Type CLS – Flatpack™, 10,000 hr@105ºC

Low-Profile Aluminum Electrolytic



With exceptional 10,000 hr. life and offering high energy density in a low profile, Type CLS allows for compact, high reliability power supply designs. Able to withstand 80,000 feet altitude. Further the reliability of your system by specifying type HRCLS for a MIL-level burn-in. Demand our high vibration (HVCLS) version package that withstands up to 30g's.

Highlights

- High Energy Density Flatpack™
- Highest Capacitance Flatpack™
- High Ripple Current
- 10,000 hours (at rated load life)
- High Reliability

Specifications

Temperature Range	-55ºC to 105ºC
Rated Voltage Range	10 Vdc to 300 Vdc
Capacitance Range	150 µF to 83,000 µF
Capacitance Tolerance	±20%
Leakage Current	≤ 0.004 × C × V microamps for C in microfarads and V in volts
Ripple Current Multipliers	**Frequency** Frequency (Hz) Vdc | 50 | 60 | 120 | 400 | 1000 | 10000 0-50 | 0.85 | 0.85 | 1.00 | 1.05 | 1.06 | 1.10 51-90 | 0.79 | 0.80 | 1.00 | 1.08 | 1.15 | 1.20 91-249 | 0.75 | 0.76 | 1.00 | 1.13 | 1.30 | 1.35 250-300 | 0.70 | 0.72 | 1.00 | 1.12 | 1.35 | 1.41 **Ambient Temperature (Natural Convection, No Heatsink)** Ambient Temperature (°C) Vdc | 45 | 55 | 65 | 75 | 85 | 95 | 105 0-50 | 2.30 | 2.20 | 2.10 | 1.90 | 1.70 | 1.40 | 1.00 51-90 | 2.40 | 2.30 | 2.15 | 1.95 | 1.70 | 1.35 | 1.00 91-249 | 2.55 | 2.40 | 2.20 | 2.00 | 1.74 | 1.40 | 1.00 250-300 | 2.35 | 2.25 | 2.10 | 1.95 | 1.70 | 1.40 | 1.00 **Airflow Velocity (No Heatsink)** Airflow velocity (No heatsink) Natural convection ≈ 0.25 m/s | 0.25 | 1.00 | 2.50 | 5.00 Ripple Current Multiplier (Bare Case) | 1.00 | 1.18 | 1.37 | 1.52 Ripple Current Multiplier (PE Sleeved) | 1.00 | 1.16 | 1.35 | 1.50
Typical Ripple Current Capability	The typical ripple current capability is set by the maximum permissible internal core temperature, maximum lead current capability of 20 Arms, and a maximum 20ºC core rise (Not heatsinked), the maximum peak voltage including ripple voltage applied continuously between the terminals is less than the rated voltage of the capacitor. In addition, the user should ensure that the peak-to-peak capacitor voltage divided by the capacitor's rated voltage V_R should not exceed the greater of 10% or 0.01352 × (VDC Rated / 1[VDC])$^{1/2}$.
Terminals - *Lead Free Version Available*	CLS: Copper wire with 60/40 tin/lead electroplate, 20 amps max CLSR: Copper wire with bright tin electroplate, 20 amps max
Case Material	Stainless Steel: 316L or 304

Low Temperature Characteristics	($Z_{-55ºC}/Z_{+25ºC}$ @120 Hz) ≤ 50 Vdc, Z < 10X, Capacitance loss < 30% 51 - 300 Vdc, Z < 3.6X, Capacitance loss < 30%
Endurance Life Test	10,000 Hours 105°C At Rated Ripple Load, with rated ripple current applied with rated voltage Δ Capacitance ±10% ESR < 1.5X Catalog Limit DCL ≤ 0.004 CV µA
Shelf Life Test	Up to 5 years ≤ 40ºC, 500 hours ≤ 105ºC Capacitance Inside Catalog Tolerance ESR < Catalog Limit DCL ≤ 0.004 CV µA
Vibration	**Amplitude** The specimens shall be subjected to a simple harmonic motion with the double amplitude or acceleration max levels noted below, whichever is less. **Acceleration Level** 10 g (peak) - Non HV (High Vibration) part numbers, 30 g (peak) - for HV part numbers, HV may not be available on all sizes. **Displacement Level** 0.06-inch double amplitude (maximum total excursion). **Frequency Range** The vibration frequency shall be varied logarithmically between the approximate limits of 10 to 2,000 Hz. **Sweep Time & Duration** The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. **Mounting** Vibration capability is dependent upon mounting restraint. The optional mounting pins, alone, are not capable of sustaining the high vibration levels. Additional mounting restraint may be required.
High Reliability Test/Burn-In	Established reliability HRCLS capacitors shall be subjected to a minimum of 100 percent of the dc rated voltage at 105ºC for 48 hours minimum but not to exceed 96 hours. During this test, capacitors shall be adequately protected against temporary voltage surges of 10 percent or more of the test voltage. After burn-in, the capacitors shall be returned to room ambient conditions and the dc leakage, capacitance, and ESR shall be measured with respect to specified limits.

