

## TS-HA Series 105°C, 3000 hours\*

- High ripple current capability
- 20mm lengths for low profile applications
- 2 and 3 pin versions available



Rated Working Voltage:	10 ~ 250 VDC	385 ~ 450 VDC
Operating Temperature:	-40 ~ +105°C	-25 ~ +105°C
Nominal Capacitance:	68 ~ 82000µF (±20% tolerance)	33 ~ 470µF (±20% tolerance)
Dissipation Factor: (120 Hz, +20°C)	Working Voltage [V]:	10 16 25 35 50 63 80 100 - 450
	Max. D.F. (%):	55 45 35 30 25 20 17 15
For capacitance values > 33000µF, add the value of: $\frac{\text{rated cap. } [\mu\text{F}] - 33000}{1000}$		
Leakage Current:	3√CV (µA) max. after 5 minutes; C = Capacitance in µF, V = WV	
Ripple Current Multipliers:	Frequency(Hz):	50 60 100-120 500 1k 10k- 10-100WV: 0.93 0.95 1.0 1.05 1.08 1.15 160-450WV: 0.75 0.8 1.0 1.2 1.25 1.4
	Ripple Current Ambient Temperature Factors** Ambient Temperature: 105°C 85°C 70°C 60°C ≤45°C Multiplier: 1.0 1.7 2.0 2.2 2.35	
Endurance:	3000 hours at +105°C with maximum specified ripple current (see page 6) *2000 hours for 20mm length sizes	

\*\*Use of temperature ripple current multipliers may limit life to the hours specified for the maximum operating temperature.

