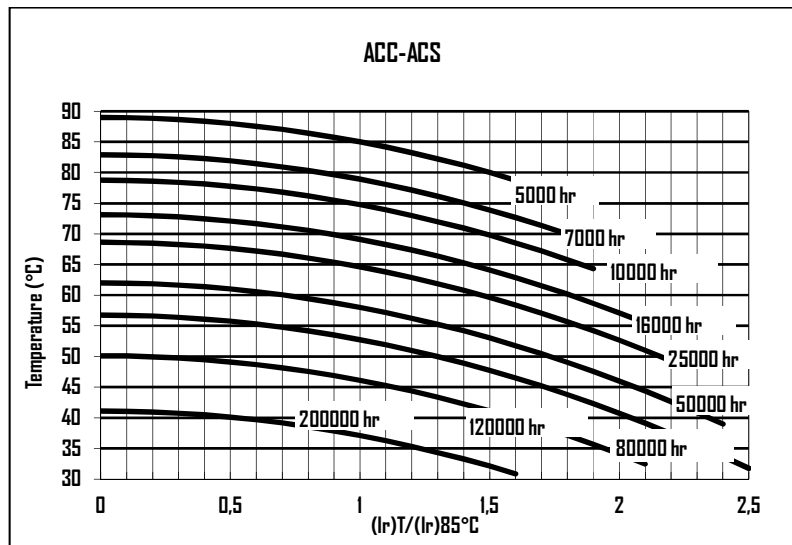


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F],  
V=rated voltage [V]

### Surge Voltage

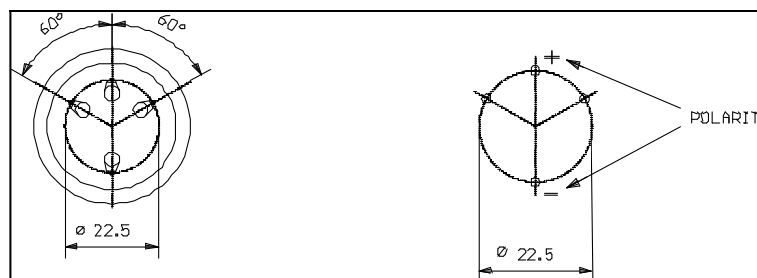
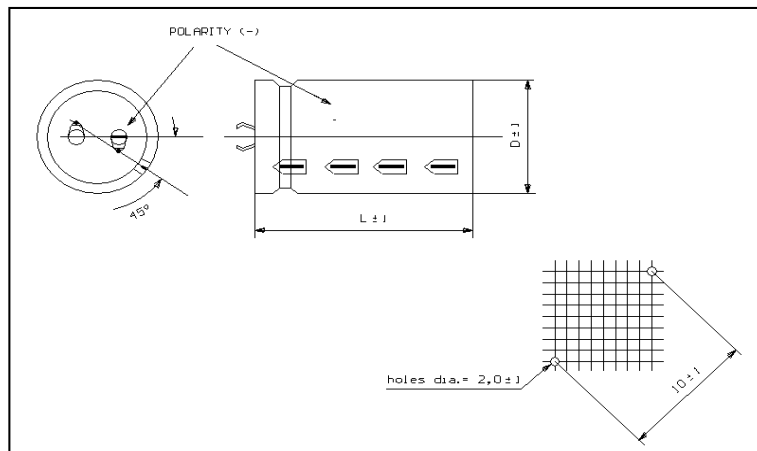
Working Voltage	40	50	63	75	100	160	200	250	350	400	450	500
Surge Voltage	46	58	73	86	115	185	230	290	385	440	495	525