Heatsinked Ripple Current

Thermal Resistance θ_{CHS} Core to Heatsink (°C/W) by Case Length "L"

Number of Sides Heatsinked	Code	Code Length / Length (in)	_K 1.5	_A 2	_H 2.5	_B 3
One Large Side Heat Sinked	J_	Bare can	6.31	4.82	3.91	3.29
		Polyester	7.34	5.25	4.95	3.80
Two Large Sides Heat Sinked		Bare can	4.09	3.07	2.45	2.04
		Polyester	4.63	3.47	2.78	2.31
One Large Side Heat Sinked	E_	Bare can	4.03	3.08	2.50	2.11
		Polyester	4.62	3.52	2.86	2.40
Two Large Sides Heat Sinked		Bare can	2.57	1.93	1.55	1.29
		Polyester	2.87	2.15	1.72	1.44

Heatsink Cooled

Temperature rise from the hottest internal spot, the core, to ambient air is $\Delta T = I^2(ESR)(\theta cc + \theta ca)$, recommended max ΔT of 30°C where θcc is the thermal resistance from core to case and θca from case to ambient. To calculate maximum ripple capability with the CLS attached to a heatsink use the maximum core temperature of 105°C, the tabulated values of θ_{CHS} in lieu of θcc, and substitute the heatsink thermal resistance for the case to ambient thermal resistance θca.

Example

As an illustration, suppose you operate an insulated CLS792M063EB1C in 65°C air and attach it to a commercial heatsink with a free-air thermal resistance of 1.0°C/W for one side. Using a good thermal grease between the CLS and the heatsink, and the total thermal resistance is 1.0 + 2.4 or 3.4ºC/W. The CLS is allowed to operate at up to 105°C, which would be a 40°C rise from 65°C, exceeding the recommended 30°C maximum heat rise. The power which would heat the core by 30°C is 30/3.4 = 8.82 W. For an ESR of 45 mΩ @ 120Hz, 8.82 W equates to a ripple current of 14.00 Arms. In addition, the user should ensure that the peak-to-peak capacitor voltage divided by the capacitor's rated voltage V_R not exceed the greater of 10% or 0.01352 × (VDC Rated / 1[VDC])$^{1/2}$. The Vpp limit for this capacitor at 120Hz is thereby calculated as 6.76 volts, while the planned 14 amps rms at 120Hz will result in a peak-to-peak voltage of 6.65 volts, just within the AC voltage limit.

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Part Numbering System

HV	HR	CLS/CLSR	100	M	200	JK	0	A
Optional	Optional	Type	Capacitance	Tolerance	Rated Voltage	Case Code	Insulation	Mounting Style
High Vibration*	**High Reliability**	**CLS:** Copper wire with 60/40 tin/lead electroplate, 20 amps max **CLSR:** Copper wire with lead free, brite tin electroplate, 20 amps max	**100** =10 µF **101** = 100 µF **272** = 2700 µF	**M=**±20%	**200** = 200 Vdc	**See chart below**	**0** = bare can **1** = polyester	**A**= mounting tabs* **C**=straight leads/ no tabs **D**=hook leads/ tabs* **E**=hook leads/ no tabs