### Part Number System



### TS-HA Standard Ratings (part numbers shown with 2 pins, 6.3mm length terminal, and top vinyl plate)

Cap. (µF)	Size (mm) D x L	Max 105°C R.C. (A <sub>rms</sub> )		20°C ESR (Ω, max.)		Panasonic Part Number	Cap. (µF)	Size (mm) D x L	Max 105°C R.C. (A <sub>rms</sub> )		20°C ESR (Ω, max.)		Panasonic Part Number	
		120Hz	10kHz~	120Hz	20kHz				120Hz	20kHz	120Hz	20kHz		
<b>10 VDC Working, 13 VDC Surge</b>							<b>16 VDC Working, 20 VDC Surge (continued)</b>							
4700	22 x 25	0.85	0.98	0.159	0.135	ECOS1AA472BA	10000	35 x 20	2.40	2.76	0.071	0.057	ECOS1CA103EL	
6800	22 x 25	1.30	1.50	0.110	0.093	ECOS1AA682BA	12000	22 x 35	2.90	3.34	0.055	0.044	ECOS1CA123BA	
10000	22 x 25	1.80	2.07	0.075	0.063	ECOS1AA103BA		25 x 30	2.90	3.34	0.055	0.044	ECOS1CA123CA	
12000	22 x 30	2.20	2.53	0.062	0.053	ECOS1AA123BA		30 x 25	2.90	3.34	0.055	0.044	ECOS1CA123DA	
15000	22 x 35	2.30	2.65	0.053	0.045	ECOS1AA153BA	15000	22 x 40	3.20	3.68	0.046	0.037	ECOS1CA153BA	
	25 x 25	2.30	2.65	0.053	0.045	ECOS1AA153CA		25 x 35	3.20	3.68	0.046	0.037	ECOS1CA153CA	
18000	22 x 40	2.40	2.76	0.044	0.038	ECOS1AA183BA	18000	30 x 30	3.20	3.68	0.046	0.037	ECOS1CA153DA	
	25 x 30	2.40	2.76	0.044	0.038	ECOS1AA183CA		22 x 45	3.50	4.03	0.040	0.034	ECOS1CA183BA	
22000	22 x 45	2.60	2.99	0.038	0.032	ECOS1AA223BA		25 x 40	3.50	4.03	0.040	0.034	ECOS1CA183CA	
	25 x 35	2.60	2.99	0.038	0.032	ECOS1AA223CA		30 x 30	3.50	4.03	0.040	0.034	ECOS1CA183DA	
	30 x 25	2.60	2.99	0.038	0.032	ECOS1AA223DA		35 x 25	3.50	4.03	0.040	0.034	ECOS1CA183EA	
27000	22 x 50	3.10	3.57	0.033	0.028	ECOS1AA273BA	22000	25 x 45	3.80	4.37	0.033	0.028	ECOS1CA223CA	
	25 x 40	3.10	3.57	0.033	0.028	ECOS1AA273CA			30 x 35	3.80	4.37	0.033	0.028	ECOS1CA223DA
	30 x 30	3.10	3.57	0.033	0.028	ECOS1AA273DA			35 x 30	3.80	4.37	0.033	0.028	ECOS1CA223EA
	35 x 25	3.10	3.57	0.033	0.028	ECOS1AA273EA		27000	25 x 50	4.20	4.83	0.028	0.025	ECOS1CA273CA
