

Snap-in type

# Discontinued

Series: NH      Type: TS

■ Features

Life time : 105°C 2000 h

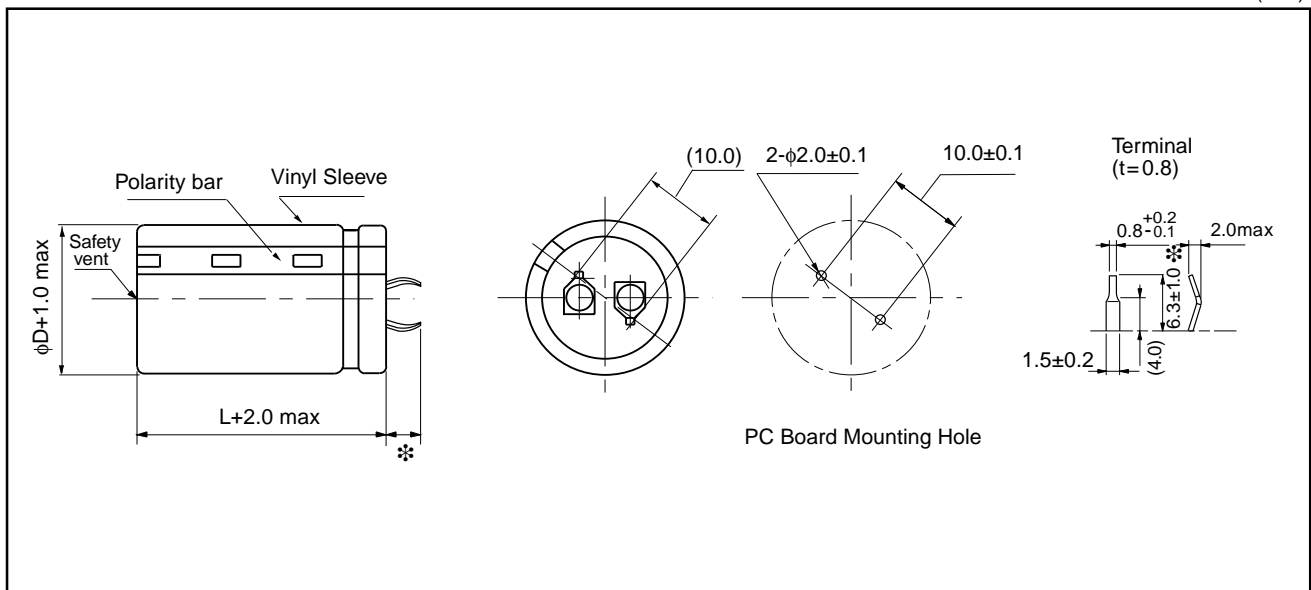


■ Specifications

Operating Temp. Range	10 to 100V.DC	160 to 250V.DC	350, 400V.DC																													
Rated W.V. Range	-40 to +105 °C		-25 to +105 °C																													
Nominal Cap.Range	20% (at 120Hz , +20°C)																															
DC Leakage Current	$C \times V \leq 100000$ $\leq 0.01CV(\mu A)$ (After 5 minutes) $C \times V \geq 100000$ $3 \sqrt{C} V (\mu A)$ max.(After 5 minutes) { C :Capacitance( $\mu F$ ) V : W.V.(V)}		$3\sqrt{CV} (\mu A)$ max. After 5 minutes { C :Capacitance( $\mu F$ ) V : W.V.(V)}																													
Tan $\delta$	<table border="1" style="display: inline-table;"> <tr> <th>W.V.(V)</th> <th>10</th> <th>16</th> <th>25</th> <th>35</th> <th>50</th> <th>63</th> <th>80</th> <th>100</th> <th>160 to 400</th> </tr> <tr> <td>tan <math>\delta</math></td> <td>0.45</td> <td>0.35</td> <td>0.30</td> <td>0.23</td> <td>0.18</td> <td>0.16</td> <td>0.12</td> <td>0.11</td> <td>0.10</td> </tr> </table> (max)									W.V.(V)	10	16	25	35	50	63	80	100	160 to 400	tan $\delta$	0.45	0.35	0.30	0.23	0.18	0.16	0.12	0.11	0.10			
W.V.(V)	10	16	25	35	50	63	80	100	160 to 400																							
tan $\delta$	0.45	0.35	0.30	0.23	0.18	0.16	0.12	0.11	0.10																							
Frequency Correction Factor for Ripple Current	<table border="1" style="display: inline-table;"> <tr> <th colspan="2">Frequency (Hz)</th> <th>50</th> <th>60</th> <th>120</th> <th>500</th> <th>1k</th> <th>10k ~ 50K</th> </tr> <tr> <td rowspan="2">C.F.</td> <td>10~100V</td> <td>0.93</td> <td>0.95</td> <td>1.0</td> <td>1.05</td> <td>1.08</td> <td>1.15</td> </tr> <tr> <td>160~400V</td> <td>0.75</td> <td>0.80</td> <td>1.0</td> <td>1.20</td> <td>1.25</td> <td>1.40</td> </tr> </table>									Frequency (Hz)		50	60	120	500	1k	10k ~ 50K	C.F.	10~100V	0.93	0.95	1.0	1.05	1.08	1.15	160~400V	0.75	0.80	1.0	1.20	1.25	1.40
Frequency (Hz)		50	60	120	500	1k	10k ~ 50K																									
C.F.	10~100V	0.93	0.95	1.0	1.05	1.08	1.15																									
	160~400V	0.75	0.80	1.0	1.20	1.25	1.40																									
Endurance	After 2000 hours application of DC voltage with specified ripple current ( $\leq$ rated DC working voltage) at +105°C, the capacitor shall meet the following limits.																															
	Capacitance change		$\pm 20\%$ of initial measured value																													
	tan $\delta$		$\leq 150\%$ of initial specified value																													
	Dc leakage current		$\leq$ Initial specified value																													
Self Life	After storage for 1000 hours at +105°C with no voltage applied, the capacitor shall meet the specified limits for "Endurance".																															