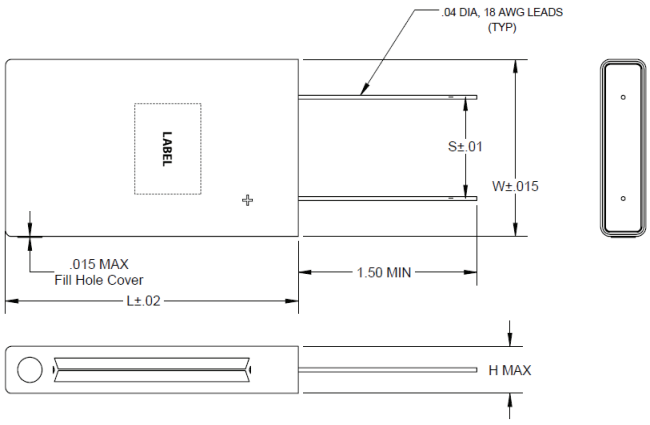
Case Codes

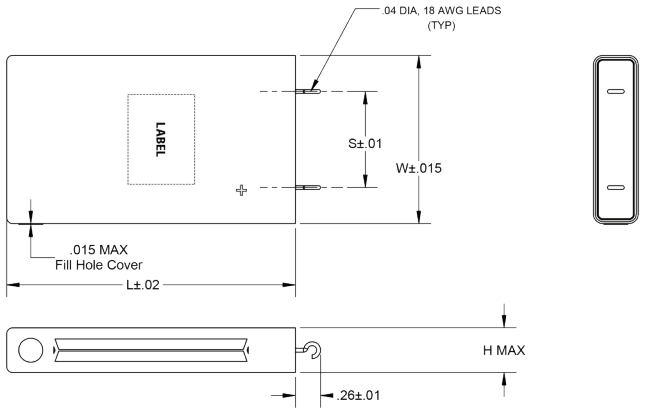
Case Code	"W"	"H"	"L"	"S"
JK	1.00	0.50	1.50	0.50
JA	1.00	0.50	2.00	0.50
JH	1.00	0.50	2.50	0.50
JB	1.00	0.50	3.00	0.50

Case Code	"W"	"H"	"L"	"S"
EK	1.75	0.50	1.50	1.00
EA	1.75	0.50	2.00	1.00
EH	1.75	0.50	2.50	1.00
EB	1.75	0.50	3.00	1.00

Outline Drawings

Note: The polyester tape wrap may add up to 0.020 inches to the thickness and width of the capacitor.





Type CLS – Flatpack™, 10,000 hr@105ºC

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Ratings

Voltage Vdc	Cap µF	P/N	120Hz 25°C (mΩ) ESR Max	20KHz 25°C (mΩ) ESR Max	105°C Arms 120Hz	105°C Arms 20KHz	Case			Surge Vdc
							H (in)	W (in)	L (in)	
10	19000	CLS193M010JK1C	76	68	2.74	3.05	0.5	1	1.5	12.5
10	28000	CLS283M010JA1C	53	46	3.64	4.04	0.5	1	2	12.5
10	32000	CLS323M010EK1C	53	47	4.02	4.47	0.5	1.75	1.5	12.5
10	39000	CLS393M010JH1C	39	34	4.55	5.06	0.5	1	2.5	12.5
10	48000	CLS483M010EA1C	37	33	5.35	5.95	0.5	1.75	2	12.5
10	49000	CLS493M010JB1C	31	28	5.41	6.02	0.5	1	3	12.5
10	65000	CLS653M010EH1C	28	25	6.62	7.36	0.5	1.75	2.5	12.5
10	83000	CLS833M010EB1C	23	20	7.80	8.67	0.5	1.75	3	12.5
25	6200	CLS622M025JK1C	82	72	2.65	2.95	0.5	1	1.5	30
25	9100	CLS912M025JA1C	56	50	3.51	3.91	0.5	1	2	30
25	10000	CLS103M025EK1C	57	50	3.90	4.33	0.5	1.75	1.5	30
25	12000	CLS123M025JH1C	42	37	4.39	4.88	0.5	1	2.5	30
25	15000	CLS153M025JB1C	34	30	5.22	5.81	0.5	1	3	30
25	15000	CLS153M025EA1C	39	35	5.20	5.78	0.5	1.75	2	30
25	20000	CLS203M025EH1C	30	26	6.43	7.14	0.5	1.75	2.5	30
25	26000	CLS263M025EB1C	24	21	7.59	8.43	0.5	1.75	3	30
40	4000	CLS402M040JK1C	82	72	2.65	2.95	0.5	1	1.5	48
40	5900	CLS592M040JA1C	56	50	3.51	3.91	0.5	1	2	48
40	6700	CLS672M040EK1C	58	51	3.87	4.30	0.5	1.75	1.5	48
40	8100	CLS812M040JH1C	42	37	4.40	4.89	0.5	1	2.5	48
40	9900	CLS992M040EA1C	40	35	5.15	5.73	0.5	1.75	2	48
40	10000	CLS103M040JB1C	33	30	5.23	5.81	0.5	1	3	48
40	13000	CLS133M040EH1C	30	27	6.37	7.08	0.5	1.75	2.5	48
40	17000	CLS173M040EB1C	25	22	7.53	8.36	0.5	1.75	3	48
50	2600	CLS262M050JK1C	93	82	2.49	2.76	0.5	1	1.5	60
50	4100	CLS412M050JA1C	61	54	3.37	3.74	0.5	1	2	60
50	4400	CLS442M050EK1C	63	56	3.69	4.10	0.5	1.75	1.5	60
50	5600	CLS562M050JH1C	45	40	4.22	4.68	0.5	1	2.5	60
50	6700	CLS672M050EA1C	43	38	4.97	5.52	0.5	1.75	2	60
50	6800	CLS682M050JB1C	38	33	4.94	5.48	0.5	1	3	60
50	9100	CLS912M050EH1C	33	29	6.16	6.84	0.5	1.75	2.5	60
50	11000	CLS113M050EB1C	27	24	7.24	8.05	0.5	1.75	3	60