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	*= C, 2 Pins   S, 4 Pins
40	6800	MB	30	40	0,30	56	45	42	8,2	4,3	AC*682M040MBI
	10000	MC	30	50	0,32	41	33	31	10,6	5,6	AC*103M040MCI
		NB	35	40	0,36	46	37	34	9,9	5,2	AC*103M040NBI
	15000	NC	35	50	0,36	31	24	23	13,3	7,0	AC*153M040NCI
	22000	PC	40	50	0,48	28	22	21	15,1	7,9	AC*223M040PCI
	33000	PE	40	75	0,48	19	15	14	22,0	11,6	AC*333M040PEI
47000	PG	40	100	0,48	13	10	10	29,9	15,7	AC*473M040PGI	
63	4700	MB	30	40	0,21	57	46	43	8,1	4,3	AC*472M063MBI
	6800	MC	30	50	0,21	39	31	30	10,8	5,7	AC*682M063MCI
		NB	35	40	0,24	45	36	34	10,0	5,3	AC*682M063NBI
	10000	NC	35	50	0,24	31	24	23	13,3	7,0	AC*103M063NCI
	12000	PC	40	50	0,29	31	25	23	14,4	7,6	AC*123M063PCI
	15000	PE	40	75	0,29	25	20	18	19,1	10,1	AC*153M063PEI
22000	PG	40	100	0,29	17	13	13	26,3	13,8	AC*223M063PGI	
100	1500	MB	30	40	0,09	76	61	57	7,0	3,7	AC*152M100MBI
	2200	MC	30	50	0,10	58	46	43	8,9	4,7	AC*222M100MCI
		NB	35	40	0,11	64	51	48	8,4	4,4	AC*222M100NBI
	3300	MC	30	50	0,12	46	37	35	9,9	5,2	AC*332M100MCI
	4700	NC	35	50	0,12	33	26	24	12,9	6,8	AC*472M100NCI
	5600	PC	40	50	0,12	27	22	20	15,2	8,0	AC*562M100PCI
6800	PE	40	75	0,12	22	18	17	20,0	10,5	AC*682M100PEI	
10000	PG	40	100	0,12	15	12	11	27,6	14,5	AC*103M100PGI	
200	680	MB	30	40	0,08	150	120	112	5,0	2,6	AC*681M200MBI
	1000	NB	35	40	0,08	102	82	76	6,7	3,5	AC*102M200NBI
	1200	MC	30	50	0,08	85	68	64	7,3	3,9	AC*122M200MCI
	1500	NC	35	50	0,08	68	54	51	8,9	4,7	AC*152M200NCI
	2200	NC	35	50	0,08	46	37	35	10,8	5,7	AC*222M200NCI
	2700	PE	40	75	0,08	38	30	28	15,4	8,1	AC*272M200PEI
		PG	40	100	0,08	31	25	23	19,4	10,2	AC*332M200PGI
	3300	QC	45	50	0,08	31	25	23	15,4	8,1	AC*332M200QCI
		QE	45	75	0,08	26	21	20	19,8	10,4	AC*392M200QEI
4700	QG	45	100	0,08	22	17	16	24,7	13,0	AC*472M200QGI	
250	470	MB	30	40	0,08	217	173	163	4,2	2,2	AC*471M250MBI
	1000	MC	30	50	0,08	102	82	76	6,7	3,5	AC*102M250MCI
		NB	35	40	0,08	102	82	76	6,7	3,5	AC*102M250NBI
	1500	NC	35	50	0,08	68	54	51	8,9	4,7	AC*152M250NCI
	1800	PC	40	50	0,08	57	45	42	10,6	5,6	AC*182M250PCI
	2200	NE	35	75	0,08	46	37	35	12,9	6,8	AC*222M250NEI
QC		45	50	0,08	46	37	35	12,5	6,6	AC*222M250QCI	
2700	PE	40	75	0,08	38	30	28	15,4	8,1	AC*272M250PEI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@55°C	[A]@85°C	*= C, 2 Pins   S, 4 Pins
250	3300	PG	40	100	0,08	31	25	23	19,4	10,2	AC*332M250PGI
	3300	QE	45	75	0,08	31	25	23	18,2	9,6	AC*332M250QEI
	3900	QG	45	100	0,08	26	21	20	22,5	11,8	AC*392M250QGI
400	220	MB	30	40	0,10	579	463	434	3,3	1,7	AC*221M400MBI
	330	MB	30	40	0,10	386	309	290	4,0	2,1	AC*331M400MBI
		MC	30	50	0,10	386	309	290	4,4	2,3	AC*331M400MCI
	390	MB	30	40	0,10	327	261	245	4,3	2,3	AC*391M400MBI
		MC	30	50	0,10	327	261	245	4,8	2,5	AC*391M400MCI
		NC	35	50	0,10	327	261	245	5,2	2,7	AC*391M400NCI
	470	MC	30	50	0,10	271	217	203	5,2	2,8	AC*471M400MCI
		NB	35	40	0,10	271	217	203	5,2	2,7	AC*471M400NBI
		NC	35	50	0,10	271	217	203	5,7	3,0	AC*471M400NCI
		PB	40	40	0,10	271	217	203	5,6	3,0	AC*471M400PBI
	560	NC	35	50	0,10	227	182	171	6,2	3,3	AC*561M400NCI
			35	60	0,10	187	150	141	6,9	3,6	AC*561M400NBI
	680	NC	35	50	0,10	187	150	141	6,9	3,6	AC*681M400NCI
			35	60	0,10	187	150	141	7,4	3,9	AC*681M400NBI
			35	75	0,10	187	150	141	8,2	4,3	AC*681M400NEI
			40	50	0,10	187	150	141	7,4	3,9	AC*681M400PCI
	820	NN	35	60	0,10	155	124	117	8,2	4,3	AC*821M400NNI
			35	75	0,10	155	124	117	9,0	4,7	AC*821M400NEI
			40	50	0,10	155	124	117	8,1	4,3	AC*821M400PCI
	1000	NN	35	60	0,10	127	102	96	9,0	4,7	AC*102M400NNI
			35	75	0,10	127	102	96	9,9	5,2	AC*102M400NEI
			40	60	0,10	127	102	96	9,7	5,1	AC*102M400PNI
			40	75	0,10	127	102	96	10,7	5,6	AC*102M400PEI
45			50	0,10	127	102	96	9,6	5,1	AC*102M400QCI	
1200	NE	35	75	0,10	106	85	80	10,9	5,7	AC*122M400NEI	
		40	75	0,10	106	85	80	11,7	6,2	AC*122M400PEI	
1500	PE	40	75	0,10	85	68	64	13,1	6,9	AC*152M400PEI	
		40	100	0,10	85	68	64	14,9	7,8	AC*152M400PGI	
		45	60	0,10	85	68	64	12,7	6,7	AC*152M400QNI	
		45	75	0,10	85	68	64	14,0	7,4	AC*152M400QEI	
		45	100	0,10	85	68	64	15,9	8,4	AC*152M400QGI	
1800	QE	45	75	0,10	71	57	53	15,3	8,1	AC*182M400QEI	
2200	QG	45	100	0,10	58	46	43	19,3	10,1	AC*222M400QGI	
450	150	MB	30	40	0,12	1019	815	764	2,5	1,3	AC*151M450MBI
	220	MB	30	40	0,12	695	556	521	3,0	1,6	AC*221M450MBI
	330	MC	30	50	0,12	463	371	347	4,0	2,1	AC*331M450MCI
		NB	35	40	0,12	463	371	347	4,0	2,1	AC*331M450NBI
		NC	35	50	0,12	463	371	347	4,4	2,3	AC*331M450NCI
470	NC	35	50	0,12	325	260	244	5,2	2,7	AC*471M450NCI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@55°C	[A]@85°C	*= C, 2 Pins   S, 4 Pins
		NN	35	60	0,12	325	260	244	5,6	3,0	AC*471M450NNI
450	470	PB	40	40	0,12	325	260	244	5,1	2,7	AC*471M450PBI
	560	NC	35	50	0,12	273	218	205	5,7	3,0	AC*561M450NCI
		NE	35	75	0,12	273	218	205	6,8	3,6	AC*561M450NEI
		PC	40	50	0,12	273	218	205	6,1	3,2	AC*561M450PCI
		PE	40	75	0,12	273	218	205	7,3	3,8	AC*561M450PEI
	680	NN	35	60	0,12	225	180	169	6,8	3,6	AC*681M450NNI
		NE	35	75	0,12	225	180	169	7,5	3,9	AC*681M450NEI
		PC	40	50	0,12	225	180	169	6,8	3,6	AC*681M450PCI
	820	NN	35	60	0,12	186	149	140	7,4	3,9	AC*821M450NNI
		NE	35	75	0,12	186	149	140	8,2	4,3	AC*821M450NEI
	1000	PN	40	60	0,12	153	122	115	8,9	4,7	AC*102M450PNI
		PE	40	75	0,12	153	122	115	9,8	5,1	AC*102M450PEI
		PG	40	100	0,12	153	122	115	11,1	5,9	AC*102M450PGI
		QC	45	50	0,12	153	122	115	8,8	4,6	AC*102M450QCI
	1360	PG	40	100	0,12	112	90	84	13,0	6,8	AC*1361X450PGI
	1500	PG	40	100	0,12	102	82	76	13,6	7,2	AC*152M450PGI
QE		45	75	0,12	102	82	76	12,8	6,7	AC*152M450QEI	
1800	QG	45	100	0,12	85	68	64	15,9	8,4	AC*182M450QGI	
2200	QG	45	100	0,12	69	56	52	17,6	9,3	AC*222M450QGI	
2700	QG	45	100	0,12	71	58	49	18,4	10	AC*272M450QGI	
500	220	MC	30	50	0,15	869	695	651	2,1	1,1	AC*221M500MCI
	330	NC	35	50	0,15	579	463	434	2,9	1,5	AC*331M500NCI
	390	NC	35	50	0,15	490	392	367	3,1	1,6	AC*391M500NCI
	470	NN	35	60	0,15	407	325	305	3,7	1,9	AC*471M500NNI
	470	PC	40	50	0,15	407	325	305	3,7	1,9	AC*471M500PCI
	560	NE	35	75	0,15	341	273	256	4,5	2,3	AC*561M500NEI
	560	PC	40	50	0,15	341	273	256	4,0	2,1	AC*561M500PCI
	680	PN	40	60	0,15	281	225	211	4,8	2,5	AC*681M500PNI
	680	PE	40	75	0,15	281	225	211	5,3	2,8	AC*681M500PEI
	680	QC	45	50	0,15	281	225	211	4,8	2,5	AC*681M500QCI
	1000	PG	40	100	0,15	191	153	143	7,3	3,8	AC*102M500PGI
	1000	QE	45	75	0,15	191	153	143	6,9	3,6	AC*102M500QEI
	1200	QG	45	100	0,15	159	127	119	8,5	4,5	AC*122M500QGI

