Wet Tantalum Capacitors, Extended Capacitance, Military Established Reliability Military MIL-PRF-M39006/33 Qualified, Style CLR93



FEATURES

- Hermetically sealed
- Tantalum cased
- Axial lead
- Tubular

LINKS TO ADDITIONAL RESOURCES

3D Models

PERFORMANCE CHARACTERISTICS

Operating Temperature: -55 °C to +85 °C (to +125 °C with voltage derating)

Capacitance Range: 15 µF to 680 µF

Capacitance Tolerance: ± 10 %, ± 20 %

Voltage Rating: 50 V_{DC} to 100 V_{DC}

STYLE, MILITARY SPECIFICATION SHEET

Style CLR93, M39006/33 MIL-PRF-39006/33

DESCRIPTION

Established reliability tantalum capacitors to military specification MIL-PRF-39006: In accordance with the military specification MIL-PRF-39006 all capacitors are marked with the military part number (M39006/xx-xxxx) rather than the older style designation (CLR93) and should be ordered as such.

For information on the performance characteristics of these capacitors, please refer to the latest issue of the military specification. MIL-PRF-39006 establishes 1000 h failure rate levels of 1 %, 0.1 %, and 0.01 %. When ordering these parts, care must be exercised that the correct part number expressing the appropriate failure level be specified.

Each order for military style capacitors requiring government inspection must state whether inspection is to be at the destination or at the Vishay plant. Orders requiring source inspection cannot be shipped until this has been accomplished.

ORDERING INFORMATION

M39006	/33	-0030	H
BASIC DOCUMENT NUMBER	SLASH SHEET	DASH NUMBER	DESIGNATION OF HIGH VIBRATION (OPTIONAL)
Indicates the basic specification; in this case MIL-PRF-39006	Indicates the specification sheet of the basic military specification	Taken from Standard Ratings table	H, optional, if specified

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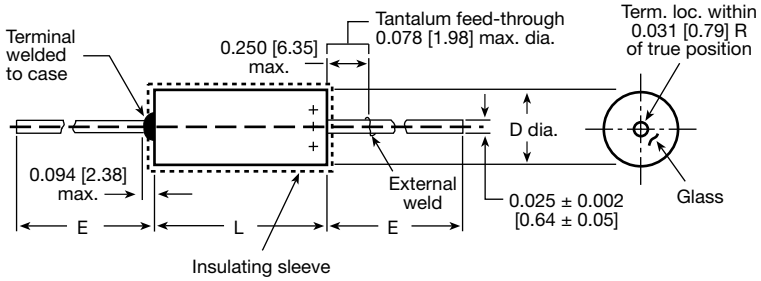
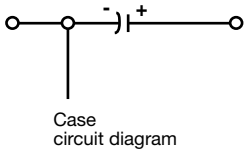
DIMENSIONS in inches [millimeters]

Style CLR93





CASE CODE	BARE CASE		WITH INSULATING SLEEVE		E LEAD LENGTH	WEIGHT (oz./g) (Max.)
	D	L	D (MAX.)	L (1)		
T1	0.188 ± 0.016 [4.78 ± 0.41]	0.453 + 0.031 / - 0.016 [11.51 + 0.79 / - 0.41]	0.219 [5.56]	0.565 [14.35]	1.500 ± 0.250 [38.10 ± 6.35]	0.10 [2.6]
T2	0.281 ± 0.016 [7.14 ± 0.41]	0.641 + 0.031 / - 0.016 [16.28 + 0.79 / - 0.41]	0.312 [7.92]	0.785 [19.94]	2.250 ± 0.250 [57.15 ± 6.35]	0.24 [6.2]
T3	0.375 ± 0.016 [9.52 ± 0.41]	0.766 + 0.031 / - 0.016 [19.46 + 0.79 / - 0.41]	0.406 [10.31]	0.95 [24.13]	2.250 ± 0.250 [57.15 ± 6.35]	0.46 [11.6]
T4	0.375 ± 0.016 [9.52 ± 0.41]	1.062 + 0.031/- 0.016 [26.97 + 0.79/- 0.41]	0.406 [10.31]	1.31 [33.27]	2.250 ± 0.250 [57.15 ± 6.35]	0.62 [17.7]

Note

(1) Typical length, for reference only

RATINGS AND CASE CODES

µF	50 V	60 V	75 V	100 V
15				T1
33			T1	
47		T1		
68	T1			T2
110			T2	
150		T2		T3
220	T2			T4
330			T3	
390		T3		
470	T3		T4	
560		T4		
680	T4			