Type CLS – Flatpack™, 10,000 hr@105ºC

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Ratings

Voltage Vdc	Cap µF	P/N	120Hz 25°C (mΩ) ESR Max	20KHz 25°C (mΩ) ESR Max	105°C Arms 120Hz	105°C Arms 20KHz	Case			Surge Vdc
							H (in)	W (in)	L (in)	
63	1900	CLS192M063JK1C	157	126	1.77	2.20	0.5	1	1.5	75
63	2800	CLS282M063JA1C	107	86	2.36	2.93	0.5	1	2	75
63	3100	CLS312M063EK1C	109	88	2.60	3.23	0.5	1.75	1.5	75
63	3800	CLS382M063JH1C	79	64	2.96	3.68	0.5	1	2.5	75
63	4600	CLS462M063EA1C	75	61	3.49	4.33	0.5	1.75	2	75
63	4900	CLS492M063JB1C	63	50	3.54	4.40	0.5	1	3	75
63	6300	CLS632M063EH1C	56	45	4.35	5.40	0.5	1.75	2.5	75
63	7900	CLS792M063EB1C	45	36	5.16	6.41	0.5	1.75	3	75
100	670	CLS671M100JK1C	367	230	1.10	1.72	0.5	1	1.5	125
100	990	CLS991M100JA1C	249	157	1.46	2.30	0.5	1	2	125
100	990	CLS991M100EK1C	261	164	1.59	2.50	0.5	1.75	1.5	125
100	1300	CLS132M100JH1C	185	116	1.83	2.88	0.5	1	2.5	125
100	1400	CLS142M100EA1C	179	113	2.14	3.35	0.5	1.75	2	125
100	1700	CLS172M100JB1C	145	91	2.20	3.45	0.5	1	3	125
100	1900	CLS192M100EH1C	133	83	2.67	4.20	0.5	1.75	2.5	125
100	2500	CLS252M100EB1C	105	66	3.20	5.03	0.5	1.75	3	125
200	290	CLS291M200JK1C	483	303	0.96	1.50	0.5	1	1.5	250
200	430	CLS431M200JA1C	328	206	1.27	2.00	0.5	1	2	250
200	460	CLS461M200EK1C	318	200	1.44	2.26	0.5	1.75	1.5	250
200	590	CLS591M200JH1C	240	151	1.61	2.52	0.5	1	2.5	250
200	680	CLS681M200EA1C	217	136	1.94	3.05	0.5	1.75	2	250
200	750	CLS751M200JB1C	190	119	1.92	3.02	0.5	1	3	250
200	930	CLS931M200EH1C	160	100	2.44	3.83	0.5	1.75	2.5	250
200	1100	CLS112M200EB1C	130	82	2.88	4.52	0.5	1.75	3	250
250	200	CLS201M250JK1C	776	448	0.84	1.38	0.5	1	1.5	300
250	290	CLS291M250JA1C	530	306	1.12	1.84	0.5	1	2	300
250	330	CLS331M250EK1C	484	279	1.30	2.14	0.5	1.75	1.5	300
250	400	CLS401M250JH1C	387	224	1.41	2.32	0.5	1	2.5	300
250	480	CLS481M250EA1C	331	191	1.75	2.88	0.5	1.75	2	300
250	510	CLS511M250JB1C	306	177	1.69	2.78	0.5	1	3	300
250	660	CLS661M250EH1C	243	140	2.20	3.62	0.5	1.75	2.5	300
250	840	CLS841M250EB1C	189	109	2.65	4.37	0.5	1.75	3	300