### Dimension, Quantity and Weight for box



Case		Connections			Packaging	
Code	DxL	PIN			Pcs/Box	Weight/box
		ACC	ACS	Length		
MB	30x40	2		6.3	100	4-6
MC	30x50	2		6.3	100	4-6
NB	35x40	2	4	6.3	100	6-8
NC	35x50	2	4	6.3	100	6-8
NN	35x60	2	4	6.3	100	5-7
NE	35x75	2	4	6.3	50	6-8
PB	40x40	2	4	6.3	126	9-10
PC	40x50	2	4	6.3	126	9-10
PN	40x60	2	4	6.3	126	9-10
PE	40x75	2	4	6.3	63	7-9
PG	40x100	2	4	6.3	63	9-10
QC	45x50		4	6.3	30	6-8
QN	45x60		4	6.3	30	6-8
QE	45x75		4	6.3	30	7-9
QG	45x100		4	6.3	30	8-10

*All dimensions in mm, torque in Nm, weight in kg*



### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

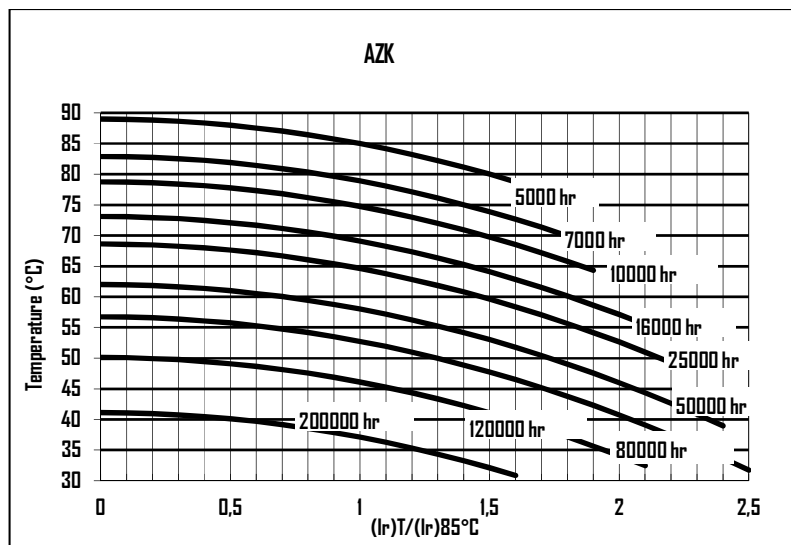


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

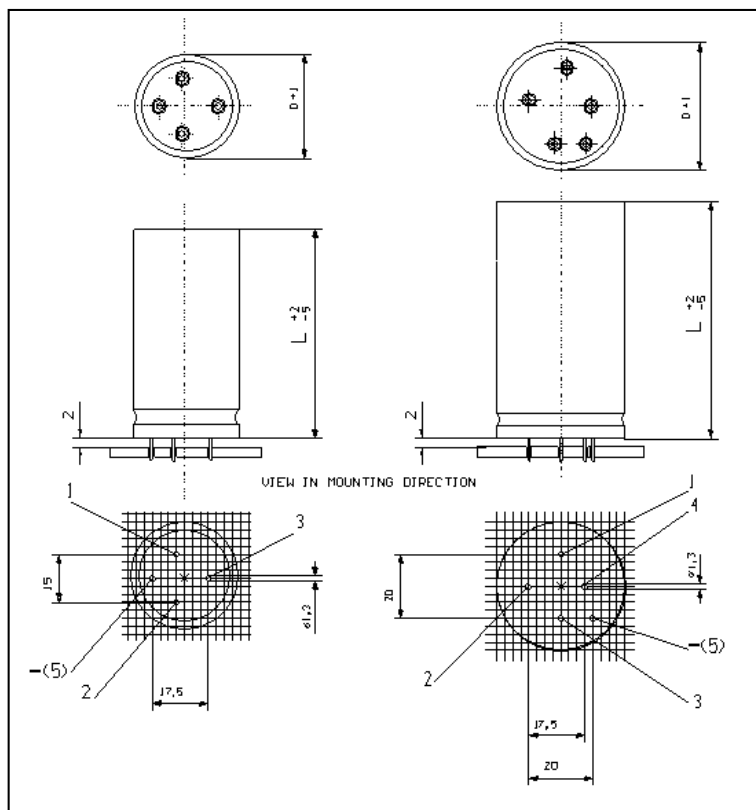
Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

### Surge Voltage

Working Voltage	200	250	400	450
Surge Voltage	230	290	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[A]@85°C	[A]@105°C		
200	470	NB	35	40	0,10	271	217	203	3,2	1,8	AZK471M200NB1
	680	NC	35	50	0,10	187	150	141	4,2	2,3	AZK681M200NC1
	1000	NC	35	50	0,10	127	102	96	5,1	2,8	AZK102M200NC1
	1500	NE	35	75	0,10	85	68	64	7,4	4,1	AZK152M200NE1
		PC	40	50	0,10	85	68	64	6,7	3,7	AZK152M200PC1
	2200	PE	40	75	0,10	58	46	43	11,0	6,1	AZK222M200PE1
3300	PG	40	100	0,10	39	31	29	13,5	7,5	AZK332M200PG1	
250	470	NB	35	40	0,10	271	217	203	2,9	1,6	AZK471M250NB1
	680	NB	35	40	0,10	187	150	141	3,8	2,1	AZK681M250NB1
	1000	PC	40	50	0,10	127	102	96	5,5	3,1	AZK102M250PC1
	1500	PE	40	75	0,10	85	68	64	8,0	4,4	AZK152M250PE1
	2200	PG	40	100	0,10	58	46	43	11,0	6,1	AZK222M250PG1
400	330	NB	35	40	0,10	386	309	290	2,7	1,5	AZK331M400NB1
	470	NC	35	50	0,10	271	217	203	3,2	1,8	AZK471M400NC1
	680	NE	35	75	0,10	187	150	141	4,1	2,3	AZK681M400NE1
		PC	40	50	0,10	187	150	141	4,2	2,3	AZK681M400PC1
	1000	NE	35	75	0,10	127	102	96	6,1	3,4	AZK102M400NE1
		PE	40	75	0,10	127	102	96	5,1	2,8	AZK102M400PE1
		PG	40	100	0,10	127	102	96	5,5	3,1	AZK102M400PG1
1500	PG	40	100	0,10	85	68	64	8,0	4,4	AZK152M400PG1	
450	220	NB	35	40	0,10	579	463	434	2,0	1,1	AZK221M450NB1
	330	NC	35	50	0,10	386	309	290	2,9	1,6	AZK331M450NC1
	470	NC	35	50	0,10	271	217	203	3,5	1,9	AZK471M450NC1
	560	PC	40	50	0,10	227	182	171	4,1	2,3	AZK561M450PC1
		NE	35	75	0,10	227	182	171	4,5	2,5	AZK561M450NE1
	680	NE	35	75	0,10	187	150	141	5,0	2,8	AZK681M450NE1
		PE	40	75	0,10	187	150	141	5,4	3,0	AZK681M450PE1
	1000	PG	40	100	0,10	127	102	96	7,4	4,1	AZK102M450PG1
1200	PG	40	100	0,10	106	85	80	8,1	4,5	AZK122M450PG1	



**Dimension, Quantity and Weight for box**


Case		Connections	Packaging	
Code	DxL	PIN- DIN Type	Pcs/Box	Weight/box
		Number		
NB	35x40	4	100	6-8
NC	35x50	4	100	6-8
NN	35x60	4	100	5-7
NE	35x75	4	50	6-8
PB	40x40	5	126	9-10
PC	40x50	5	126	9-10
PN	40x60	5	126	9-10
PE	40x75	5	63	7-9
PG	40x100	5	63	9-10