■ Dimensions

(mm)



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Discontinued

W.V. (V.DC)	Capacitance ( $\mu$ F)	Case size		Ripple Current (A r.m.s. 120Hz)	Part No.	
		Dia. (mm)	Length (mm)			
10	4700	22.5	25	1.8	ECES1AG472D	
		22.5	31.5	2.1	ECES1AG682E	
	6800	25.5	25	2.1	ECES1AG682J	
		22.5	40	2.5	ECES1AG103G	
		25.5	31.5	2.5	ECES1AG103K	
	10000	30.5	25	2.5	ECES1AG103Q	
		15000	22.5	50	3.1	ECES1AG153H
			25.5	40	3.1	ECES1AG153M
	22000	30.5	31.5	3.1	ECES1AG153R	
		33000	25.5	50	3.4	ECES1AG223N
			30.5	40	3.4	ECES1AG223T
	33000	35.5	31.5	3.4	ECES1AG223X	
		33000	30.5	50	3.9	ECES1AG333U
	33000		35.5	40	3.9	ECES1AG333Y
16		3300	22.5	25	1.6	ECES1CG332D
	22.5		31.5	2.0	ECES1CG472E	
	4700	25.5	25	2.0	ECES1CG472J	
		6800	22.5	40	2.4	ECES1CG682G
			25.5	31.5	2.4	ECES1CG682K
	10000	30.5	25	2.4	ECES1CG682Q	
		10000	22.5	50	2.9	ECES1CG103H
			25.5	40	2.9	ECES1CG103M
	15000	30.5	31.5	2.9	ECES1CG103R	
		15000	25.5	50	3.5	ECES1CG153N
			30.5	40	3.5	ECES1CG153T
	22000	35.5	31.5	3.5	ECES1CG153X	
		22000	30.5	50	4.2	ECES1CG223U
	22000		35.5	40	4.2	ECES1CG223Y
25		2200	22.5	25	1.5	ECES1EG222D
	3300		22.5	31.5	1.7	ECES1EG332E
	3300	25.5	25	1.7	ECES1EG332J	
		4700	22.5	40	2.2	ECES1EG472G
			25.5	31.5	2.2	ECES1EG472K
	4700	30.5	25	2.2	ECES1EG472Q	
		6800	22.5	50	2.6	ECES1EG682H
			25.5	40	2.6	ECES1EG682M
	6800	30.5	31.5	2.6	ECES1EG682R	
		10000	25.5	50	3.1	ECES1EG103N
			30.5	40	3.1	ECES1EG103T
	10000	35.5	31.5	3.1	ECES1EG103X	
		15000	30.5	50	3.5	ECES1EG153U
	15000		35.5	40	3.5	ECES1EG153Y
35		1500	22.5	25	1.4	ECES1VG152D
	2200		22.5	31.5	1.6	ECES1VG222E
		2200	25.5	25	1.6	ECES1VG222J
	3300		22.5	40	1.8	ECES1VG332G
			25.5	31.5	1.8	ECES1VG332K
	3300	30.5	25	1.8	ECES1VG332Q	
		4700	22.5	50	2.3	ECES1VG472H
			25.5	40	2.3	ECES1VG472M
	4700	30.5	31.5	2.3	ECES1VG472R	
		6800	25.5	50	2.9	ECES1VG682N
			30.5	40	2.9	ECES1VG682T
	6800	35.5	31.5	2.9	ECES1VG682X	
		10000	30.5	50	3.5	ECES1VG103U
	10000		35.5	40	3.5	ECES1VG103Y