33000	25 x 45	3.40	3.91	0.027	0.023	ECOS1AA333CA			30 x 40	4.20	4.83	0.028	0.025	ECOS1CA273DA
	30 x 35	3.40	3.91	0.027	0.023	ECOS1AA333DA			35 x 30	4.20	4.83	0.028	0.025	ECOS1CA273EA
39000	35 x 30	3.40	3.91	0.027	0.023	ECOS1AA333EA	33000	30 x 45	4.70	5.41	0.023	0.020	ECOS1CA333DA	
	25 x 50	3.70	4.26	0.025	0.021	ECOS1AA393CA			35 x 35	4.70	5.41	0.023	0.020	ECOS1CA333EA
47000	30 x 40	3.70	4.26	0.025	0.021	ECOS1AA393DA	39000	30 x 50	5.10	5.87	0.022	0.020	ECOS1CA393DA	
	35 x 30	3.70	4.26	0.025	0.021	ECOS1AA393EA			35 x 40	5.10	5.87	0.022	0.020	ECOS1CA393EA
	30 x 45	4.20	4.83	0.023	0.020	ECOS1AA473DA		47000	35 x 45	5.50	6.33	0.020	0.018	ECOS1CA473EA
35 x 35	4.20	4.83	0.023	0.020	ECOS1AA473EA		56000		35 x 50	6.00	6.90	0.019	0.017	ECOS1CA563EA
56000	30 x 50	5.00	5.75	0.022	0.019	ECOS1AA563DA	<b>25 VDC Working, 32 VDC Surge</b>							
68000	35 x 40	5.00	5.75	0.022	0.021	ECOS1AA563EA	2200	22 x 20	1.30	1.50	0.241	0.181	ECOS1EA222BL	
<b>16 VDC Working, 20 VDC Surge</b>							2200	22 x 25	1.30	1.50	0.241	0.181	ECOS1EA222BA	
3300	22 x 20	1.30	1.50	0.216	0.173	ECOS1CA332BL	3300	22 x 25	1.62	1.86	0.161	0.121	ECOS1EA332BA	
	22 x 25	1.30	1.50	0.176	0.141	ECOS1CA332BA		25 x 20	1.60	1.84	0.161	0.121	ECOS1EA332CL	
4700	22 x 25	1.52	1.75	0.123	0.099	ECOS1CA472BA	4700	22 x 25	2.00	2.30	0.106	0.079	ECOS1EA472BA	
	25 x 20	1.60	1.84	0.152	0.121	ECOS1CA472CL		30 x 20	1.80	2.07	0.113	0.085	ECOS1EA472DL	
6800	22 x 25	2.20	2.53	0.085	0.068	ECOS1CA682BA	5600	22 x 30	2.20	2.53	0.089	0.067	ECOS1EA562BA	
	30 x 20	1.80	2.07	0.105	0.084	ECOS1CA682DL	6800	22 x 30	2.40	2.76	0.073	0.055	ECOS1EA682BA	
8200	22 x 30	2.40	2.76	0.071	0.057	ECOS1CA822BA		25 x 25	2.40	2.76	0.073	0.055	ECOS1EA682CA	
10000	22 x 30	2.60	2.99	0.066	0.053	ECOS1CA103BA		35 x 20	2.30	2.65	0.080	0.060	ECOS1EA682EL	
	25 x 25	2.60	2.99	0.066	0.053	ECOS1CA103CA	8200	22 x 35	2.70	3.11	0.061	0.045	ECOS1EA822BA	
								25 x 30	2.70	3.11	0.061	0.045	ECOS1EA822CA	

