

### Aluminum Electrolytic Capacitors

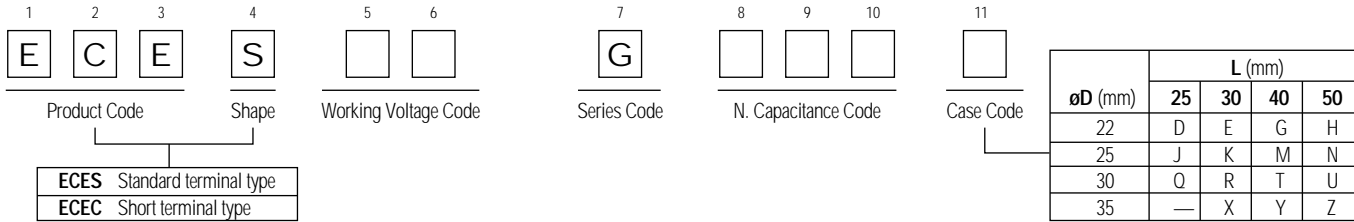
Series: TS-NH



#### ■ Features

- Long life: 105°C 2,000 hours; high ripple current handling ability
- Wide CV value range (47 ~ 47,000 μF/10 ~ 400V)
- Various case sizes and top vent constructions

#### ■ Explanation of Part Numbers



#### ■ Specifications

Operating temperature range	-40 to +105°C	-25 to +105°C											
Rated working voltage	10 to 250 V DC	400 V DC											
Nominal capacitance range	68 to 47,000 μF	33 to 220 μF											
Capacitance tolerance	±20% (120 Hz/+20°C)												
DC leakage current	$I \leq 0.01 CV$ [μA] $CV \leq 1,000,000$ for 16 ~ 100V $I \leq 3\sqrt{CV}$ [μA] $CV > 1,000,000$ for 16 ~ 100 V and all items of 160 ~ 450V Leakage current shall be measured after 5 minutes application of rated working voltage at +20°C. (C = nominal capacitance in μF, V = rated working voltage in V)												
tan δ	(120 Hz/+20°C)												
	<b>W.V. (V)</b>	<b>10</b>	<b>16</b>	<b>25</b>	<b>35</b>	<b>50</b>	<b>63</b>	<b>80</b>	<b>100</b>	<b>160</b>	<b>200</b>	<b>250</b>	<b>400</b>
	tan δ max.	0.45	0.35	0.30	0.23	0.18	0.16	0.12	0.11	0.15	0.15	0.15	0.15
Ripple current	Refer to standard products table (120 Hz, +105°C) Correction factor for frequency												
	<b>Frequency [Hz]</b>	<b>50</b>	<b>60</b>	<b>120</b>	<b>500</b>	<b>1k</b>							<b>10k-50k</b>
	16 ~ 100V	0.93	0.95	1.00	1.05	1.08							1.15
	160 ~ 450V	0.75	0.80	1.00	1.20							1.40	
Endurance	<b>Test conditions</b>												
	Duration	2,000 hours											
	Ambient temperature	+105°C											
	Applied voltage	DC voltage with maximum permissible ripple current specified at +105°C (≤ rated working voltage)											
	<b>Post-test requirements at +20°C</b>												
	Leakage current	≤ initial specified value											
	Capacitance change	± 20% of initial measured value											
	tan δ	≤ 150% of initial specified value											
Shelf life	<b>Test conditions</b> (Post-test requirements at +20°C. Same limits as "Endurance".)												
	Duration	1,000 hours											
	Ambient temperature	+105°C											
	Applied voltage	(none)											
	Pre-treatment for measurements: Measurements shall be conducted after application of DC working voltage for 30 minutes												