*All dimensions in mm, torque in Nm, weight in kg*

## Series AZS - AZC - 105°C 5.000h

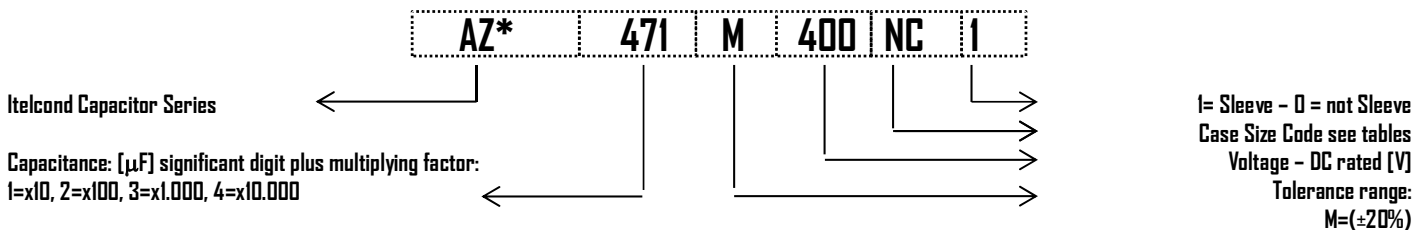
### Capacitors PCB type -

- AZC 2 pins
- AZS 4 pins
- Capacitance Tolerance: -20 + 20% - standard (M)
- Climatic category: 40/105/56
- Case: 30x40 - 45x100
- Temperature - 40°C + 105°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- No insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@105^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@105^\circ\text{C}}$  is the limit given by tables, @ 105°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	50	65	75	85	95	105
$K_t$	2.40	2.20	2.10	1.80	1.30	1.00

Table 1- $K_t$  Values

$V_n$ / Hz	$K_f$
	$V > 160$
50	0.88
100	1.00
300	1.20
400	1.25
500	1.35
>1000	1.40

Table 2- $K_f$  Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

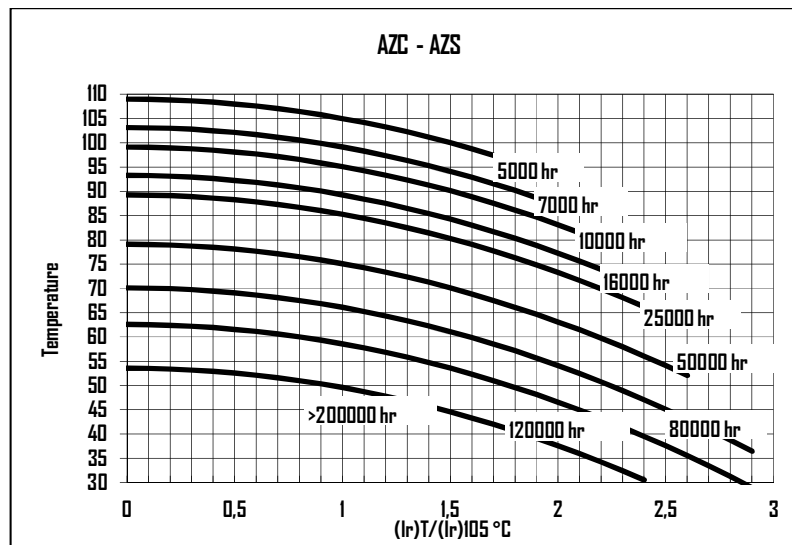
$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current



### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 0,004 \times C \times V$
Operating limit	@25°C	$I_f \leq 0,001 \times C \times V$

Where:  $I_f$ =leakage current [ $\mu$ A], C=capacitance [ $\mu$ F],  
V=rated voltage [V]

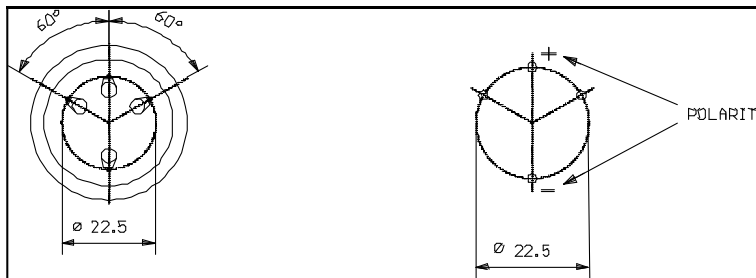
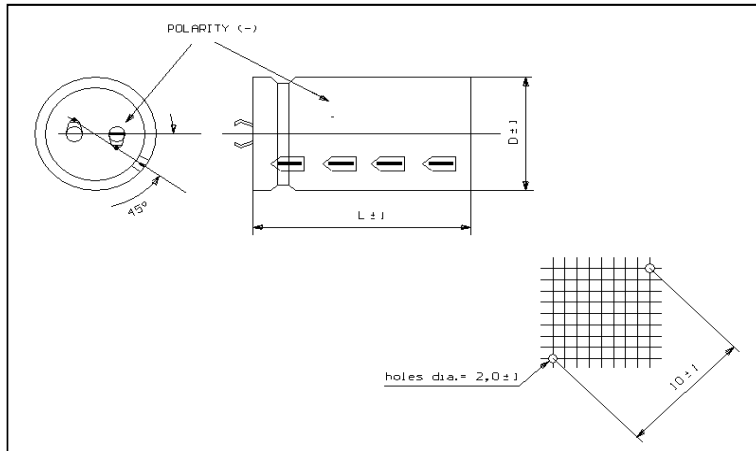
### Surge Voltage