## TS-HA Standard Ratings (continued)

Cap. ( $\mu$ F)	Size (mm) D x L	Max 105°C R.C. ( $A_{rms}$ )		20°C ESR ( $\Omega$ , max.)		Panasonic Part Number
		120Hz	10kHz-	120Hz	20kHz	
<b>25 VDC Working, 32 VDC Surge (continued)</b>						
8200	30 x 25	2.70	3.11	0.061	0.045	ECOS1EA822DA
10000	22 x 40	3.00	3.45	0.051	0.039	ECOS1EA103BA
	25 x 35	3.00	3.45	0.051	0.039	ECOS1EA103CA
	30 x 30	3.00	3.45	0.051	0.039	ECOS1EA103DA
12000	22 x 45	3.20	3.68	0.044	0.033	ECOS1EA123BA
	25 x 40	3.20	3.68	0.044	0.035	ECOS1EA123CA
	30 x 30	3.20	3.68	0.044	0.035	ECOS1EA123DA
	35 x 25	3.20	3.68	0.044	0.035	ECOS1EA123EA
15000	25 x 45	3.60	4.14	0.036	0.031	ECOS1EA153CA
	30 x 35	3.60	4.14	0.036	0.031	ECOS1EA153DA
	35 x 30	3.60	4.14	0.036	0.031	ECOS1EA153EA
18000	25 x 50	3.90	4.49	0.030	0.027	ECOS1EA183CA
	30 x 40	3.90	4.49	0.030	0.027	ECOS1EA183DA
	35 x 35	3.90	4.49	0.030	0.027	ECOS1EA183EA
22000	30 x 45	4.30	4.95	0.025	0.022	ECOS1EA223DA
	35 x 35	4.30	4.95	0.025	0.022	ECOS1EA223EA
27000	35 x 45	4.80	5.52	0.021	0.019	ECOS1EA273EA
33000	35 x 50	5.50	6.33	0.018	0.016	ECOS1EA333EA
<b>35 VDC Working, 44 VDC Surge</b>						
1500	22 x 20	1.10	1.27	0.287	0.216	ECOS1VA152BL
	22 x 25	1.10	1.27	0.287	0.216	ECOS1VA152BA
2200	22 x 25	1.48	1.70	0.196	0.147	ECOS1VA222BA
	25 x 20	1.40	1.61	0.196	0.147	ECOS1VA222CL
3300	22 x 25	1.90	2.19	0.121	0.090	ECOS1VA332BA
	30 x 20	1.70	1.96	0.131	0.098	ECOS1VA332DL
3900	22 x 30	2.00	2.30	0.111	0.083	ECOS1VA392BA
4700	22 x 35	2.20	2.53	0.088	0.066	ECOS1VA472BA
	25 x 25	2.20	2.53	0.088	0.066	ECOS1VA472CA
	35 x 20	2.00	2.30	0.095	0.071	ECOS1VA472EL
5600	22 x 35	2.40	2.76	0.074	0.056	ECOS1VA562BA
	25 x 30	2.40	2.76	0.074	0.056	ECOS1VA562CA
	30 x 25	2.40	2.76	0.074	0.056	ECOS1VA562DA
6800	22 x 40	2.60	2.99	0.061	0.046	ECOS1VA682BA
	25 x 35	2.60	2.99	0.061	0.046	ECOS1VA682CA
	30 x 30	2.60	2.99	0.061	0.046	ECOS1VA682DA
8200	22 x 50	2.90	3.34	0.051	0.038	ECOS1VA822BA
	25 x 40	2.90	3.34	0.051	0.038	ECOS1VA822CA
	30 x 30	2.90	3.34	0.051	0.038	ECOS1VA822DA
	35 x 25	2.90	3.34	0.051	0.038	ECOS1VA822EA
10000	25 x 45	3.20	3.68	0.041	0.031	ECOS1VA103CA
	30 x 35	3.20	3.68	0.041	0.031	ECOS1VA103DA
	35 x 30	3.20	3.68	0.041	0.031	ECOS1VA103EA
12000	25 x 50	3.50	4.03	0.035	0.026	ECOS1VA123CA
	30 x 40	3.50	4.03	0.035	0.026	ECOS1VA123DA
	35 x 30	3.50	4.03	0.035	0.026	ECOS1VA123EA
15000	30 x 45	3.90	4.49	0.030	0.022	ECOS1VA153DA
	35 x 35	3.90	4.49	0.030	0.022	ECOS1VA153EA
18000	35 x 40	4.30	4.95	0.028	0.021	ECOS1VA183EA
22000	35 x 50	5.00	5.75	0.023	0.017	ECOS1VA223EA
<b>50 VDC Working, 63 VDC Surge</b>						
1000	22 x 20	0.90	1.04	0.265	0.199	ECOS1HA102BL
	22 x 25	0.90	1.04	0.232	0.174	ECOS1HA102BA
1500	22 x 25	1.25	1.44	0.155	0.116	ECOS1HA152BA
	25 x 20	1.20	1.38	0.177	0.133	ECOS1HA152CL