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Discontinued

W.V. (V.DC)	Capacitance ( $\mu$ F)	Case size		Ripple Current (A r.m.s. 120Hz)	Part No.
		Dia. (mm)	Length (mm)		
50	1000	22.5	25	1.3	ECES1HG102D
	1500	22.5	31.5	1.5	ECES1HG152E
		25.5	25	1.5	ECES1HG152J
	2200	22.5	40	1.9	ECES1HG222G
		25.5	31.5	1.9	ECES1HG222K
		30.5	25	1.9	ECES1HG222Q
	3300	22.5	50	2.3	ECES1HG332H
		25.5	40	2.3	ECES1HG332M
		30.5	31.5	2.3	ECES1HG332R
	4700	25.5	50	2.8	ECES1HG472N
		30.5	40	2.8	ECES1HG472T
		35.5	31.5	2.8	ECES1HG472X
6800	30.5	50	3.2	ECES1HG682U	
	35.5	40	3.2	ECES1HG682Y	
63	680	22.5	25	0.9	ECES1JG681D
	1000	22.5	31.5	1.3	ECES1JG102E
		25.5	25	1.3	ECES1JG102J
	1500	22.5	40	1.6	ECES1JG152G
		25.5	31.5	1.6	ECES1JG152K
		30.5	25	1.6	ECES1JG152Q
	2200	22.5	50	2.0	ECES1JG222H
		25.5	40	2.0	ECES1JG222M
		30.5	31.5	2.0	ECES1JG222R
	3300	25.5	50	2.5	ECES1JG332N
		30.5	40	2.5	ECES1JG332T
		35.5	31.5	2.5	ECES1JG332X
	4700	30.5	50	2.9	ECES1JG472U
		35.5	40	2.9	ECES1JG472Y
	80	470	22.5	25	0.8
680		22.5	31.5	1.2	ECES1KG681E
		25.5	25	1.2	ECES1KG681J
1000		22.5	40	1.5	ECES1KG102G
		25.5	31.5	1.5	ECES1KG102K
		30.5	25	1.5	ECES1KG102Q
1500		22.5	50	1.8	ECES1KG152H
		25.5	40	1.8	ECES1KG152M
		30.5	31.5	1.8	ECES1KG152R
2200		25.5	50	2.3	ECES1KG222N
		30.5	40	2.3	ECES1KG222T
		35.5	31.5	2.3	ECES1KG222X
3300		30.5	50	2.8	ECES1KG332U
		35.5	40	2.8	ECES1KG332Y
100		330	22.5	25	0.7
	470	22.5	31.5	1.2	ECES2AG471E
		25.5	25	1.2	ECES2AG471J
	680	22.5	40	1.4	ECES2AG681G
		25.5	31.5	1.4	ECES2AG681K
		30.5	25	1.4	ECES2AG681Q
	1000	22.5	50	1.7	ECES2AG102H
		25.5	40	1.7	ECES2AG102M
		30.5	31.5	1.7	ECES2AG102R
	1500	25.5	50	2.1	ECES2AG152N
		30.5	40	2.1	ECES2AG152T
		35.5	31.5	2.1	ECES2AG152R
	2200	30.5	50	2.6	ECES2AG222U
		35.5	40	2.6	ECES2AG222Y

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W.V. (V.DC)	Capacitance ( $\mu$ F)	Case size		Ripple Current (A r.m.s. 120Hz)	Part No.	
		Dia. (mm)	Length (mm)			
160	150	22.5	25	0.7	ECES2CG151D	
		22.5	31.5	1.0	ECES2CG221E	
	220	25.5	25	1.0	ECES2CG221J	
		22.5	40	1.2	ECES2CG331G	
		25.5	31.5	1.2	ECES2CG331K	
	330	30.5	25	1.2	ECES2CG331Q	
		470	22.5	50	1.4	ECES2CG471H
			25.5	40	1.4	ECES2CG471M
	680	30.5	31.5	1.4	ECES2CG471R	
		680	25.5	50	1.7	ECES2CG681N
			30.5	40	1.7	ECES2CG681T
	820	35.5	31.5	1.7	ECES2CG681X	
820		30.5	50	2.0	ECES2CG821U	
		35.5	40	2.0	ECES2CG821Y	
180	100	22.5	25	0.72	ECES2PG101D	
		22.5	31.5	0.8	ECES2PG151E	
	150	25.5	25	0.8	ECES2PG151J	
		220	22.5	40	1.0	ECES2PG221G
			25.5	31.5	1.0	ECES2PG221K
	330	30.5	25	1.0	ECES2PG221Q	
		330	22.5	50	1.2	ECES2PG331H
			25.5	40	1.2	ECES2PG331M
	470	30.5	31.5	1.2	ECES2PG331R	
		470	25.5	50	1.4	ECES2PG471N
			30.5	40	1.4	ECES2PG471T
	680	35.5	31.5	1.4	ECES2PG471X	
		680	30.5	50	1.7	ECES2PG681U
			35.5	40	1.7	ECES2PG681Y
	200	100	22.5	25	0.72	ECES2DP101D
22.5			31.5	0.8	ECES2DP101E	
150		25.5	25	0.8	ECES2DP101J	
		220	22.5	40	1.0	ECES2DP221G
			25.5	31.5	1.0	ECES2DP221K
330		30.5	25	1.0	ECES2DP221Q	
		330	22.5	50	1.2	ECES2DP331H
			25.5	40	1.2	ECES2DP331M
470		30.5	31.5	1.2	ECES2DP331R	
		470	25.5	50	1.4	ECES2DP471N
			30.5	40	1.4	ECES2DP471T
680		35.5	31.5	1.4	ECES2DP471X	
		680	30.5	50	1.7	ECES2DP681U
			35.5	40	1.7	ECES2DP681Y
250		68	22.5	25	0.45	ECES2EP680D
	22.5		31.5	0.72	ECES2EP101E	
	100	25.5	25	0.72	ECES2EP101J	
		150	22.5	40	0.8	ECES2EP151G
			25.5	31.5	0.8	ECES2EP151K
	220	30.5	25	0.8	ECES2EP151Q	
		220	22.5	50	1.05	ECES2EP221H
			25.5	40	1.05	ECES2EP221M
	330	30.5	31.5	1.05	ECES2EP221R	
		330	25.5	50	1.25	ECES2EP331N
			30.5	40	1.25	ECES2EP331T
	470	35.5	31.5	1.25	ECES2EP331X	
		470	30.5	50	1.45	ECES2EP471U
			35.5	40	1.45	ECES2EP471Y