Working Voltage	200	250	400	450
Surge Voltage	230	290	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[A]@85°C	[A]@105°C	*= C, 2 Pins   S, 4 Pins	
200	470	MB	30	40	0,10	271	217	203	2,9	1,6	AZ*471M200MBI
	680	MB	30	40	0,10	187	150	141	3,5	1,9	AZ*681M200MBI
	1000	MC	30	50	0,10	127	102	96	4,7	2,6	AZ*102M200MCI
		NB	35	40	0,10	127	102	96	4,6	2,6	AZ*102M200NBI
	1500	NC	35	50	0,10	85	68	64	6,2	3,5	AZ*152M200NCI
	2200	NE	35	75	0,10	58	46	43	9,0	5,0	AZ*222M200NEI
		QC	45	50	0,10	58	46	43	8,7	4,8	AZ*222M200QCI
	3300	PG	40	100	0,10	39	31	29	13,5	7,5	AZ*332M200PGI
QE		45	75	0,10	39	31	29	12,7	7,0	AZ*332M200QEI	
3900	QG	45	100	0,10	33	26	24	15,7	8,7	AZ*392M200QGI	
250	470	MB	30	40	0,10	271	217	203	2,9	1,6	AZ*471M250MBI
	680	MC	30	50	0,10	187	150	141	3,8	2,1	AZ*681M250MCI
		NB	35	40	0,10	187	150	141	3,8	2,1	AZ*681M250NBI
	1000	NB	35	40	0,10	127	102	96	4,6	2,6	AZ*102M250NBI
		NC	35	50	0,10	127	102	96	5,1	2,8	AZ*102M250NCI
	1500	NE	35	75	0,10	85	68	64	7,4	4,1	AZ*152M250NEI
		PC	40	50	0,10	85	68	64	6,7	3,7	AZ*152M250PCI
PE		40	75	0,10	85	68	64	8,0	4,4	AZ*152M250PEI	
2200	PG	40	100	0,10	58	46	43	11,0	6,1	AZ*222M250PGI	
400	220	MB	30	40	0,10	579	463	434	2,0	1,1	AZ*221M400MBI
	330	MB	30	40	0,10	386	309	290	2,4	1,4	AZ*331M400MBI
	470	MC	30	50	0,10	271	217	203	3,2	1,8	AZ*471M400MCI
		NB	35	40	0,10	271	217	203	3,2	1,8	AZ*471M400NBI
		NC	35	50	0,10	271	217	203	3,5	1,9	AZ*471M400NCI
	560	NC	35	50	0,10	227	182	171	3,8	2,1	AZ*561M400NCI
	680	NC	35	50	0,10	187	150	141	4,2	2,3	AZ*681M400NCI
		NN	35	60	0,10	187	150	141	4,5	2,5	AZ*681M400NNI
		NE	35	75	0,10	187	150	141	5,0	2,8	AZ*681M400NEI
		PC	40	50	0,10	187	150	141	4,5	2,5	AZ*681M400PCI
	820	NN	35	60	0,10	155	124	117	5,0	2,8	AZ*821M400NNI
		PN	40	60	0,10	155	124	117	5,4	3,0	AZ*821M400PNI
	1000	NN	35	60	0,10	127	102	96	5,5	3,1	AZ*102M400NNI
		NE	35	75	0,10	127	102	96	6,1	3,4	AZ*102M400NEI
		PN	40	60	0,10	127	102	96	5,9	3,3	AZ*102M400PNI
		PE	40	75	0,10	127	102	96	6,5	3,6	AZ*102M400PEI
QC		45	50	0,10	127	102	96	5,9	3,3	AZ*102M400QCI	
QN		45	60	0,10	127	102	96	6,3	3,5	AZ*102M400QNI	
1200	PE	40	75	0,10	106	85	80	7,2	4,0	AZ*122M400PEI	
	PG	40	100	0,10	106	85	80	8,1	4,5	AZ*122M400PGI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@85°C	[A]@105°C	*= C, 2 Pins   S, 4 Pins
<b>400</b>	1500	PG	40	100	0,10	85	68	64	9,1	5,1	AZ*152M400PGI
		QN	45	60	0,10	85	68	64	7,8	4,3	AZ*152M400QNI
		QE	45	75	0,10	85	68	64	8,6	4,8	AZ*152M400QEI
	1800	QG	45	100	0,10	71	57	53	10,6	5,9	AZ*182M400QGI
	2200	QG	45	100	0,10	58	46	43	11,8	6,5	AZ*222M400QGI
<b>450</b>	220	MB	30	40	0,10	579	463	434	2,0	1,1	AZ*221M450MBI
	330	MC	30	50	0,10	386	309	290	2,7	1,5	AZ*331M450MCI
		NB	35	40	0,10	386	309	290	2,7	1,5	AZ*331M450NBI
	470	NC	35	50	0,10	271	217	203	3,5	1,9	AZ*471M450NCI
	560	NE	35	75	0,10	227	182	171	4,5	2,5	AZ*561M450NEI
		PC	40	50	0,10	227	182	171	4,1	2,3	AZ*561M450PCI
	680	NC	35	50	0,10	234	150	141	4,4	2,35	AZ*681M450NCI
		NN	35	60	0,10	187	155	141	4,5	2,5	AZ*681M450NNI
		NE	35	75	0,10	187	150	141	5,0	2,8	AZ*681M450NEI
		PE	40	75	0,10	187	150	141	5,4	3,0	AZ*681M450PEI
		QC	45	50	0,10	187	150	141	4,9	2,7	AZ*681M450QCI
	820	NN	35	60	0,10	194	165	125	4,3	2,7	AZ*821M450NNI
		NE	35	75	0,10	155	124	117	5,5	3,1	AZ*821M450NEI
	1000	PN	40	60	0,10	159	110	101	6,0	3,2	AZ*102M450PNI
		PE	40	75	0,10	127	102	96	6,5	3,6	AZ*102M450PEI
		PG	40	100	0,10	127	102	96	7,4	4,1	AZ*102M450PGI
		QE	45	75	0,10	127	102	96	7,0	3,9	AZ*102M450QEI
1200	PG	40	100	0,10	106	85	80	8,1	4,5	AZ*122M450PGI	
1500	QG	45	100	0,10	85	68	64	9,7	5,4	AZ*152M450QGI	

**Dimension, Quantity and Weight for box**



Case		Connections			Packaging	
Code	DxL	PIN			Pcs/Box	Weight/box
		AZC	AZS	Lenght		
MB	30x40	2		6.3	100	4-6
MC	30x50	2		6.3	100	4-6
NB	35x40	2	4	6.3	100	6-8
NC	35x50	2	4	6.3	100	6-8
NN	35x60	2	4	6.3	100	5-7
NE	35x75	2	4	6.3	50	6-8
PB	40x40	2	4	6.3	126	9-11
PC	40x50	2	4	6.3	126	9-11
PN	40x60	2	4	6.3	126	9-11
PE	40x75	2	4	6.3	63	10-12
PG	40x100	2	4	6.3	63	7-9
QC	45x50		4	6.3	30	6-8
QN	45x60		4	6.3	30	6-8
QE	45x75		4	6.3	30	7-9
QG	45x100		4	6.3	30	8-10

*All dimensions in mm, torque in Nm, weight in kg*



## Series ATS - ATC- 105°C 8.000h

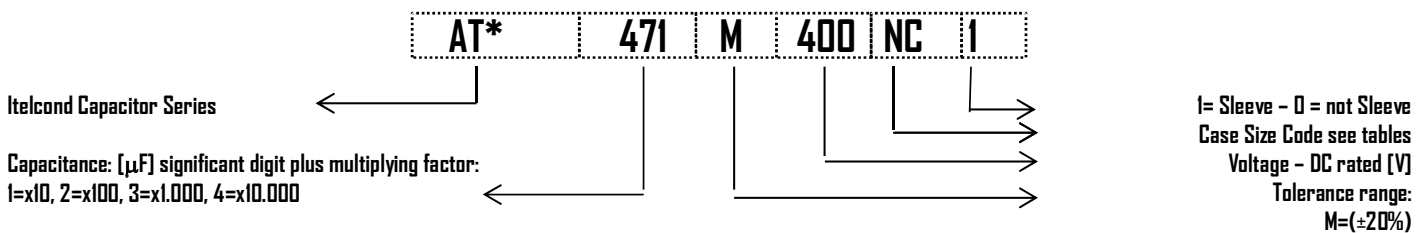
### Capacitors PCB type – Very professional – Extra Long Life

- ATC 2 pins
- ATS 4 pins
- Capacitance Tolerance: -20 + 20% – standard (M)
- Climatic category: 25/105/56
- Case: 30x40 – 45x100
- Temperature – 55°C + 105°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- No insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@105^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@85^\circ\text{C}}$  is the limit given by tables, @ 105°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	50	65	75	85	95	105
$K_t$	2.40	2.20	2.10	1.80	1.30	1.00

Table 1- $K_t$  Values

	$K_f$
$V_n/\text{Hz}$	$V>160$
50	0.88
100	1.00
300	1.20
400	1.25
500	1.35
>1000	1.40