1800	22 x 25	1.50	1.73	0.129	0.097	ECOS1HA182BA
2200	22 x 30	1.70	1.96	0.105	0.079	ECOS1HA222BA
	30 x 20	1.40	1.61	0.121	0.090	ECOS1HA222DL
2700	22 x 30	1.80	2.07	0.086	0.064	ECOS1HA272BA
	25 x 25	1.80	2.07	0.086	0.064	ECOS1HA272CA
3300	22 x 35	2.00	2.30	0.070	0.053	ECOS1HA332BA
	25 x 30	2.00	2.30	0.070	0.053	ECOS1HA332CA
	35 x 20	1.70	1.96	0.085	0.064	ECOS1HA332EL
3900	22 x 40	2.20	2.53	0.064	0.048	ECOS1HA392BA
	25 x 35	2.20	2.53	0.064	0.048	ECOS1HA392CA
	30 x 25	2.20	2.53	0.064	0.048	ECOS1HA392DA
4700	22 x 45	2.50	2.88	0.053	0.040	ECOS1HA472BA
	25 x 40	2.50	2.88	0.053	0.040	ECOS1HA472CA
	30 x 30	2.50	2.88	0.053	0.040	ECOS1HA472DA
	35 x 25	2.50	2.88	0.053	0.040	ECOS1HA472EA
5600	22 x 50	2.80	3.22	0.050	0.038	ECOS1HA562BA
	25 x 40	2.80	3.22	0.050	0.038	ECOS1HA562CA
	30 x 35	2.80	3.22	0.050	0.038	ECOS1HA562DA
6800	35 x 30	2.80	3.22	0.050	0.038	ECOS1HA562EA
	25 x 50	3.30	3.80	0.046	0.035	ECOS1HA682CA
30 x 40	3.30	3.80	0.046	0.035	ECOS1HA682DA	
	<b>50 VDC Working, 63 VDC Surge</b>					
6800	35 x 30	3.30	3.80	0.046	0.035	ECOS1HA682CA
	30 x 40	3.30	3.80	0.046	0.035	ECOS1HA682DA
<b>80 VDC Working, 100 VDC Surge</b>						
470	22 x 20	0.80	0.92	0.459	0.298	ECOS1KA471BL
	22 x 25	0.80	0.92	0.388	0.272	ECOS1KA471BA
680	22 x 25	1.00	1.15	0.268	0.188	ECOS1KA681BA
	25 x 20	1.00	1.15	0.317	0.206	ECOS1KA681CL
820	22 x 25	1.20	1.38	0.222	0.145	ECOS1KA821BA
1000	22 x 30	1.30	1.50	0.182	0.119	ECOS1KA102BA
	25 x 25	1.30	1.50	0.182	0.119	ECOS1KA102CA
	30 x 20	1.20	1.38	0.216	0.140	ECOS1KA102DL
1200	22 x 30	1.50	1.73	0.166	0.116	ECOS1KA122BA
	25 x 25	1.50	1.73	0.166	0.116	ECOS1KA122CA
1500	22 x 35	1.70	1.96	0.133	0.093	ECOS1KA152BA
	25 x 30	1.70	1.96	0.133	0.093	ECOS1KA152CA
	35 x 20	1.40	1.61	0.155	0.108	ECOS1KA152EL
1800	22 x 40	1.80	2.07	0.111	0.077	ECOS1KA182BA
	25 x 35	1.80	2.07	0.111	0.077	ECOS1KA182CA
	30 x 25	1.80	2.07	0.111	0.077	ECOS1KA182DA
2200	22 x 45	2.10	2.42	0.090	0.063	ECOS1KA222BA
	25 x 35	2.10	2.42	0.090	0.063	ECOS1KA222CA
	30 x 30	2.10	2.42	0.090	0.063	ECOS1KA222DA
	35 x 25	2.10	2.42	0.090	0.063	ECOS1KA222EA
2700	25 x 45	2.40	2.76	0.074	0.055	ECOS1KA272CA
	30 x 35	2.40	2.76	0.074	0.055	ECOS1KA272DA
	35 x 30	2.40	2.76	0.074	0.055	ECOS1KA272EA
3300	25 x 50	2.60	2.99	0.065	0.049	ECOS1KA332CA
	30 x 40	2.60	2.99	0.065	0.049	ECOS1KA332DA
	35 x 30	2.60	2.99	0.065	0.049	ECOS1KA332EA
3900	30 x 45	3.00	3.45	0.060	0.045	ECOS1KA392DA
	35 x 35	3.00	3.45	0.060	0.045	ECOS1KA392EA
	30 x 50	3.30	3.80	0.049	0.037	ECOS1KA472DA
4700	35 x 40	3.30	3.80	0.049	0.037	ECOS1KA472EA
	35 x 45	3.70	4.26	0.050	0.038	ECOS1KA562EA
6800	35 x 50	3.90	4.49	0.041	0.031	ECOS1KA682EA
<b>100 VDC Working, 125 VDC Surge</b>						
330	22 x 20	0.80	1.20	0.653	0.392	ECOS2AA331BL
	22 x 25	0.80	1.20	0.553	0.332	ECOS2AA331BA



