

CA45L SERIES

LOW ESR CHIP TANTALUM CAPACITOR

CHIP TANTALUM CAPACITOR ▲ SMD type
 High surge grade MnO₂
 Meets or exceeds EIA Standard 535BAAC
 Laser marked epoxy case
 Moisture Sensitivity Level ▲ MSL 3
Low ESR and high ripple current capability

SPECIFICATION

| Item | Characteristics ^{Note 1} | | | | |
|---|--------------------------------------|--|--------|-------|--------|
| Related Documents | EIA 535BAAC ▲ QC300801 ▲ Q/YHC 45-01 | | | | |
| Rated Temperature Range ^{Note 2} | -55°C to +125°C | | | | |
| Capacitance Range | C _R | 0.1μF to 1000μF | | | |
| Capacitance Tolerance | ΔC | ±10% ▲ ±20% | | | |
| Rated Voltage Range | V _R | 2.5V _{DC} to 50V _{DC} | | | |
| Dissipation Factor | tan δ | -55°C < 1.5 x (+25°C value) | | | |
| | | +25°C 6% to 30% (Refer to individual items) | | | |
| | | +85°C < 1.5 x (+25°C value) | | | |
| | | +125°C < 1.5 x (+25°C value) | | | |
| Leakage Current ^{Note 3} | I _{LEAK} | Less than 0.01 x C _R x V _R or 0.5μA (whichever is greater) | | | |
| Rated Voltage ≤ 85°C | V _R | 2.5V 4V 6.3V 10V 16V 20V 25V 35V 50V | | | |
| Derated Voltage > 85°C to ≤ 125°C | V _C | 1.7V 2.5V 4V 6.3V 10V 13V 16V 23V 33V | | | |
| Surge Voltage ≤ 85°C | V _{S_85} | 3.2V 5V 8V 13V 20V 26V 32V 46V 60V | | | |
| Derated Surge Voltage > 85°C to ≤ 125°C | V _{S_125} | 2.2V 3.4V 5V 8V 12V 16V 20V 26V 38V | | | |
| Case Sizes | Size | Code | Length | Width | Height |
| | 2012 | P | 2.0mm | 1.2mm | 1.2mm |
| | 3216 | A | 3.2mm | 1.6mm | 1.6mm |
| | 3528 | B | 3.5mm | 2.8mm | 1.9mm |
| | 6032 | C | 6.0mm | 3.2mm | 2.5mm |
| | 7343 | D | 7.3mm | 4.3mm | 2.8mm |
| 7343 | E | 7.3mm | 4.3mm | 4.0mm | |

Notes:

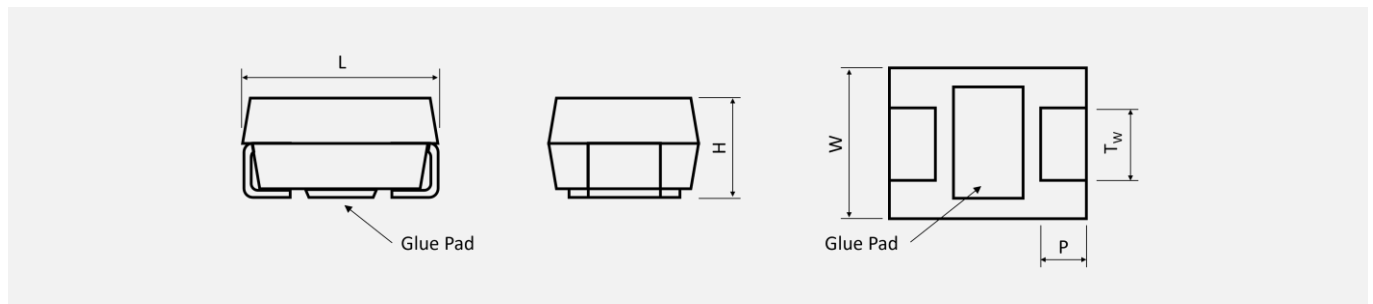
- All technical data measured at 25°C
- Above 85°C voltage derating is required
- The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.