### Expected Life for Ripple Current and Ambient Stress

#### ■ Calculation Formula

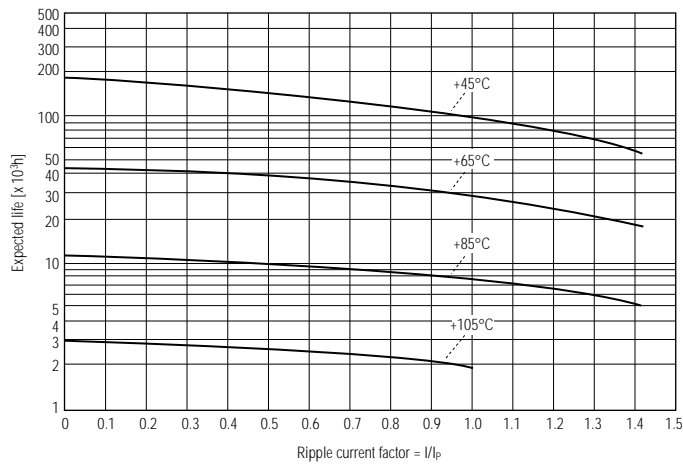
The life of aluminum electrolytic capacitors is highly affected by applied ripple current and ambient temperature. In general, the relation between life time, ripple current, and ambient temperature is known as:

#### Where:

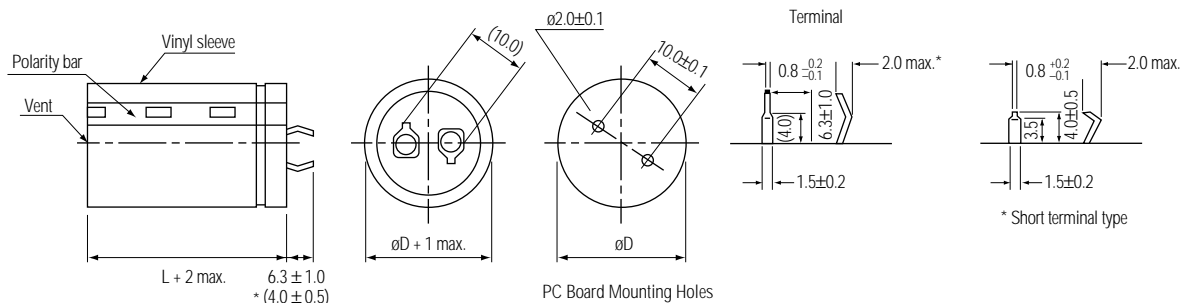
- I: Ripple current to be applied to the capacitor T°C (120 Hz... [A rms])
- I<sub>p</sub>: Specified maximum permissible ripple current at 120 Hz, +85°C... [A rms]
- L: Expected life at T°C... [h]
- L<sub>0</sub>: Specified life (series TS-U: 2,000 hours)... [h]
- T: Ambient temperature [°C]
- T<sub>0</sub>: Hot spot temperature in the capacitor element = [maximum operating temperature] + [Δt at maximum ambient temperature] = [maximum temperature (series TS-U: +90°C)]... [°C]
- Δt: Temperature rise at constant current flow of maximum permissible ripple current value specified at +85°C (see graph1 Δt vs T)... [°C]

Conditions:  $(I/I_p)^2 \leq 2$  times

#### ■ Expected Life (calculated on the basis of specified life under high temperature loading)



#### ■ Dimensions in mm (not to scale)



### ■ Case Size

Cap. (μF) (code)	Ripple Current*	Case size øD x L (mm)			
10V					
4,700	1.80	22x25			
6,800	2.10	22x30	25x25		
10,000	2.50	22x40	25x30	30x25	
15,000	3.10	22x50	25x40	30x30	
22,000	3.40		25x50	30x40	35x30
33,000	3.90			30x50	35x40
47,000	4.90				35x50

25V					
2,200	1.50	22x25			
3,300	1.70	22x30	25x25		
4,700	2.20	22x40	25x30	30x25	
6,800	2.60	22x50	25x40	30x30	
10,000	3.10		25x50	30x40	35x30
15,000	3.50			30x50	35x40
22,000	4.00				35x50