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W.V. (V.DC)	Capacitance ( $\mu$ F)	Case size		Ripple Current (A r.m.s. 120Hz)	Part No.
		Dia. (mm)	Length (mm)		
350	47	22.5	25	0.44	ECES2VG470D
	68	22.5	31.5	0.56	ECES2VG680E
		25.5	25	0.56	ECES2VG680J
	100	22.5	40	0.69	ECES2VG101G
		25.5	31.5	0.69	ECES2VG101K
		30.5	25	0.69	ECES2VG101Q
	150	22.5	50	0.82	ECES2VG151H
		25.5	40	0.82	ECES2VG151M
		30.5	31.5	0.82	ECES2VG151R
	220	25.5	50	1.0	ECES2VG221N
		30.5	40	1.0	ECES2VG221T
		35.5	31.5	1.0	ECES2VG221X
	330	30.5	50	1.2	ECES2VG331U
		35.5	40	1.2	ECES2VG331Y
	400	33	22.5	25	0.33
47		22.5	31.5	0.47	ECES2GG470E
		25.5	25	0.47	ECES2GG470J
68		22.5	40	0.56	ECES2GG680G
		25.5	31.5	0.56	ECES2GG680K
		30.5	25	0.56	ECES2GG680Q
100		22.5	50	0.69	ECES2GG101H
		25.5	40	0.69	ECES2GG101M
		30.5	31.5	0.69	ECES2GG101R
150		25.5	50	0.82	ECES2GG151N
		30.5	40	0.82	ECES2GG151T
		35.5	31.5	0.82	ECES2GG151X
220		30.5	50	1.0	ECES2GG221U
		35.5	40	1.0	ECES2GG221Y

## ⚠ Application Guidelines

### 1. Circuit Design

Ensure that operational and mounting conditions follow the specified conditions detailed in the catalog and specification sheets.

#### 1.1 Operating Temperature and Frequency

Electrolytic capacitor electrical parameters are normally specified at 20°C temperature and 120Hz frequency. These parameters vary with changes in temperature and frequency. Circuit designers should take these changes into consideration.

(1) Effects of operating temperature on electrical parameters

- a) At higher temperatures, leakage current and capacitance increase while equivalent series resistance (ESR) decreases.
- b) At lower temperatures, leakage current and capacitance decrease while equivalent series resistance (ESR) increases.

(2) Effects of frequency on electrical parameters

- a) At higher frequencies, capacitance and impedance decrease while  $\tan \delta$  increases.
- b) At lower frequencies, ripple current generated heat will rise due to an increase in equivalent series resistance (ESR).

### 1.2 Operating Temperature and Life Expectancy

(1) Expected life is affected by operating temperature. Generally, each 10°C reduction in temperature will double the expected life. Use capacitors at the lowest possible temperature below the maximum guaranteed temperature.

(2) If operating conditions exceed the maximum guaranteed limit, rapid electrical parameter deterioration will occur, and irreversible damage will result.

Check for maximum capacitor operating temperatures including ambient temperature, internal capacitor temperature rise caused by ripple current, and the effects of radiated heat from power transistors, IC's or resistors.

Avoid placing components which could conduct heat to the capacitor from the back side of the circuit board.

(3) The formula for calculating expected life at lower operating temperatures is as follows;

$$L_2 = L_1 \times 2^{\frac{T_1 - T_2}{10}} \quad \text{where,}$$

L1: Guaranteed life (h) at temperature, T<sub>1</sub> °C

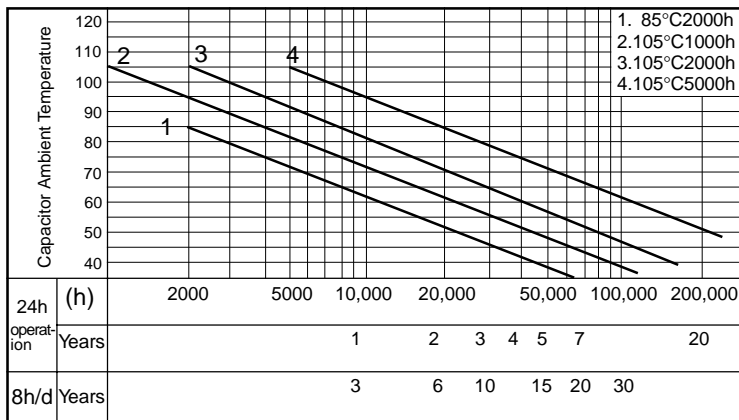
L2: Expected life (h) at temperature, T<sub>2</sub> °C

T<sub>1</sub>: Maximum operating temperature (°C)

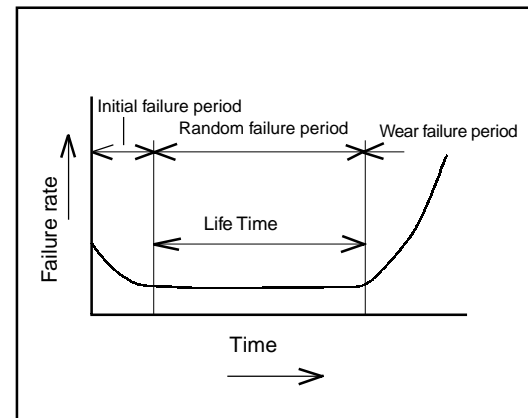
T<sub>2</sub>: Actual operating temperature, ambient temperature + temperature rise due to ripple current heating (°C)

A quick reference capacitor guide for estimating expected life is included for your reference.