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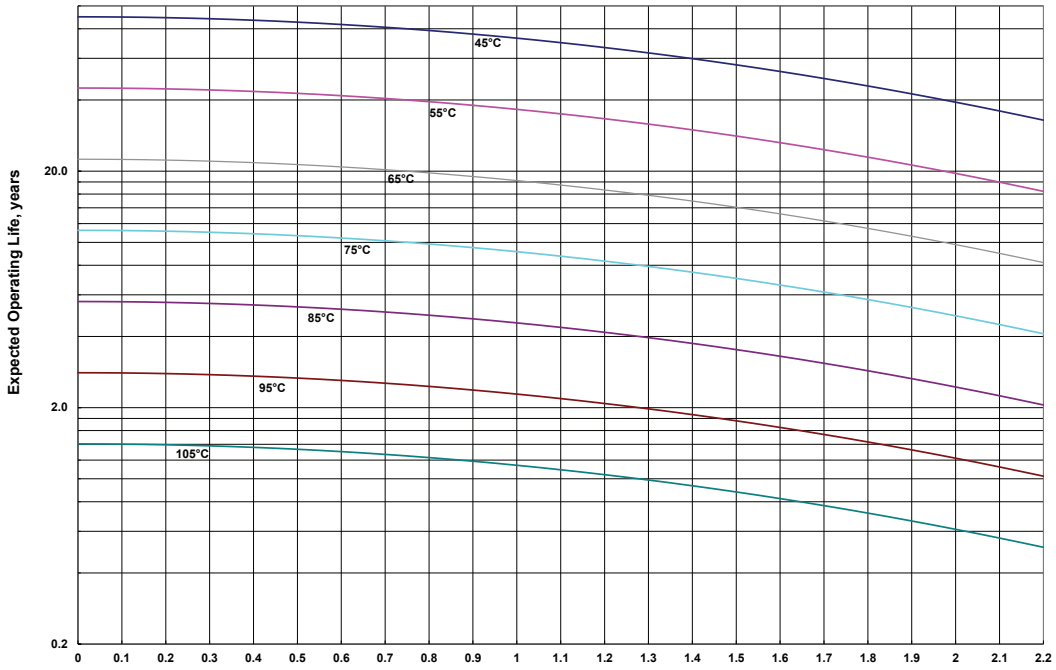
Low-Profile Aluminum Electrolytic