APPLICATIONS

| Consumer Electronics | DC/DC Converter | Filter Circuits | Telecom Infrastructure |
|----------------------|-----------------|-----------------|------------------------|
| | | | |

PACKAGE OUTLINE AND CASE DIMENSIONS

| Case Code | EIA/IECQ Size | L (mm) | W (mm) | H (mm) | P (mm) | Tw (mm) |
|-----------|---------------|-----------|-----------|-----------|-----------|-----------|
| P | 2012 | 2.0 ± 0.2 | 1.2 ± 0.2 | 1.2 ± 0.2 | 0.5 ± 0.3 | 1.2 ± 0.1 |
| A | 3216 | 3.2 ± 0.2 | 1.6 ± 0.2 | 1.6 ± 0.2 | 0.8 ± 0.3 | 1.2 ± 0.1 |
| B | 3528 | 3.5 ± 0.2 | 2.8 ± 0.2 | 1.9 ± 0.2 | 0.8 ± 0.3 | 2.2 ± 0.1 |
| C | 6032 | 6.0 ± 0.3 | 3.2 ± 0.3 | 2.5 ± 0.3 | 1.3 ± 0.3 | 2.2 ± 0.1 |
| D | 7343 | 7.3 ± 0.3 | 4.3 ± 0.3 | 2.8 ± 0.3 | 1.3 ± 0.3 | 2.4 ± 0.1 |
| E | 7343 | 7.3 ± 0.3 | 4.3 ± 0.3 | 4.0 ± 0.3 | 1.3 ± 0.3 | 2.4 ± 0.1 |


CAPACITOR RATINGS AND CASE CODES

| C _R (μF) | Capacitance Code | Rated Voltage V _R at 85°C (V) | | | | | | | | |
|------------------------|---------------------|--|-------|---------|---------|-------|-------|-------|-------|-----|
| | | 2.5 | 4 | 6.3 | 10 | 16 | 20 | 25 | 35 | 50 |
| 0.10 | 104 | | | | | | P | | A | A |
| 0.15 | 154 | | | | | | P | | A | A/B |
| 0.22 | 224 | | | | | | P | | A | A/B |
| 0.33 | 334 | | | | | | P | A | A | B |
| 0.47 | 474 | | | | | P | P | A | A/B | B/C |
| 0.68 | 684 | | | | | P | P/A | A | A/B | B/C |
| 1.0 | 105 | | | | P | P/A | P/A | A/B | A/B | B/C |
| 1.5 | 155 | | | | P/A | P/A | P/A/B | A/B | A/B/C | C/D |
| 2.2 | 225 | | P | P/A | P/A/B | P/A/B | A/B | A/B/C | B/C | C/D |
| 3.3 | 335 | | P/A | P/A | P/A/B | A/B | A/B/C | A/B/C | B/C | D |
| 4.7 | 475 | | P/A | P/A | P/A/B | A/B | A/B/C | B/C | B/C/D | D |
| 6.8 | 685 | | P/A | P/A/B | P/A/B | A/B/C | B/C | B/C/D | C/D | D |
| 10 | 106 | | P/A/B | P/A/B | P/A/B/C | A/B/C | B/C/D | C/D | C/D | D |
| 15 | 156 | | A/B | A/B/C | A/B/C | B/C | B/C/D | C/D | D | |
| 22 | 226 | | A/B/C | A/B/C | A/B/C | B/C/D | B/C/D | C/D | D | |
| 33 | 336 | A | A/B/C | A/B/C | A/B/C/D | B/C/D | C/D | D | | |
| 47 | 476 | A | A/B/C | A/B/C/D | B/C/D | C/D | D | D | | |
| 68 | 686 | A | B/C/D | B/C/D | B/C/D | C/D | D | | | |
| 100 | 107 | B | B/C/D | B/C/D | C/D | D | D | | | |
| 150 | 157 | B | B/C/D | C/D | D | D | | | | |
| 220 | 227 | B/C/D | C/D | C/D | D | | | | | |
| 330 | 337 | C/D | D | D | | | | | | |
| 470 | 477 | D | D | D | | | | | | |
| 680 | 687 | D | D | | | | | | | |
| 1000 | 108 | D | | | | | | | | |