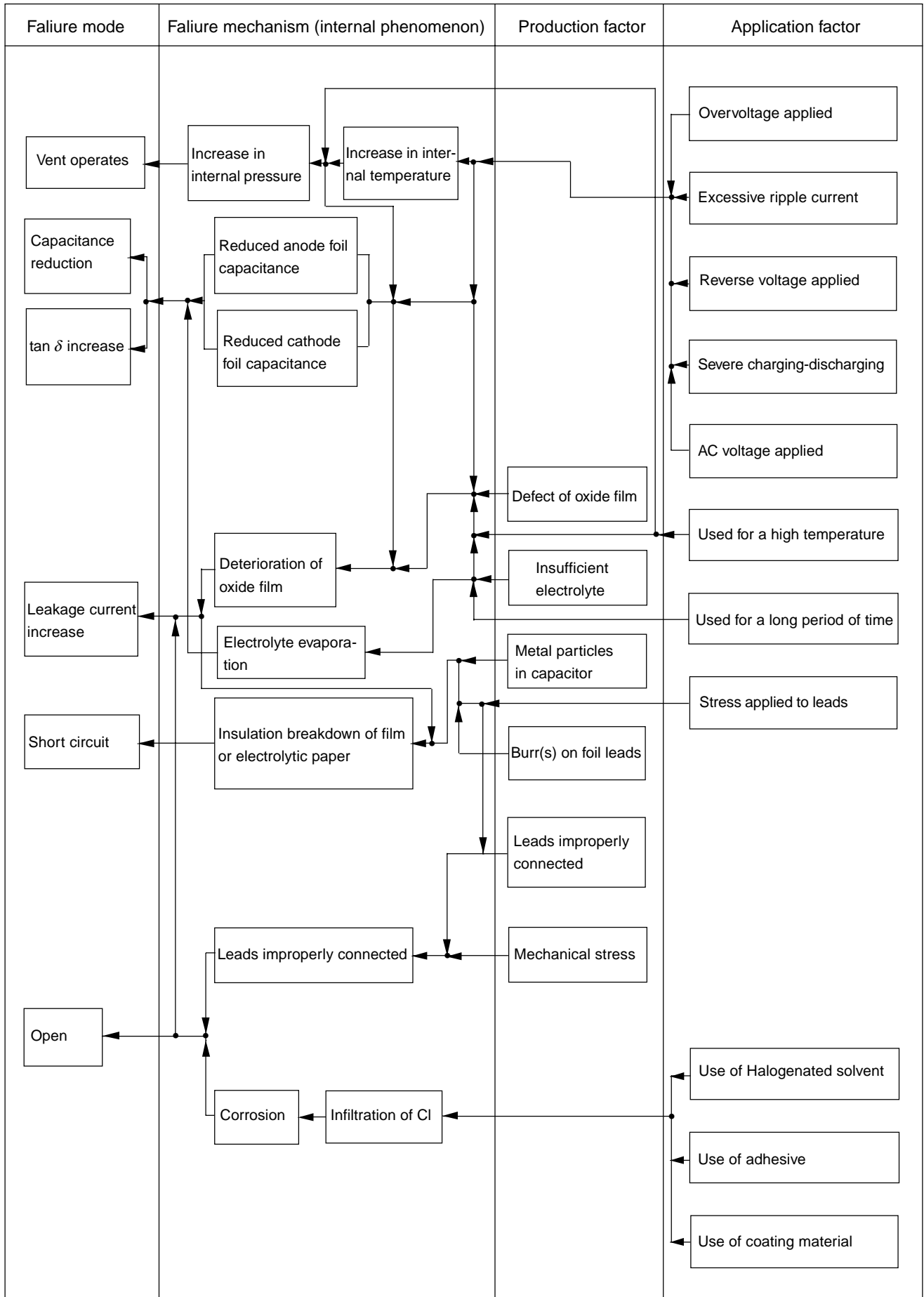
### ■ Expected Life Estimate Quick Reference Guide



### ■ Failure rate curve



■ Typical failure modes and their factors



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### 1.3 Common Application Conditions to Avoid

The following misapplication load conditions will cause rapid deterioration to capacitor electrical parameters. In addition, rapid heating and gas generation within the capacitor can occur causing the pressure relief vent to operate and resultant leakage of electrolyte. Under extreme conditions, explosion and fire could result. Leaking electrolyte is combustible and electrically conductive.

#### (1) Reverse Voltage

DC capacitors have polarity. Verify correct polarity before insertion. For circuits with changing or uncertain polarity, use DC bipolar capacitors. DC bipolar capacitors are not suitable for use in AC circuits.

#### (2) Charge/Discharge Applications

Standard capacitors are not suitable for use in repeating charge/discharge applications. For charge/discharge applications consult us and advise actual conditions.