Ratings

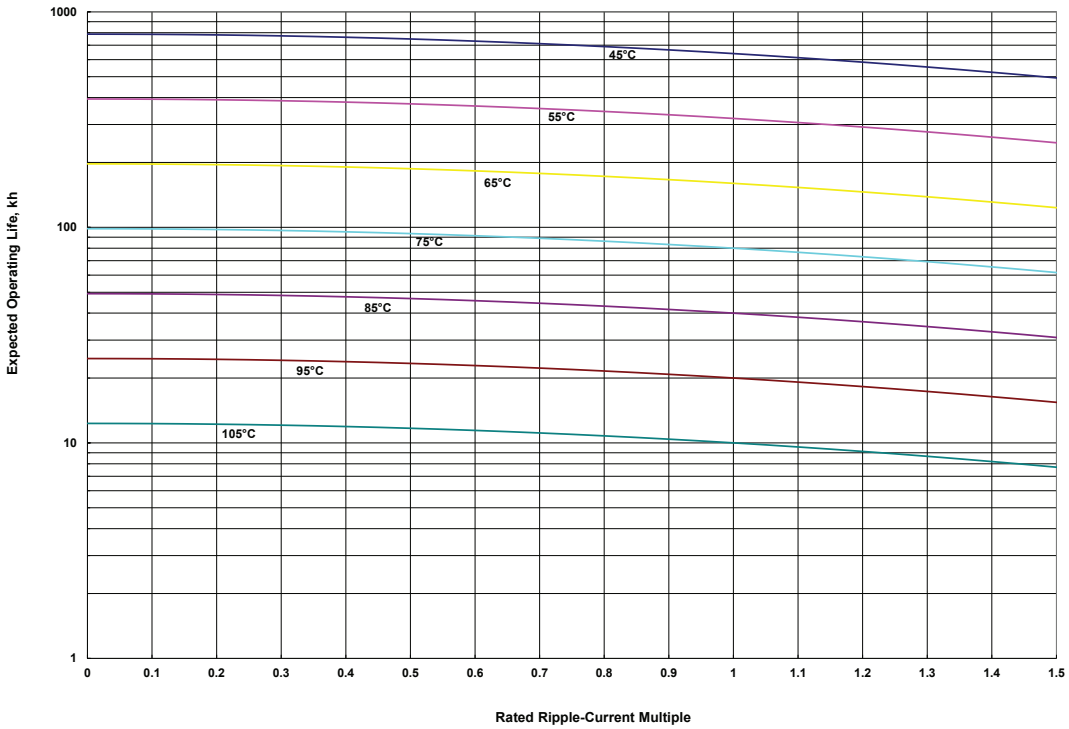
Voltage Vdc	Cap µF	P/N	120Hz 25°C (mΩ) ESR Max	20KHz 25°C (mΩ) ESR Max	105°C Arms 120Hz	105°C Arms 20KHz	Case			Surge Vdc
							H (in)	W (in)	L (in)	
300	150	CLS151M300JK1C	859	496	0.80	1.31	0.5	1	1.5	350
300	230	CLS231M300JA1C	575	332	1.07	1.77	0.5	1	2	350
300	250	CLS251M300EK1C	532	307	1.24	2.04	0.5	1.75	1.5	350
300	310	CLS311M300JH1C	424	245	1.35	2.22	0.5	1	2.5	350
300	370	CLS371M300EA1C	362	209	1.67	2.76	0.5	1.75	2	350
300	390	CLS391M300JB1C	336	194	1.61	2.65	0.5	1	3	350
300	510	CLS511M300EH1C	265	153	2.11	3.47	0.5	1.75	2.5	350
300	640	CLS641M300EB1C	210	122	2.51	4.14	0.5	1.75	3	350