Table 2- $K_f$  Value



### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_0 \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves. End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_0 \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

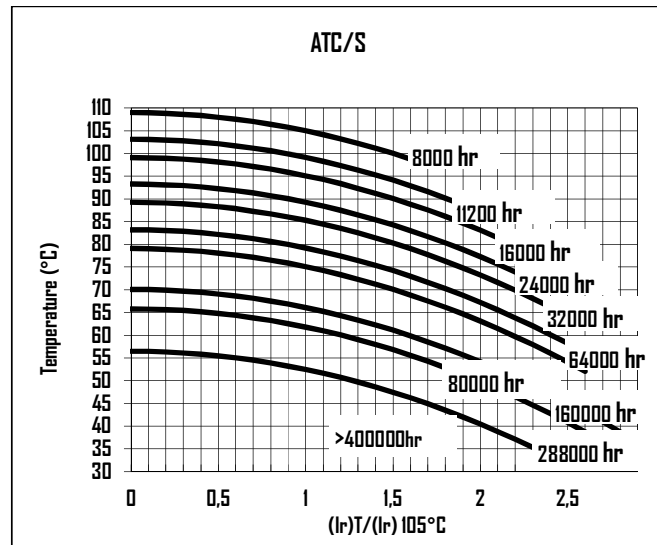


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 1.3 \cdot \sqrt{C \cdot V}$
Operating limit	@25°C	$I_f \leq 1.0 \cdot \sqrt{C \cdot V}$

Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

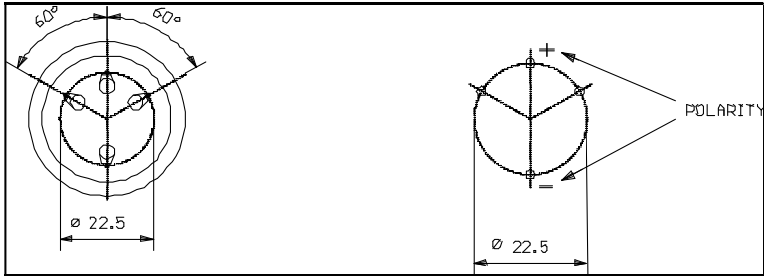
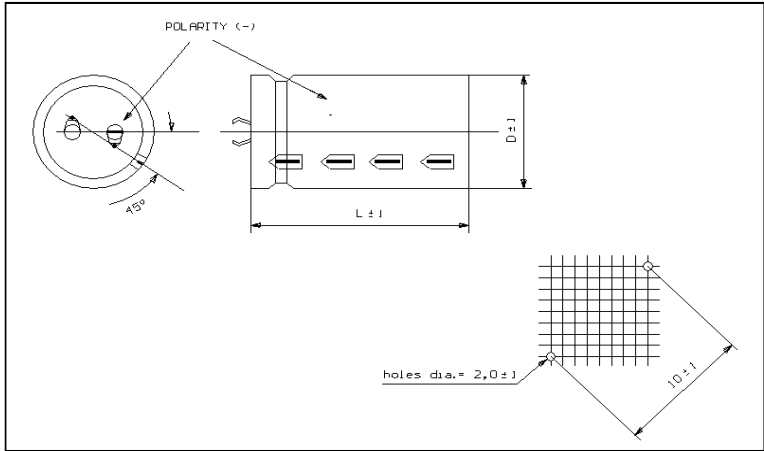
### Surge Voltage

Working Voltage	200	250	400	450
Surge Voltage	230	290	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz	[mΩ]@10KHz	[mΩ]@10KHz	[A]@85°C	[A]@105°C	*= C, 2 Pins   S, 4 Pins
200	220	MB	30	40	0,08	463	371	347	2,2	1,2	AT*221M200MBI
	330	NB	35	40	0,08	309	247	232	3,0	1,7	AT*331M200NBI
	470	NC	35	50	0,08	217	173	163	3,9	2,2	AT*471M200NCI
	680	MC	30	50	0,08	150	120	112	4,3	2,4	AT*681M200MCI
		PC	40	50	0,08	150	120	112	5,1	2,8	AT*681M200PCI
	1000	NC	35	50	0,08	102	82	76	5,7	3,2	AT*102M200NCI
		PE	40	75	0,08	102	82	76	7,3	4,1	AT*102M200PEI
	1500	PC	40	50	0,08	68	54	51	7,5	4,2	AT*152M200PCI
		PG	40	100	0,08	68	54	51	10,2	5,7	AT*152M200PGI
	1800	PE	40	75	0,08	57	45	42	9,8	5,4	AT*182M200PEI
QC		45	50	0,08	57	45	42	8,8	4,9	AT*182M200QCI	
2200	PG	40	100	0,08	46	37	35	12,3	6,9	AT*222M200PGI	
	QE	45	75	0,08	46	37	35	11,6	6,4	AT*222M200QEI	
3300	QG	45	100	0,08	31	25	23	16,1	8,9	AT*332M200QGI	
250	220	MB	30	40	0,08	463	371	347	2,2	1,2	AT*221M250MBI
		NB	35	40	0,08	463	371	347	2,4	1,3	AT*221M250NBI
	330	NC	35	50	0,08	309	247	232	3,3	1,8	AT*331M250NCI
	470	MC	30	50	0,08	217	173	163	3,6	2,0	AT*471M250MCI
	680	NC	35	50	0,08	150	120	112	4,7	2,6	AT*681M250NCI
	1000	NC	35	50	0,08	102	82	76	5,7	3,2	AT*102M250NCI
	1200	PC	40	50	0,08	85	68	64	6,7	3,7	AT*122M250PCI
		PE	40	75	0,08	68	54	51	8,9	5,0	AT*152M250PEI
	1500	QC	45	50	0,08	68	54	51	8,1	4,5	AT*152M250QCI
		PG	40	100	0,08	46	37	35	12,3	6,9	AT*222M250PGI
2200	QE	45	75	0,08	46	37	35	11,6	6,4	AT*222M250QEI	
	QG	45	100	0,08	38	30	28	14,6	8,1	AT*272M250QGI	
400	220	MB	30	40	0,08	463	371	347	2,2	1,2	AT*221M400MBI
	330	MC	30	50	0,08	309	247	232	3,0	1,7	AT*331M400MCI
		NC	35	50	0,08	309	247	232	3,3	1,8	AT*331M400NCI
	470	NC	35	50	0,08	217	173	163	3,9	2,2	AT*471M400NCI
	680	NN	35	60	0,08	150	120	112	5,1	2,8	AT*681M400NNI
		NE	35	75	0,08	150	120	112	5,6	3,1	AT*681M400NEI
		PC	40	50	0,08	150	120	112	5,1	2,8	AT*681M400PCI
	820	PC	40	50	0,08	124	99	93	5,6	3,1	AT*821M400PCI
	1000	PN	40	60	0,08	102	82	76	6,6	3,7	AT*102M400PNI
		PE	40	75	0,08	102	82	76	7,3	4,1	AT*102M400PEI
PG		40	100	0,08	102	82	76	8,3	4,6	AT*102M400PGI	
QC		45	50	0,08	102	82	76	6,6	3,7	AT*102M400QCI	
1200	PE	40	75	0,08	85	68	64	8,0	4,4	AT*122M400PEI	
	QN	45	60	0,08	85	68	64	7,8	4,3	AT*122M400QNI	