#### (3) Overvoltage

Do not apply voltages exceeding the maximum specified rated voltages. Voltage up to the surge voltage rating are acceptable for short periods of time. Ensure that the sum of the DC voltage and the superimposed AC ripple voltage does not exceed the rated voltage.

#### (4) Ripple Current

Do not apply ripple currents exceeding the maximum specified value. For high ripple current applications, use a capacitor designed for high ripple currents or contact us with your requirements.

Ensure that allowable ripple currents superimposed on low DC bias voltages do not cause reverse voltage conditions.

### 1.4 Using Two or More Capacitors in Series or Parallel

#### (1) Capacitors Connected in Parallel

The circuit resistance can closely approximate the series resistance of the capacitor causing an imbalance of ripple current loads within the capacitors. Careful design of wiring methods can minimize the possibility of excessive ripple currents applied to a capacitor.

#### (2) Capacitors Connected in Series

Normal DC leakage current differences among capacitors can cause voltage imbalances. The use of voltage divider shunt resistors with consideration to leakage currents, can prevent capacitor voltage imbalances.

### 1.5 Capacitor Mounting Considerations

#### (1) Double - Sided Circuit Boards

Avoid wiring Pattern runs which pass between the mounted capacitor and the circuit board. When dipping into a solder bath, excess solder may collect under the capacitor by capillary action and shortcircuit the anode and cathode terminals.

#### (2) Circuit Board Hole Positioning

The vinyl sleeve of the capacitor can be damaged if solder passes through a lead hole for subsequently processed parts. Special care when locating hole positions in proximity to capacitors is recommended.

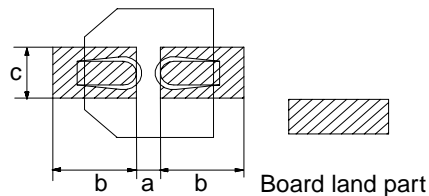
#### (3) Circuit Board Hole Spacing

The circuit board holes spacing should match the capacitor lead wire spacing within the specified tolerances. Incorrect spacing can cause excessive lead wire stress during the insertion process. This may result in premature capacitor failure due to short or open circuit, increased leakage current, or electrolyte leakage.

#### (4) Land/Pad Pattern

The circuit board land/pad pattern size for chip capacitors is specified in the following table.

[ Table of Board Land Size vs. Capacitor Size ]



Size	a	b	c
A( $\phi 3$ )	0.6	2.2	1.5
B( $\phi 4$ )	1.0	2.5	1.6
C( $\phi 5$ )	1.5	2.8	1.6
D( $\phi 6.3$ )	1.8	3.2	1.6
E( $\phi 8 \times 6.2L$ )	2.2	4.0	1.6
F( $\phi 8 \times 10.2L$ )	3.1	4.0	2.0
G( $\phi 10 \times 10.2L$ )	4.6	4.1	2.0

Among others, when the size a is wide, back fillet can not be made, decreasing fitting strength.

※ Decide considering mounting condition, solderability and fitting strength, etc. based on the design standards of your company.



## (5) Clearance for Case Mounted Pressure Relief Vents

Capacitors with case mounted pressure relief vents require sufficient clearance to allow for proper vent operation. The minimum clearances are dependent on capacitor diameters as follows.

- φ6.3 to φ16 mm : 2 mm minimum,
- φ18 to φ35 mm : 3 mm minimum.
- φ40 mm or greater: 5 mm minimum

## (6) Clearance for Seal Mounted Pressure Relief Vents

A hole in the circuit board directly under the seal vent location is required to allow proper release of pressure.

## (7) Wiring Near the Pressure Relief Vent

Avoid locating high voltage or high current wiring or circuit board paths above the pressure relief vent. Flammable, high temperature gas exceeding 100°C may be released which could dissolve the wire insulation and ignite.

## (8) Circuit Board Patterns Under the Capacitor

Avoid circuit board runs under the capacitor as electrolyte leakage could cause an electrical short.

## (9) Screw Terminal Capacitor Mounting

- Do not orient the capacitor with the screw terminal side of the capacitor facing downwards.
- Tighten the terminal and mounting bracket screws within the torque range specified in the specification.

## 1.6 Electrical Isolation of the Capacitor

Completely isolate the capacitor as follows.

- Between the cathode and the case (except for axially leaded B types) and between the anode terminal and other circuit paths.
- Between the extra mounting terminals (on T types) and the anode terminal, cathode terminal, and other circuit paths.

## 1.7 Capacitor Sleeve

The vinyl sleeve or laminate coating is intended for marking and identification purposes and is not meant to electrically insulate the capacitor.

The sleeving may split or crack if immersed into solvents such as toluene or xylene, and then exposed to high temperatures.

Always consider safety when designing equipment and circuits. Plan for worst case failure modes such as short circuits and open circuits which could occur during use.

- (1) Provide protection circuits and protection devices to allow safe failure modes.
- (2) Design redundant or secondary circuits where possible to assure continued operation in case of main circuit failure.

