

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



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}

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

STYLE, MILITARY SPECIFICATION SHEET

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

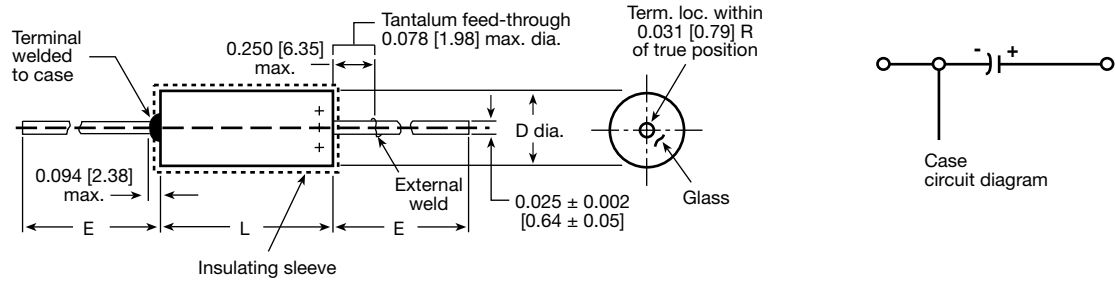
rate levels of 1 %, 0.1 %, and 0.01 %. When ordering these parts, care must be exercised that the correct part number expressing the appropriate failure level be specified.

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 |

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 | | | |



| STANDARD RATINGS - CLR93, M39006/33-XXXX | | | | | | | | | | | | | | |
|---|--------------|----------------------------|---|-----|------|---------------------------|-------------------|----------------------------------|---|--|-----------------------------------|--------|---------|--|
| CAPACITANCE (μ F) | CASE CODE | CAP. TOL. (\pm %) | PART NO. M39006/33- FAILURE RATE LEVEL (%/1000 h) | | | MAX. DCL (μ A) AT | | MAX. DF AT 25 °C (%) | MAX. ESR AT +25 °C 120 Hz (Ω) | MAX. IMP. AT -55 °C (Ω) | MAX. CAPACITANCE CHANGE (%) AT | | | MAX. (1) RIPPLE CURRENT AT +85 °C 40 kHz (mA) |
| | | | M | P | R | +25 °C | +85 °C +125 °C | | | | -55 °C | +85 °C | +125 °C | |
| | | | 1.0 | 0.1 | 0.01 | | | | | | | | | |
| 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



| 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 | | | | | | | |
| | | ≤ 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 | | |



| 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. |



| 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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