### TS-HA Standard Ratings (continued)

Cap. ( $\mu$ F)	Size (mm) D x L	Max 105°C R.C. ( $A_{rms}$ )		20°C ESR ( $\Omega$ , max.)		Panasonic Part Number
		120Hz	10kHz-	120Hz	20kHz	
<b>400 VDC Working, 450 VDC Surge</b>						
33	22 x 20	0.20	0.28	5.024	1.758	ECOS2GA330BL
	22 x 25	0.30	0.42	4.521	1.582	ECOS2GA330BA
47	22 x 25	0.43	0.60	2.822	0.988	ECOS2GA470BA
	25 x 20	0.25	0.35	3.527	1.235	ECOS2GA470CL
56	22 x 25	0.51	0.71	2.368	0.829	ECOS2GA560BA
68	22 x 30	0.56	0.78	1.950	0.683	ECOS2GA680BA
	25 x 25	0.56	0.78	1.950	0.683	ECOS2GA680CA
	30 x 20	0.35	0.49	2.438	0.853	ECOS2GA680DL
82	22 x 35	0.64	0.90	1.617	0.566	ECOS2GA820BA
	25 x 25	0.64	0.90	1.617	0.566	ECOS2GA820CA
100	22 x 35	0.69	0.97	1.326	0.464	ECOS2GA101BA
	25 x 30	0.69	0.97	1.326	0.464	ECOS2GA101CA
	35 x 20	0.47	0.66	1.658	0.580	ECOS2GA101EL
120	22 x 40	0.75	1.05	1.105	0.387	ECOS2GA121BA
	25 x 35	0.75	1.05	1.105	0.387	ECOS2GA121CA
	30 x 25	0.75	1.05	1.105	0.387	ECOS2GA121DA
150	22 x 50	0.82	1.15	0.884	0.309	ECOS2GA151BA
	25 x 40	0.82	1.15	0.884	0.309	ECOS2GA151CA
	30 x 30	0.82	1.15	0.884	0.309	ECOS2GA151DA
180	25 x 45	0.95	1.33	0.737	0.258	ECOS2GA181CA
	30 x 35	0.95	1.33	0.737	0.258	ECOS2GA181DA
	35 x 25	0.95	1.33	0.737	0.258	ECOS2GA181EA
220	25 x 50	1.10	1.54	0.603	0.211	ECOS2GA221CA
	30 x 40	1.10	1.54	0.603	0.211	ECOS2GA221DA
	35 x 30	1.10	1.54	0.603	0.211	ECOS2GA221EA
270	30 x 45	1.20	1.68	0.491	0.172	ECOS2GA271DA
	35 x 35	1.20	1.68	0.491	0.172	ECOS2GA271EA
330	30 x 50	1.35	1.89	0.402	0.161	ECOS2GA331DA
	35 x 40	1.35	1.89	0.402	0.161	ECOS2GA331EA
390	35 x 45	1.55	2.17	0.340	0.136	ECOS2GA391EA
470	35 x 50	1.75	2.45	0.282	0.127	ECOS2GA471EA
<b>450 VDC Working, 500 VDC Surge</b>						
56	22 x 25	0.40	0.56	2.368	0.947	ECOS2WA560BA
68	22 x 30	0.50	0.70	1.950	0.780	ECOS2WA680BA
	25 x 25	0.50	0.70	1.950	0.780	ECOS2WA680CA
82	22 x 35	0.56	0.78	1.617	0.647	ECOS2WA820BA
100	22 x 40	0.64	0.90	1.326	0.531	ECOS2WA101BA
	25 x 30	0.64	0.90	1.326	0.531	ECOS2WA101CA
	30 x 25	0.64	0.90	1.326	0.531	ECOS2WA101DA
120	22 x 45	0.72	1.01	1.105	0.442	ECOS2WA121BA
	25 x 35	0.72	1.01	1.105	0.442	ECOS2WA121CA
150	22 x 50	0.79	1.11	0.884	0.354	ECOS2WA151BA
	25 x 40	0.79	1.11	0.884	0.354	ECOS2WA151CA
	30 x 30	0.79	1.11	0.884	0.354	ECOS2WA151DA
	35 x 25	0.79	1.11	0.884	0.354	ECOS2WA151EA
180	25 x 45	0.87	1.22	0.737	0.295	ECOS2WA181CA
	30 x 35	0.87	1.22	0.737	0.295	ECOS2WA181DA
220	25 x 50	1.00	1.40	0.678	0.271	ECOS2WA221CA
	30 x 40	1.00	1.40	0.678	0.271	ECOS2WA221DA
	35 x 30	1.00	1.40	0.678	0.271	ECOS2WA221EA
270	30 x 45	1.17	1.64	0.614	0.246	ECOS2WA271DA
	35 x 35	1.17	1.64	0.614	0.246	ECOS2WA271EA
330	30 x 50	1.38	1.93	0.502	0.201	ECOS2WA331DA
	35 x 40	1.38	1.93	0.502	0.201	ECOS2WA331EA
390	35 x 50	1.55	2.17	0.425	0.170	ECOS2WA391EA