## 2. Capacitor Handling Techniques

### 2.1 Considerations Before Using

- (1) Capacitors have a finite life. Do not reuse or recycle capacitors from used equipment.
- (2) Transient recovery voltage may be generated in the capacitor due to dielectric absorption. If required, this voltage can be discharged with a resistor with a value of about 1 kΩ.
- (3) Capacitors stored for long periods of time may exhibit an increase in leakage current. This can be corrected by gradually applying rated voltage in series with a resistor of approximately 1 kΩ.
- (4) If capacitors are dropped, they can be damaged mechanically or electrically. Avoid using dropped capacitors.
- (5) Dented or crushed capacitors should not be used. The seal integrity can be compromised and loss of electrolyte/shortened life can result.

### 2.2 Capacitor Insertion

- (1) Verify the correct capacitance and rated voltage of the capacitor.
- (2) Verify the correct polarity of the capacitor before inserting.
- (3) Verify the correct hole spacing before insertion (land pattern size on chip type) to avoid stress on the terminals.
- (4) Ensure that the auto insertion equipment lead clinching operation does not stress the capacitor leads where they enter the seal of the capacitor. For chip type capacitors, excessive mounting pressure can cause high leakage current, short circuit, or disconnection.

### 2.3 Manual Soldering

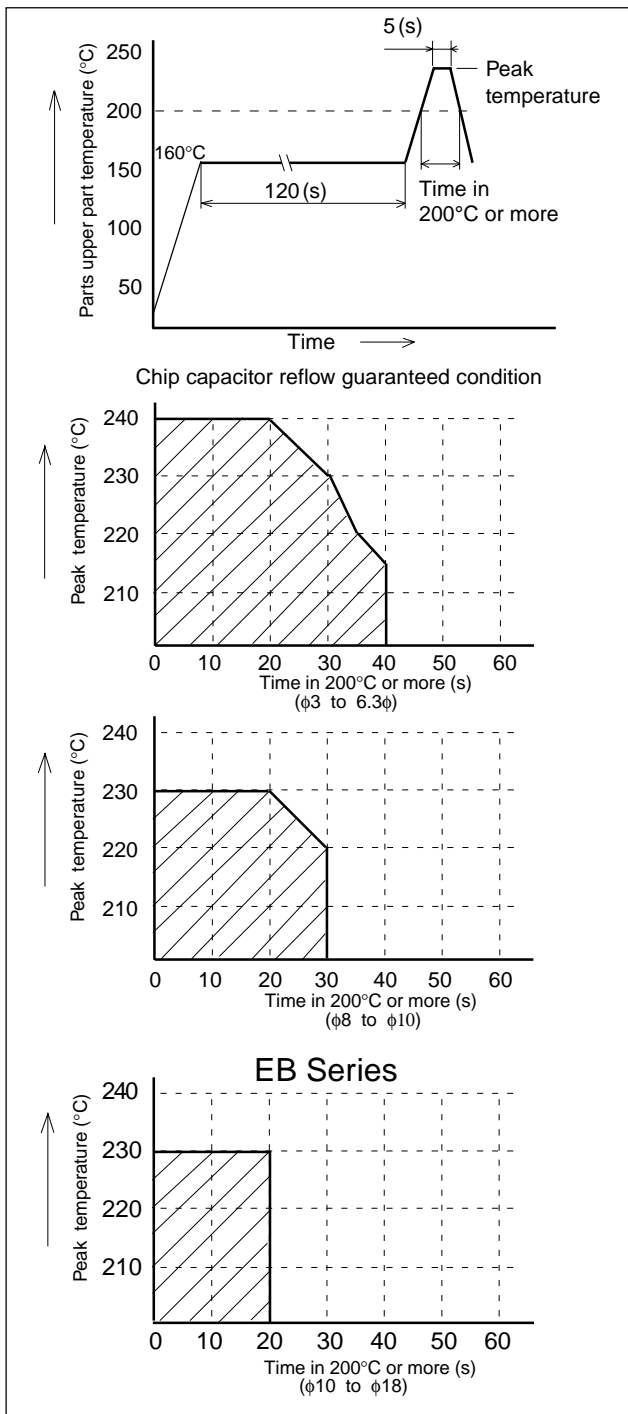
- (1) Observe temperature and time soldering specifications or do not exceed temperatures of 350°C for 3 seconds or less.
- (2) If lead wires must be formed to meet terminal board hole spacing, avoid stress on the leadwire where it enters the capacitor seal.
- (3) If a soldered capacitor must be removed and reinserted, avoid excessive stress to the capacitor leads.
- (4) Avoid touching the tip of the soldering iron to the capacitor, to prevent melting of the vinyl sleeve.

## 2.4 Flow Soldering

- (1) Do not immerse the capacitor body into the solder bath as excessive internal pressure could result.
- (2) Observe proper soldering conditions (temperature, time, etc.). Do not exceed the specified limits.
- (3) Do not allow other parts or components to touch the capacitor during soldering.

## 2.5 Reflow Soldering for Chip Capacitors

- (1) For reflow, use a thermal conduction system such as infrared radiation (IR) or hot blast. Vapor heat transfer systems (VPS) are not recommended.
- (2) Observe proper soldering conditions (temperature, time, etc.). Do not exceed the specified limits.
- (3) Reflow should be performed one time. Consult us for additional reflow restrictions.



## 2.6 Other Soldering Considerations

Rapid temperature rises during the preheat operation and resin bonding operation can cause cracking of the capacitor vinyl sleeve. For heat curing, do not exceed 150°C for a maximum time of 2 minutes.