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STANDARD RATINGS - CLR93, M39006/33-XXXX

CAPACITANCE (µF)	CASE CODE	CAP. TOL. (± %)	PART NO. M39006/33- FAILURE RATE LEVEL (%/1000 h) M 1.0	P 0.1	R 0.01	MAX. DCL (µA) AT +25 °C	MAX. DCL (µA) AT +85 °C +125 °C	MAX. DF AT 25 °C (%)	MAX. ESR AT +25 °C 120 Hz (Ω)	MAX. IMP. AT -55 °C (Ω)	MAX. CAPACITANCE CHANGE (%) AT -55 °C	+85 °C	+125 °C	MAX. [1] RIPPLE CURRENT AT +85 °C 40 kHz (mA)
50 V_{DC} AT +85 °C; 30 V_{DC} AT +125 °C														
68	T1	20	0021			1	5	9.2	1.5	35	-25	8	15	1050
68	T1	10	0022			1	5	9.2	1.5	35	-25	8	15	1050
220	T2	20	0023			2	10	17.9	0.9	17.5	-50	8	15	1800
220	T2	10	0024			2	10	17.9	0.9	17.5	-50	8	15	1800
470	T3	20	0027			3	25	31.9	0.75	10	-50	8	15	2100
470	T3	10	0028			3	25	31.9	0.75	10	-50	8	15	2100
680	T4	20	0029			5	40	43.1	0.7	10	-58	10	20	2750
680	T4	10	0030			5	40	43.1	0.7	10	-58	10	20	2750
60 V_{DC} AT +85 °C; 40 V_{DC} AT +125 °C														
47	T1	20	0031			1	5	8.5	2.0	44	-25	8	12	1050
47	T1	10	0032			1	5	8.5	2.0	44	-25	8	12	1050
150	T2	20	0033			2	10	14.9	1.1	20	-40	8	15	1650
150	T2	10	0034			2	10	14.9	1.1	20	-40	8	15	1650
390	T3	20	0037			3	25	31.8	0.9	15	-60	8	15	2100
390	T3	10	0038			3	25	31.8	0.9	15	-60	8	15	2100
560	T4	20	0039			5	40	40.5	0.8	10	-58	8	15	2750
560	T4	10	0040			5	40	40.5	0.8	10	-58	8	15	2750
75 V_{DC} AT +85 °C; 50 V_{DC} AT +125 °C														
33	T1	20	0041			1	5	7.5	2.5	66	-25	5	9	1050
33	T1	10	0042			1	5	7.5	2.5	66	-25	5	9	1050
110	T2	20	0043			2	10	12.9	1.3	24	-35	6	10	1650
110	T2	10	0044			2	10	12.9	1.3	24	-35	6	10	1650
330	T3	20	0047			3	30	29.9	1.0	12	-45	6	10	2100
330	T3	10	0048			3	30	29.9	1.0	12	-45	6	10	2100
470	T4	20	0049			5	50	38.3	0.9	12	-55	8	12	2750
470	T4	10	0050			5	50	38.3	0.9	12	-55	8	12	2750
100 V_{DC} AT +85 °C; 65 V_{DC} AT +125 °C														
15	T1	20	0051			1	5	4.8	3.5	125	-18	3	10	1050
15	T1	10	0052			1	5	4.8	3.5	125	-18	3	10	1050
68	T2	20	0053			2	10	12.9	2.1	37	-30	4	12	1650
68	T2	10	0054			2	10	12.9	2.1	37	-30	4	12	1650
150	T3	20	0057			3	25	21.7	1.6	22	-35	6	12	2100
150	T3	10	0058			3	25	21.7	1.6	22	-35	6	12	2100
220	T4	20	0059			5	50	23.9	1.2	15	-40	6	12	2750
220	T4	10	0060			5	50	23.9	1.2	15	-40	6	12	2750

Notes

- Dash number will include the letter “H” to indicate the optional vibration and shock requirements (i.e., 53.79 *g’s* random vibration, 80 *g’s* sinusoidal vibration, and 500 *g’s* shock)

[1] For ripple current limits at various temperatures, voltages, and frequencies, see “Ripple Current” table

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CLR93 RIPPLE CURRENT MULTIPLIERS VS. FREQUENCY, TEMPERATURE, AND APPLIED PEAK VOLTAGE