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@85°C	[A]@105°C	*= C, 2 Pins   S, 4 Pins
	1500	PG	40	100	0,08	68	54	51	10,2	5,7	AT*152M400PGI
	1500	QE	45	75	0,08	68	54	51	9,6	5,3	AT*152M400QEI
<b>400</b>	1800	QG	45	100	0,08	57	45	42	11,9	6,6	AT*182M400QGI
<b>450</b>	220	MB	30	40	0,09	521	417	391	2,1	1,2	AT*221M450MBI
	330	MC	30	50	0,09	347	278	261	2,8	1,6	AT*331M450MCI
		NB	35	40	0,09	347	278	261	2,8	1,6	AT*331M450NBI
	470	NC	35	50	0,09	244	195	183	3,7	2,0	AT*471M450NCI
		PB	40	40	0,09	244	195	183	3,6	2,0	AT*471M450PBI
	560	PC	40	50	0,09	205	164	154	4,3	2,4	AT*561M450PCI
	680	NE	35	75	0,09	169	135	126	5,3	2,9	AT*681M450NEI
	820	PE	40	75	0,09	140	112	105	6,2	3,5	AT*821M450PEI
		QC	45	50	0,09	140	112	105	5,6	3,1	AT*821M450QCI
	1000	PG	40	100	0,09	115	92	86	7,8	4,4	AT*102M450PGI
		QE	45	75	0,09	115	92	86	7,4	4,1	AT*102M450QEI
1200	PG	40	100	0,09	96	76	72	8,6	4,8	AT*122M450PGI	
1500	QG	45	100	0,09	76	61	57	10,2	5,7	AT*152M450QGI	

**Dimension, Quantity and Weight for box**



Case		Connections			Packaging	
Code	DxL	PIN		Pcs/Box	Weight/box	
		Number	Lenght			
MB	30x40	2		6.3	100	4-6
MC	30x50	2		6.3	100	4-6
NB	35x40	2	4	6.3	100	6-8
NC	35x50	2	4	6.3	100	6-8
NN	35x60	2	4	6.3	100	5-7
NE	35x75	2	4	6.3	50	6-8
PB	40x40	2	4	6.3	126	9-11
PC	40x50	2	4	6.3	126	9-11
PN	40x60	2	4	6.3	126	9-11
PE	40x75	2	4	6.3	63	10-12
PG	40x100	2	4	6.3	63	7-9
QC	45x50		4	6.3	30	6-8
QN	45x60		4	6.3	30	6-8
QE	45x75		4	6.3	30	7-9
QG	45x100		4	6.3	30	8-10

*All dimensions in mm, torque in Nm, weight in kg*



## Series ATK- 105°C 8.000h

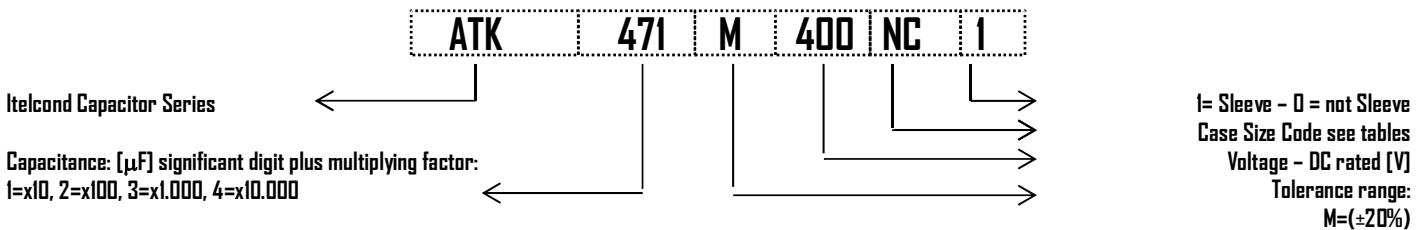
Capacitors PCB type -DIN style Solder Pins - Very professional - Extra Long Life

- ATK DIN 4-5 pins
- Capacitance Tolerance: -20 + 20% - standard (M)
- Climatic category: 25/105/56
- Case: 35x40 - 40x100
- Temperature - 55°C + 105°C

### Mechanical Outlines

- Case: aluminium made
- Terminals: solder pin
- Sealing: hermetic on Rubber Bakelite cover
- Pressure Release Vent: onto aluminium case
- No insulated bottom
- Sleeve: self-extinguishing thermo shrinkable
- Size: see enclosed drawings
- External Material UL94-V0

### Ordering Code: Example



### Ripple Current

The allowable values of ripple current in Ampères, are related to the temperature and frequency by following equation:

$$I_{\text{Ripple}} = K_t \cdot K_f \cdot I_{\text{Ripple}@105^\circ\text{C}}$$

Where:

- $I_{\text{Ripple}@105^\circ\text{C}}$  is the limit given by tables, @ 105°C/100HZ
- $K_t$  is the Temperature Correlation Factor
- $K_f$  is the Frequency Correlation Factor

Note .Superimposed alternating voltage summed to DC volage must not exceed rated voltage, rated ripple current must not be exceeded and no reverse polarity is allowed

°C	50	65	75	85	95	105
$K_t$	2.40	2.20	2.10	1.80	1.30	1.00

Table 1-Kt Values

Vn/Hz	Kf
	V>160
50	0.88
100	1.00
300	1.20
400	1.25
500	1.35
>1000	1.40

Table 2-Kf Values

### Expected Lifetime End of Life Criteria

During useful life typical electrical parameters of electrolytic capacitor are subject to change.

End of Life criteria, when rated temperature, voltage and ripple are applied, are:

$$\frac{\Delta C}{C_{t0}} \leq 30\% \quad \text{Equation 1}$$

$$ESR \leq 3 \cdot ESR_{t0} \quad \text{Equation 2}$$

$$I_f \leq I_{ft0} \quad \text{Equation 3}$$

where  $t_0$  is the initial value

### Voltage Endurance Test Requirements

On Voltage Endurance Test are based Expected Lifetime Curves.

End of Life criteria, when rated temperature, and voltage are applied for 2'000hrs, are

$$\frac{\Delta C}{C_{t0}} \leq 10\% \quad \text{Equation 4}$$

$$ESR \leq 1,3 \cdot ESR_{t0} \quad \text{Equation 5}$$

$$I_f \leq I_{ft0} \quad \text{Equation 6}$$

where  $t_0$  is the initial value

### Expected Lifetime Vs Temperature and Ripple Current

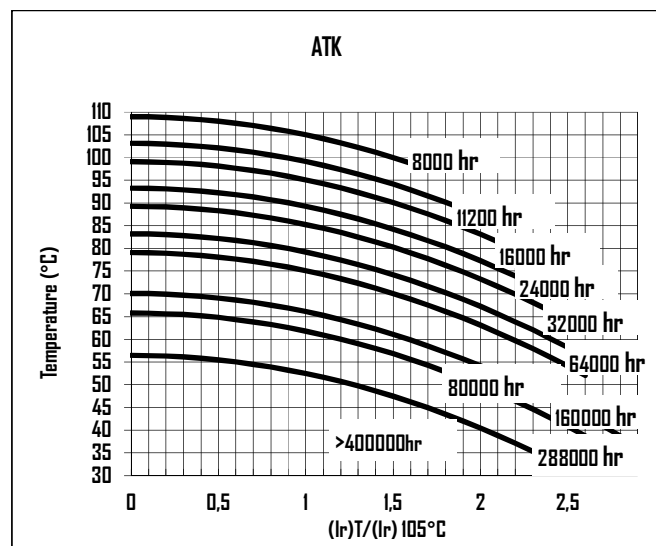


Table 3

### Leakage Current

After the rated voltage has been applied to the capacitor for 5 minutes the leakage current must be within those limits.