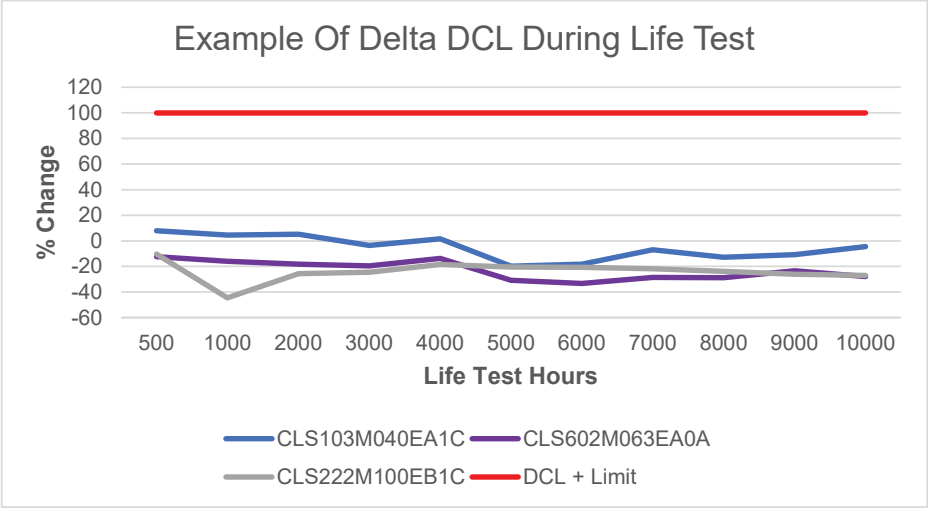
Typical Performance Curves

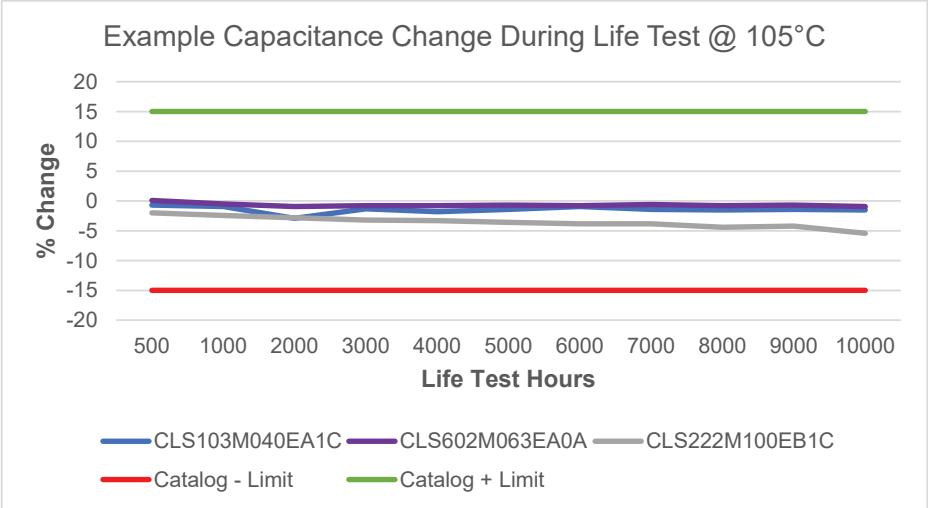
Type CLS Operating Life in Years vs Ripple Current

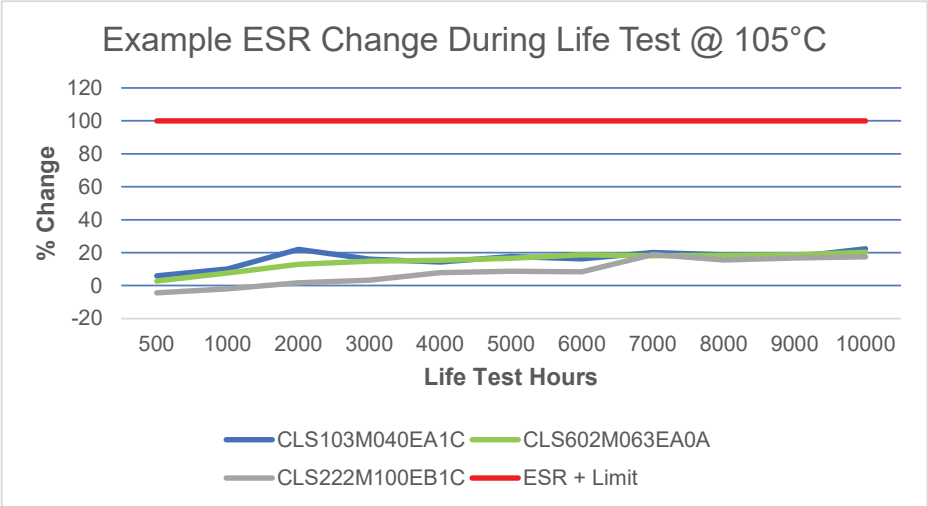


Type CLS Operating Life in Kilohours vs Ripple Current




Example Of Delta DCL During Life Test
% Change
120
100
80
60
40
20
0
-20
-40
-60
500 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Life Test Hours
CLS103M040EA1C
CLS602M063EA0A
CLS222M100EB1C
DCL + Limit


Example Capacitance Change During Life Test @ 105°C
% Change
20
15
10
5
0
-5
-10
-15
-20
500 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Life Test Hours
CLS103M040EA1C
CLS602M063EA0A
CLS222M100EB1C
Catalog - Limit
Catalog + Limit


Example ESR Change During Life Test @ 105°C
% Change
120
100
80
60
40
20
0
-20
500 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Life Test Hours
CLS103M040EA1C
CLS602M063EA0A
CLS222M100EB1C
ESR + Limit

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