FREQUENCY OF APPLIED RIPPLE CURRENT		120 Hz				800 Hz				1 kHz				10 kHz				40 kHz				100 kHz			
AMBIENT STILL AIR		TEMP °C				TEMP °C				TEMP °C				TEMP °C				TEMP °C				TEMP °C			
		≤ 55	85	105	125	≤ 55	85	105	125	≤ 55	85	105	125	≤ 55	85	105	125	≤ 55	85	105	125	≤ 55	85	105	125
% OF APPLIED VOLTAGE	100 %	0.60	0.39	-	-	0.71	0.43	-	-	0.72	0.46	-	-	0.88	0.55	-	-	1.0	0.63	-	-	1.1	0.69	-	-
	90 %	0.60	0.46	-	-	0.71	0.55	-	-	0.72	0.55	-	-	0.88	0.67	-	-	1.0	0.77	-	-	1.1	0.85	-	-
	80 %	0.60	0.52	0.35	-	0.71	0.62	0.42	-	0.72	0.62	0.42	-	0.88	0.76	0.52	-	1.0	0.87	0.59	-	1.1	0.96	0.65	-
	70 %	0.60	0.58	0.44	-	0.71	0.69	0.52	-	0.72	0.70	0.52	-	0.88	0.85	0.64	-	1.0	0.97	0.73	-	1.1	1.07	0.80	-
	66 2/3 %	0.60	0.60	0.46	0.27	0.71	0.71	0.55	0.32	0.72	0.72	0.55	0.32	0.88	0.88	0.68	0.40	1.0	1.0	0.77	0.45	1.1	1.1	0.85	0.50

Notes

1. At +125 °C the rated voltage of the capacitors decreases to 66 2/3 % of the +85 °C rated voltage
2. The peak of the applied AC ripple voltage plus the applied DC voltage must not exceed the DC voltage rating of the capacitor either forward or reverse
3. The ripple current listed represents a rating calculated using a maximum internal temperature rise (ΔT) of +50 °C at 40 kHz at + 85 °C ambient with a maximum peak rated voltage of 66 2/3 % of the +85 °C peak voltage rating
4. The maximum allowable internal temperature rise (ΔT) decreases linearly to a calculated +10 °C rise at +125 °C ambient
5. The internal temperature rise is directly proportional to the equivalent series resistance of the capacitor and equivalent series resistance increases with decreasing frequency

TYPICAL PERFORMANCE CHARACTERISTICS OF M39006/33 CAPACITORS

ELECTRICAL PERFORMANCE CHARACTERISTICS

ITEM	PERFORMANCE CHARACTERISTICS		
Operating temperature range	-55 °C to +85 °C (to +125 °C with voltage derating)		
Capacitance tolerance	± 20 %, ± 10 %, at 120 Hz, at +25 °C		
Capacitance change by temperature	Limit per Standard Ratings table		
ESR	Limit per Standard Ratings table, at +25 °C, 120 Hz		
Impedance	Limit per Standard Ratings table, at -55 °C, 120 Hz		
DCL (Leakage current)	Limit per Standard Ratings table		
AC ripple current	Limit per Standard Ratings table, at +85 °C and 40 kHz		
Reverse voltage	Not applicable		
Maximum operating voltage	Rated (+85 °C) V_{DC}	Derated (+125 °C) V_{DC}	Surge (+85 °C) V_{DC}
	50	30	57.5
	60	40	69.0
	75	50	86.2
	100	65	115.0
Surge voltage	The DC surge voltage is the maximum voltage to which the capacitor can be subjected under any conditions including transients and peak ripple at the highest line voltage. The DC surge voltage is 115 % of rated DC voltage		

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PERFORMANCE CHARACTERISTICS		
ITEM	**CONDITION**	**POST TEST PERFORMANCE**
Surge voltage	85 °C 1000 successive test cycles at the applicable DC surge voltage specified in series with a 1 kΩ resistor at the rate of 30 s ON, 5.5 min OFF	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed the specified value Capacitance change — Within +5 %, -20 % of initial measurement Dissipation factor — Not to exceed the specified value There shall be no evidence of mechanical damage or leakage of electrolyte
Life testing	Method 108 of MIL-STD-202. Capacitors shall be capable of withstanding a 10 000 h life test at a temperature +85 °C at rated voltage	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage at 85 °C and 125 °C — Not to exceed 125 % of the specified value DC leakage at 25 °C — Not to exceed the specified value Capacitance change — Within +10 %, -20 % of initial measurement Dissipation factor — Not to exceed 200 % of the specified value Dielectric withstanding voltage — 2000 V_{DC}, min. Insulation resistance — 100 MΩ, min.
AC ripple life	As specified in MIL-PRF-39006: 2000 h, +85 °C	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed the specified value Capacitance change — Within ± 10 % of initial measurement Dissipation factor — Not to exceed the specified value There shall be no damage, obliteration of marking, or leakage of electrolyte