Maximum limit	@25°C	$I_f \leq 1.3 \cdot \sqrt{C \cdot V}$
Operating limit	@25°C	$I_f \leq 1.0 \cdot \sqrt{C \cdot V}$

Where:  $I_f$ =leakage current [ $\mu$ A],  $C$ =capacitance [ $\mu$ F],  
 $V$ =rated voltage [V]

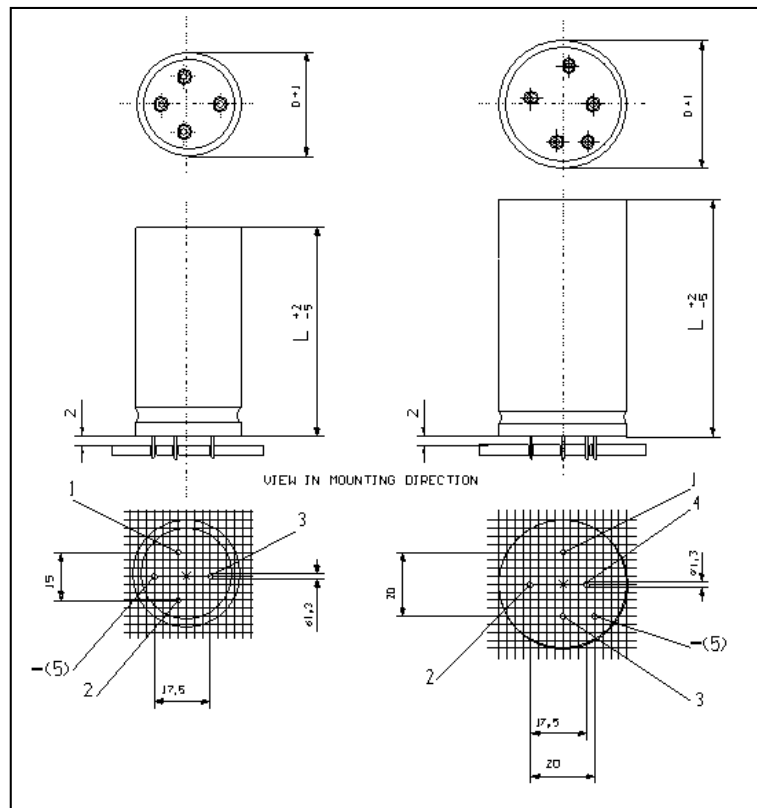
### Surge Voltage

Working Voltage	200	250	400	450
Surge Voltage	230	290	440	495

	Capacitance	Case	Diam	Height	Tanδ	ESRmax   typ		Zmax	Iripple @100Hz		Ordering Code
	[μF]@100Hz		[mm]	[mm]	[%]@100Hz	[mΩ]@100Hz		[mΩ]@10KHz	[A]@85°C	[A]@105°C	
200	220	NB	35	40	0,08	463	371	347	2,2	1,2	ATK221M200NB1
	330	NB	35	40	0,08	309	247	232	3,0	1,7	ATK331M200NB1
	470	NC	35	50	0,08	217	173	163	3,9	2,2	ATK471M200NC1
	680	PC	40	50	0,08	150	120	112	5,1	2,8	ATK681M200PC1
	1000	PE	40	75	0,08	102	82	76	7,3	4,1	ATK102M200PE1
	1500	PG	40	100	0,08	68	54	51	10,2	5,7	ATK152M200PG1
250	220	NB	30	40	0,08	463	371	347	2,2	1,2	ATK221M250NB1
	330	NC	35	50	0,08	309	247	232	3,3	1,8	ATK331M250NC1
	680	PC	40	50	0,08	150	120	112	5,1	2,8	ATK681M250PC1
	1800	PE	40	75	0,08	57	45	42	9,8	5,4	ATK182M250PE1
	2200	PG	40	100	0,08	46	37	35	12,3	6,9	ATK222M250PG1
400	100	NB	35	40	0,08	1019	815	764	1,5	0,8	ATK101M400NB1
	150	NB	35	40	0,08	679	544	510	2,0	1,1	ATK151M400NB1
	220	NC	35	50	0,08	463	371	347	2,7	1,5	ATK221M400NC1
	330	NC	35	50	0,08	309	247	232	3,3	1,8	ATK331M400NC1
		PC	40	50	0,08	309	247	232	3,5	2,0	ATK331M400PC1
	470	PC	40	50	0,08	217	173	163	4,2	2,3	ATK471M400PC1
	680	NN	35	60	0,08	150	120	112	5,1	2,8	ATK681M400NN1
		NE	35	75	0,08	150	120	112	5,6	3,1	ATK681M400NE1
		PN	40	60	0,08	150	120	112	5,5	3,0	ATK681M400PN1
		PE	40	75	0,08	150	120	112	6,0	3,3	ATK681M400PE1
		QN	45	60	0,08	150	120	112	5,9	3,3	ATK681M400QN1
	1000	NE	35	75	0,08	102	82	76	6,8	3,8	ATK102M400NE1
		PE	40	75	0,08	102	82	76	7,3	4,1	ATK102M400PE1
PG		40	100	0,08	102	82	76	8,3	4,6	ATK102M400PG1	
450	220	NB	35	40	0,09	521	417	391	2,1	1,2	ATK221M450NB1
	330	NC	35	50	0,09	347	278	261	2,8	1,6	ATK331M450NC1
		NB	35	40	0,09	347	278	261	2,8	1,6	ATK331M450NB1
	470	NC	35	50	0,09	244	195	183	3,7	2,0	ATK471M450NC1
		PB	40	40	0,09	244	195	183	3,6	2,0	ATK471M450PB1
	560	PC	40	50	0,09	205	164	154	4,3	2,4	ATK561M450PC1
	680	NE	35	75	0,09	169	135	126	5,3	2,9	ATK681M450NE1
		PE	40	75	0,09	169	135	126	5,7	3,2	ATK681M450PE1
	820	PE	40	75	0,09	140	112	105	6,2	3,5	ATK821M450PE1
		QE	45	75	0,09	140	112	105	6,7	3,7	ATK821M450QE1
	1000	PG	40	100	0,09	115	92	86	7,8	4,4	ATK102M450PG1
QG		45	100	0,09	115	92	86	8,4	4,6	ATK102M450QG1	
1200	PG	40	100	0,09	96	76	72	8,6	4,8	ATK122M450PG1	
1200	QG	45	100	0,09	96	76	72	9,2	5,1	ATK122M450QG1	



### Dimension, Quantity and Weight for box



Case		Connections	Packaging	
Code	DxL	PIN- DIN Type	Pcs/Box	Weight/box
		Number		
NB	35x40	4	100	6-8
NC	35x50	4	100	6-8
NN	35x60	4	100	5-7
NE	35x75	4	50	6-8
PB	40x40	5	126	9-11
PC	40x50	5	126	9-11
PN	40x60	5	126	9-11
PE	40x75	5	63	10-12
PG	40x100	5	63	7-9

*All dimensions in mm, torque in Nm, weight in kg*