50V					
1,000	1.30	22x25			
1,500	1.50	22x30	25x25		
2,200	1.90	22x40	25x30	30x25	
3,300	2.30	22x50	25x40	30x30	
4,700	2.80		25x50	30x40	35x30
6,800	3.20			30x50	35x40
10,000	3.70				35x50

80V					
470	0.80	22x25			
680	1.20	22x30	25x25		
1,000	1.50	22x40	25x30	30x25	
1,500	1.80	22x50	25x40	30x30	
2,200	2.30		25x50	30x40	35x30
3,300	2.80			30x50	35x40
4,700	3.00				35x50

160V					
150	0.70	22x25			
220	1.00	22x30	25x25		
330	1.20	22x40	25x30	30x25	
470	1.40	22x50	25x40	30x30	
680	1.70		25x50	30x40	35x30
820	2.00			30x50	35x40
1,200	2.30				35x50

250V					
68	0.45	22x25			
100	0.72	22x30	25x25		
150	0.80	22x40	25x30	30x25	
220	1.05	22x50	25x40	30x30	
330	1.25		25x50	30x40	35x30
470	1.45			30x50	35x40
680	1.80				35x50

Cap. (μF) (code)	Ripple Current*	Case size øD x L (mm)			
16V					
3,300	1.60	22x25			
4,700	2.00	22x30	25x25		
6,800	2.40	22x40	25x30	30x25	
10,000	2.90	22x50	25x40	30x30	
15,000	3.50		25x50	30x40	35x30
22,000	4.20			30x50	35x40
33,000	4.80				35x50

35V					
1,500	1.40	22x25			
2,200	1.60	22x30	25x25		
3,300	1.80	22x40	25x30	30x25	
4,700	2.30	22x50	25x40	30x30	
6,800	2.90		25x50	30x40	35x30
10,000	3.50			30x50	35x40
15,000	3.90				35x50

63V					
680	0.90	22x25			
1,000	1.30	22x30	25x25		
1,500	1.60	22x40	25x30	30x25	
2,200	2.00	22x50	25x40	30x30	
3,300	2.50		25x50	30x40	35x30
4,700	2.90			30x50	35x40
6,800	3.30				35x50

100V					
330	0.70	22x25			
470	1.20	22x30	25x25		
680	1.40	22x40	25x30	30x25	
1,000	1.70	22x50	25x40	30x30	
1,500	2.10		25x50	30x40	35x30
2,200	2.60			30x50	35x40
3,300	2.90				35x50

200V					
100	0.72	22x25			
150	0.80	22x30	25x25		
220	1.00	22x40	25x30	30x25	
330	1.20	22x50	25x40	30x30	
470	1.40		25x50	30x40	35x30
680	1.70			30x50	35x40
1,000	2.10				35x50

400V					
33	0.33	22x25			
47	0.47	22x30	25x25		
68	0.56	22x40	25x30	30x25	
100	0.79	22x50	25x40	30x30	
150	0.82		25x50	30x40	35x30
220	1.00			30x50	35x40
330	1.20				35x50

\* Ripple current: [A] rms at 120 Hz, +105°C

**Note:** When capacitors of ø35 x 50φ are mounted to P.C.B., reinforce them with supplementary support or adhesives. (Avoid using adhesives including halogenated composition.)