ENVIRONMENTAL CHARACTERISTICS		
ITEM	**CONDITION**	**POST TEST PERFORMANCE**
Stability at low and high temperatures	As specified in MIL-PRF-39006	The capacitors shall meet the requirements of MIL-PRF-39006
Moisture resistance	Method 106 of MIL-STD-202	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed 125 % of +25 °C specified value Capacitance change — Within ± 8 % of initial measurement Dissipation factor — Not to exceed 115 % of the specified value
Thermal shock	Method 107 of MIL-STD-202, condition A (with step 3 at +125 °C) Number of cycles: 300 cycles for qualification and group C, subgroup 7; 30 cycles for group B and group C, subgroup 8	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed 200 % of +25 °C specified value for qualification and group C DC leakage — Not to exceed 125 % of +25 °C specified value for group B Capacitance change — Within ± 5 % of initial measurement Dissipation factor — Not to exceed 115 % of the specified value
Salt atmosphere (corrosion)	Method 101 of MIL-STD-202, condition B (48 h)	There shall be no harmful corrosion, and the finish shall protect at least 90 % of any exposed metal surface of the capacitor. There shall be no unwrapping of, or mechanical damage to, the insulating sleeving, when applicable. Marking shall remain legible
Low temperature storage	Method 502 of MIL-STD-810, Storage temperature: -62 °C +0 °C, -3 °C. Exposure time: 72 h followed by a 1 h exposure at +125 °C, +7 °C, -0 °C within 24 h after low temperature storage	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed the specified value Capacitance change — Within ± 5 % of initial measurement Dissipation factor — Not to exceed the specified value There shall be no evidence of leakage of electrolyte
Seal	Method 112 of MIL-STD-202, conditions A or D, and C	When the capacitors are tested as specified in MIL-PRF-39006, there shall be no evidence of leakage.
Barometric pressure (reduced)	Method 105 of MIL-STD-202, condition E (150 000 ft) (45 720.1 m)	There shall be no flashover, breakdown, or harmful deformation of the case, and mechanical damage, obliteration of marking, or leakage of electrolyte.

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MECHANICAL PERFORMANCE CHARACTERISTICS		
ITEM	**CONDITION**	**POST TEST PERFORMANCE**
Shock (specified pulse)	Method 213 of MIL-STD-202, condition I (100 *g's*) or condition D (500 *g's*) for "H" designated units	The capacitors shall meet the requirements of MIL-PRF-39006
Vibration, high frequency	Method 204 of MIL-STD-202, condition D (20 *g's*) or condition H (80 *g's*) for "H" designated units	The capacitors shall meet the requirements of MIL-PRF-39006
Random vibration ("H" designated units only)	Method 214 of MIL-STD-202, condition II-K (53.79 *g's*).	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed 125 % of the specified value Capacitance change — Within ± 5 % of initial measurement Dissipation factor — Not to exceed 115 % of the specified value There shall be no evidence of harmful corrosion, mechanical damage, obliteration of marking, or leakage of electrolyte.
Solderability	Method 208 of MIL-STD-202	The capacitors shall meet the requirements of MIL-PRF-39006
Terminal strength	Pull test: method 211 of MIL-STD-202, condition A. Wire-lead bend: in accordance with MIL-PRF-39006	There shall be no loosening of or permanent damage to the terminals, terminal weld or solder, or seal.
Dielectric withstanding voltage	Method 301 of MIL-STD-202, 2000 V_{DC} min.	The capacitors shall meet the requirements of MIL-PRF-39006
Insulation resistance	Method 302 of MIL-STD-202, condition B (500 V_{DC} ± 10 %)	The insulation resistance shall be not less than 100 MΩ
Resistance to solvent	Method 215 of MIL-STD-202	There shall be no mechanical or visual damage to capacitors post-conditioning. Marking shall remain legible, no degradation of the can material.
Resistance to soldering heat	Method 210 of MIL-STD-202, condition C	The capacitors shall meet the requirements of MIL-PRF-39006: DC leakage — Not to exceed the specified value Capacitance change — Within ± 5 % of initial measurement Dissipation factor — Not to exceed the specified value There shall be no evidence of mechanical damage

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