## 2.7 Capacitor Handling after Soldering

- (1) Avoid movement of the capacitor after soldering to prevent excessive stress on the leadwires where they enter the seal.
- (2) Do not use the capacitor as a handle when moving the circuit board assembly.
- (3) Avoid striking the capacitor after assembly to prevent failure due to excessive shock.

## 2.8 Circuit Board Cleaning

- (1) Circuit boards can be immersed or ultrasonically cleaned using suitable cleaning solvents for up to 5 minutes and up to 60°C maximum temperatures. The boards should be thoroughly rinsed and dried.

Recommended cleaning solvents include Pine Alpha ST-100S, Sunelec B-12, DK Beclear CW-5790, Aqua Cleaner 210SEP, Cold Cleaner P3-375, Telpen Cleaner EC-7R, Clean-thru 750H, Clean-thru 750L, Clean thru 710M, Techno Cleaner 219, Techno Care FRW-17, Techno Care FRW-1, Techno Care FRV-1, IPA (isopropyl alcohol)

\* The use of ozone depleting cleaning agents are not recommended in the interest of protecting the environment.

- (2) Avoid using the following solvent groups unless specifically allowed for in the specification;

- Halogenated cleaning solvents: except for solvent resistant capacitor types, halogenated solvents can permeate the seal and cause internal capacitor corrosion and failure. For solvent resistant capacitors, carefully follow the temperature and time requirements of the specification. 1-1-1 trichloroethane should never be used on any aluminium electrolytic capacitor.
- Alkali solvents: could attack and dissolve the aluminum case.
- Petroleum based solvents: deterioration of the rubber seal could result.
- Xylene: deterioration of the rubber seal could result.
- Acetone: removal of the ink markings on the vinyl sleeve could result.

\* Temperature measuring method: Measure temperature in assuming quantitative production, by sticking the thermo-couple to the capacitor upper part with epoxy adhesives.

- (3) A thorough drying after cleaning is required to remove residual cleaning solvents which may be trapped between the capacitor and the circuit board. Avoid drying temperatures which exceed the maximum rated temperature of the capacitor.
- (4) Monitor the contamination levels of the cleaning solvents during use by electrical conductivity, pH, specific gravity, or water content. Chlorine levels can rise with contamination and adversely affect the performance of the capacitor.

\* Please consult us for additional information about acceptable cleaning solvents or cleaning methods.

Type	Series	Cleaning permitted
Surface mount type	V(Except EB Series)	○
Lead type	Bi-polar SU	○
	M	○(~ 100V)
	KA	○
	Bi-polar KA	○
	FB	○
	FC	○
	GA	○
	NHG	○(~ 100V)
	EB	○(~ 100V)
TA	○	
Snap-in type	TS UP	○(~ 100V)
	TS HA	○(~ 100V)

## 2.9 Mounting Adhesives and Coating Agents

When using mounting adhesives or coating agents to control humidity, avoid using materials containing halogenated solvents. Also, avoid the use of chloroprene based polymers.

\* After applying adhesives or coatings, dry thoroughly to prevent residual solvents from being trapped between the capacitor and the circuit board.

## 3. Precautions for using capacitors

### 3.1 Environmental Conditions

Capacitors should not be used in the following environments.

- (1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitor.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

### 3.2 Electrical Precautions

- (1) Avoid touching the terminals of the capacitor as possible electric shock could result. The exposed aluminium case is not insulated and could also cause electric shock if touched.
- (2) Avoid short circuiting the area between the capacitor terminals with conductive materials including liquids such as acids or alkaline solutions.

## 4. Emergency Procedures

- (1) If the pressure relief vent of the capacitor operates, immediately turn off the equipment and disconnect from the power source. This will minimize additional damage caused by the vaporizing electrolyte.
- (2) Avoid contact with the escaping electrolyte gas which can exceed 100°C temperatures. If electrolyte or gas enters the eye, immediately flush the eye with large amounts of water. If electrolyte or gas is ingested by mouth, gargle with water. If electrolyte contacts the skin, wash with soap and water.

## 5. Long Term Storage

Leakage current of a capacitor increases with long storage times. The aluminium oxide film deteriorates as a function of temperature and time. If used without reconditioning, an abnormally high current will be required to restore the oxide film. This current surge could cause the circuit or the capacitor to fail. Capacitor should be reconditioned by applying rated voltage in series with a 1000 Ω, current limiting resistor for a time period of 30 minutes.

### 5.1 Environmental Conditions (Storage)

Capacitors should not be stored in the following environments.

- (1) Temperature exposure above 35°C or below 15 °C.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

### 6. Capacitor Disposal

When disposing of capacitors, use one of the following methods.

- Incinerate after crushing the capacitor or puncturing the can wall (to prevent explosion due to internal pressure rise). Capacitors should be incinerated at high temperatures to prevent the release of toxic gases such as chlorine from the polyvinyl chloride sleeve, etc.
- Dispose of as solid waste.
- Local laws may have specific disposal requirements which must be followed.

The application guidelines above are taken from:

Technical Report EIAJ RCR-2367 issued by the Japan Electronic Industry Association, Inc. -  
Guideline of notabilia for aluminium electrolytic capacitors with non-solid electrolytic for use in electronic equipment.

Refer to this Technical Report for additional details.