### ■ Standard Products

W.V. (V DC)	Cap. ( $\mu$ F)	Part No.	Case Size $\phi$ D x L (mm)	Leakage Current (+20°C/5 min) [mA] max.	$\tan \delta$ (120 Hz/+20°C) max.	Ripple Current [A] rms max. (120 Hz/+105°C, 2000h)
10	4,700	ECES1AG472D	22 x 25	0.47	0.45	1.80
	6,800	ECES1AG682E	22 x 30	0.68	0.45	2.10
		ECES1AG682J	25 x 25			
	10,000	ECES1AG103G	22 x 40	1.00	0.45	2.50
		ECES1AG103K	25 x 30			
		ECES1AG103Q	30 x 25			
	15,000	ECES1AG153H	22 x 50	1.16	0.45	3.10
ECES1AG153M		25 x 40				
ECES1AG153R		30 x 30				
22,000	ECES1AG223N	25 x 50	1.40	0.45	3.40	
	ECES1AG223T	30 x 40				
	ECES1AG223X	35 x 30				
33,000	ECES1AG333U	30 x 50	1.72	0.45	3.90	
	ECES1AG333Y	35 x 40				
47,000	ECES1AG473Z	35 x 50	2.05	0.45	4.90	
25	3,300	ECES1CG332D	22 x 25	0.52	0.35	1.60
	4,700	ECES1CG472E	22 x 30	0.75	0.35	2.00
		ECES1CG472J	25 x 25			
	6,800	ECES1CG682G	22 x 40	0.98	0.35	2.40
		ECES1CG682K	25 x 30			
		ECES1CG682Q	30 x 25			
	10,000	ECES1CG103H	22 x 50	1.20	0.35	2.90
ECES1CG103M		25 x 40				
ECES1CG103R		30 x 30				
15,000	ECES1CG153N	25 x 50	1.46	0.35	3.50	
	ECES1CG153T	30 x 40				
	ECES1CG153X	35 x 30				
22,000	ECES1CG223U	30 x 50	1.77	0.35	4.20	
	ECES1CG223Y	35 x 40				
33,000	ECES1CG333Z	35 x 50	2.17	0.35	4.80	
25	2,200	ECES1EG222D	22 x 25	0.55	0.30	1.50
	3,300	ECES1EG332E	22 x 30	0.82	0.30	1.70
		ECES1EG332J	25 x 25			
	4,700	ECES1EG472G	22 x 40	1.02	0.30	2.60
		ECES1EG472K	25 x 30			
		ECES1EG472Q	30 x 25			
	6,800	ECES1EG682H	22 x 50	1.23	0.30	2.60
ECES1EG682M		25 x 40				
ECES1EG682R		30 x 30				
10,000	ECES1EG103N	25 x 50	1.50	0.30	3.10	
	ECES1EG103T	30 x 40				
	ECES1EG103X	35 x 30				
15,000	ECES1EG153U	30 x 50	1.83	0.30	3.50	
	ECES1EG153Y	35 x 40				
22,000	ECES1EG223Z	35 x 50	2.22	0.30	4.00	
35	1,500	ECES1VG152D	22 x 25	0.52	0.23	1.40
	2,200	ECES1VG222D	22 x 30	0.77	0.23	1.60
		ECES1VG222J	25 x 25			
	3,300	ECES1VG332G	22 x 30	1.01	0.23	1.80
		ECES1VG332K	25 x 30			
ECES1VG332Q		30 x 25				
4,700	ECES1VG472H	22 x 50	1.21	0.23	2.30	
	ECES1VG472M	25 x 40				
	ECES1VG472R	30 x 30				

## ■ Standard Products (cont'd)

W.V. (V DC)	Cap. ( $\mu$ F)	Part No.	Case Size $\phi$ D x L (mm)	Leakage Current (+20°C/5 min) [mA] max.	$\tan \delta$ (120 Hz/+20°C) max.	Ripple Current [A] rms max. (120 Hz/+105°C, 2000h)			
35	6,800	ECES1VG682N	25 x 50	1.46	0.23	2.90			
		ECES1VG682T	30 x 40						
		ECES1VG682X	35 x 30						
35	10,000	ECES1VG103U	30 x 50	1.77	0.23	3.50			
		ECES1VG103Y	35 x 40						
		ECES1VG152Z	35 x 50						
35	15,000	ECES1VG152Z	35 x 50	2.17	0.23	3.90			
		ECES1HG102D	22 x 25				0.50	0.18	1.30
		ECES1HG152E	22 x 30						
ECES1HG152J	25 x 25								
63	2,200	ECES1HG222G	22 x 40	0.99	0.18	1.90			
		ECES1HG222K	25 x 30						
		ECES1HG222Q	30 x 25						
63	3,300	ECES1HG332H	22 x 50	1.21	0.18	2.30			
		ECES1HG332M	25 x 40						
		ECES1HG332R	30 x 30						
63	4,700	ECES1HG472N	25 x 50	1.45	0.18	2.80			
		ECES1HG472T	30 x 40						
		ECES1HG472X	35 x 30						
63	6,800	ECES1HG682U	30 x 50	1.74	0.18	3.20			
		ECES1HG682Y	35 x 40						
		ECES1HG103Z	35 x 50						
63	10,000	ECES1HG103Z	35 x 50	2.12	0.18	3.70			
		ECES1JG681D	22 x 25				0.42	0.16	0.90
		ECES1JG102E	22 x 30						
ECES1JG102J	25 x 25								
80	1,500	ECES1JG152G	22 x 40	0.94	0.16	1.60			
		ECES1JG152K	25 x 30						
		ECES1JG152Q	30 x 25						
80	2,200	ECES1JG222H	22 x 50	1.11	0.16	2.00			
		ECES1JG222M	25 x 40						
		ECES1JG222R	30 x 30						
80	3,300	ECES1JG332N	25 x 50	1.36	0.16	2.50			
		ECES1JG332T	30 x 40						
		ECES1JG332X	35 x 30						
80	4,700	ECES1JG472U	30 x 50	1.63	0.16	2.90			
		ECES1JG472Y	35 x 40						
		ECES1JG682Z	35 x 50						
80	6,800	ECES1JG682Z	35 x 50	1.96	0.16	3.30			
		ECES1KG471D	22 x 25				0.37	0.12	0.80
		ECES1KG681E	22 x 30						
ECES1KG681J	25 x 25								
100	1,000	ECES1KG102G	22 x 40	0.80	0.12	0.50			
		ECES1KG102K	25 x 30						
		ECES1KG102Q	30 x 25						
100	1,500	ECES1KG152H	22 x 50	1.03	0.12	1.80			
		ECES1KG152M	25 x 40						
		ECES1KG152R	30 x 30						
100	2,200	ECES1KG222N	25 x 50	1.25	0.12	2.30			
		ECES1KG222T	30 x 40						
		ECES1KG222X	35 x 30						
100	3,300	ECES1KG332U	30 x 50	1.54	0.12	2.80			
		ECES1KG332Y	35 x 40						
		ECES1KG472Z	35 x 50						
100	4,700	ECES1KG472Z	35 x 50	1.83	0.12	3.00			

### ■ Standard Products (cont'd)

W.V. (V DC)	Cap. ( $\mu$ F)	Part No.	Case Size $\phi$ D x L (mm)	Leakage Current (+20°C/5 min) [mA] max.	$\tan \delta$ (120 Hz/+20°C) max.	Ripple Current [A] rms max. (120 Hz/+105°C, 2000h)
100	330	ECES2AG331D	22 x 25	0.33	0.11	0.70
	470	ECES2AG471E	22 x 30	0.47	0.11	1.20
		ECES2AG471J	25 x 25			
	680	ECES2AG681G	22 x 40	0.68	0.11	1.40
		ECES2AG681K	25 x 30			
		ECES2AG681Q	30 x 25			
	1,000	ECES2AG102H	22 x 50	1.00	0.11	1.70
ECES2AG102M		25 x 40				
ECES2AG102R		30 x 30				
1,500	ECES2AG152N	25 x 50	1.16	0.11	2.10	
	ECES2AG152T	30 x 40				
	ECES2AG152X	35 x 30				
2,200	ECES2AG222U	30 x 50	1.40	0.11	2.60	
	ECES2AG222Y	35 x 40				
3,300	ECES2AG332Z	35 x 50	1.72	0.11	2.90	
160	150	ECES2AG151D	22 x 25	0.46	0.15	0.70
	220	ECES2AG221E	22 x 30	0.56	0.15	1.00
		ECES2AG221J	25 x 25			
	330	ECES2AG331G	22 x 40	0.68	0.15	1.20
		ECES2AG331K	25 x 30			
		ECES2AG331Q	30 x 25			
	470	ECES2AG471H	22 x 50	0.82	0.15	1.40
		ECES2AG471M	25 x 40			
ECES2AG471R		30 x 30				
680	ECES2AG681N	25 x 50	0.98	0.15	1.70	
	ECES2AG681T	30 x 40				
	ECES2AG681X	35 x 30				
820	ECES2AG821U	30 x 50	1.08	0.15	2.00	
	ECES2AG821Y	35 x 40				
1,200	ECES2AG122Z	35 x 50	1.31	0.15	2.30	
200	100	ECES2DG101D	22 x 25	0.42	0.15	0.72
	150	ECES2DG151E	22 x 30	0.51	0.15	0.80
		ECES2DG151J	25 x 25			
	220	ECES2DG221G	22 x 40	0.62	0.15	1.00
		ECES2DG221K	25 x 30			
		ECES2DG221Q	30 x 25			
	330	ECES2DG331H	22 x 50	0.77	0.15	1.20
		ECES2DG331M	25 x 40			
ECES2DG331R		30 x 30				
470	ECES2DG471N	25 x 50	0.91	0.15	1.40	
	ECES2DG471T	30 x 40				
	ECES2DG471X	35 x 30				
680	ECES2DG681U	30 x 50	1.10	0.15	1.70	
	ECES2DG681Y	35 x 40				
1,000	ECES2DG102Z	35 x 50	1.34	0.15	2.10	

## ■ Standard Products (cont'd)

W.V. (V DC)	Cap. ( $\mu$ F)	Part No.	Case Size $\phi$ D x L (mm)	Leakage Current (+20°C/5 min) [mA] max.	$\tan \delta$ (120 Hz/+20°C) max.	Ripple Current [A] rms max. (120 Hz/+105°C, 2000h)
250	68	ECES2EG680D	22 x 25	0.39	0.15	0.45
	100	ECES2EG101E	22 x 30	0.47	0.15	0.72
		ECES2EG101J	25 x 25			
	150	ECES2EG151G	22 x 40	0.58	0.15	0.80
		ECES2EG151K	25 x 30			
		ECES2EG151Q	30 x 25			
	220	ECES2EG221H	22 x 50	0.70	0.15	1.05
ECES2EG221M		25 x 40				
ECES2EG221R		30 x 30				
330	ECES2EG331N	25 x 50	0.86	0.15	1.25	
	ECES2EG331T	30 x 40				
	ECES2EG331X	35 x 30				
470	ECES2EG471U	30 x 50	1.02	0.15	1.45	
	ECES2EG471Y	35 x 40				
680	ECES2EG681Z	35 x 50	1.23	0.15	1.80	
400	33	ECES2GG330D	22 x 25	0.34	0.15	0.33
	47	ECES2GG470E	22 x 50	0.41	0.15	0.47
		ECES2GG470J	25 x 25			
	68	ECES2GG680G	22 x 40	0.49	0.15	0.56
		ECES2GG680K	25 x 50			
		ECES2GG680Q	30 x 25			
	100	ECES2GG101H	22 x 50	0.60	0.15	0.69
ECES2GG101M		25 x 40				
ECES2GG101R		30 x 50				
150	ECES2GG151N	25 x 50	0.73	0.15	0.82	
	ECES2GG151T	30 x 40				
	ECES2GG151X	35 x 50				
220	ECES2GG221U	30 x 50	0.88	0.15	1.00	
	ECES2GG221Y	35 x 40				
330	ECES2GG331Z	35 x 50	1.08	0.15	1.20	