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|--|------------------------|-----------|--|---|--|-----------------------------------|-------|----------------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 2.5V _{DC} (at 85°C) ▲ 1.7V _{DC} (at 125°C) | 33 | A | 0.8 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L336□002AT |
| | 47 | A | 1.2 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L476□002AT |
| | 68 | A | 1.7 | 6 | 0.7 | 0.327 | 0.295 | 0.131 | CA45L686□002AT |
| | 100 | B | 2.5 | 8 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L107□002BT |
| | 150 | B | 3.8 | 8 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L157□002BT |
| | 220 | B | 5.5 | 8 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L227□002BT |
| | 220 | C | 5.5 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L227□002CT |
| | 220 | D | 5.5 | 8 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L227□002DT |
| | 330 | C | 8.3 | 12 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L337□002CT |
| | 330 | D | 8.3 | 12 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L337□002DT |
| | 470 | D | 11.8 | 12 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L477□002DT |
| | 680 | D | 117 | 14 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L687□002DT |
| 1000 | D | 25 | 14 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L108□002DT | |
| 4V _{DC} (at 85°C) ▲ 2.5V _{DC} (at 125°C) | 2.2 | P | 0.5 | 6 | 7 | 0.09 | 0.087 | 0.039 | CA45L225□004PT |
| | 3.3 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L335□004PT |
| | 3.3 | A | 0.5 | 6 | 2.5 | 0.173 | 0.156 | 0.069 | CA45L335□004AT |
| | 4.7 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L475□004PT |
| | 4.7 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L475□004AT |
| | 6.8 | P | 0.5 | 6 | 5 | 0.114 | 0.103 | 0.046 | CA45L685□004PT |
| | 6.8 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L685□004AT |
| | 10 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L106□004PT |
| | 10 | A | 0.5 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L106□004AT |
| | 10 | B | 0.5 | 6 | 1 | 0.292 | 0.262 | 0.117 | CA45L106□004BT |
| | 15 | A | 0.6 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L156□004AT |
| | 15 | B | 0.6 | 6 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L156□004BT |
| | 22 | A | 0.9 | 6 | 0.9 | 0.289 | 0.260 | 0.115 | CA45L226□004AT |
| | 22 | B | 0.9 | 6 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L226□004BT |
| | 22 | C | 0.9 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L226□004CT |
| | 33 | A | 1.3 | 6 | 3 | 0.158 | 0.142 | 0.063 | CA45L336□004AT |
| | 33 | B | 1.3 | 6 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L336□004BT |
| | 33 | C | 1.3 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L336□004CT |
| | 47 | A | 1.9 | 6 | 0.8 | 0.306 | 0.276 | 0.122 | CA45L476□004AT |
| | 47 | B | 1.9 | 6 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L476□004BT |
| | 47 | C | 1.9 | 6 | 0.25 | 0.663 | 0.597 | 0.265 | CA45L476□004CT |
| | 68 | B | 2.7 | 6 | 2 | 0.206 | 0.186 | 0.082 | CA45L686□004BT |
| | 68 | C | 2.7 | 6 | 0.25 | 0.663 | 0.597 | 0.265 | CA45L686□004CT |
| | 68 | D | 2.7 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L686□004DT |
| | 100 | B | 4 | 8 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L107□004BT |
| | 100 | C | 4 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L107□004CT |
| | 100 | D | 4 | 8 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L107□004DT |
| 150 | B | 6 | 8 | 0.4 | 0.461 | 0.415 | 0.184 | CA45L157□004BT | |
| 150 | C | 6 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L157□004CT | |
| 150 | D | 6 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L157□004DT | |

- Note:** 1 All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.
- 2 □ : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|--|------------------------|-----------|--|---|--|-----------------------------------|-------|----------------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 4V _{DC} (at 85°C) ▲ 2.5V _{DC} (at 125°C) | 220 | C | 8.8 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L227□004CT |
| | 220 | D | 8.8 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L227□004DT |
| | 330 | D | 13.2 | 12 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L337□004DT |
| | 470 | D | 18.8 | 12 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L477□004DT |
| | 680 | D | 27.2 | 14 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L687□004DT |
| 6.3V _{DC} (at 85°C) ▲ 4V _{DC} (at 125°C) | 2.2 | P | 0.5 | 6 | 7 | 0.096 | 0.087 | 0.039 | CA45L225□006PT |
| | 2.2 | A | 0.5 | 6 | 2.5 | 0.173 | 0.156 | 0.069 | CA45L225□006AT |
| | 3.3 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L335□006PT |
| | 3.3 | A | 0.5 | 6 | 2.5 | 0.173 | 0.156 | 0.069 | CA45L335□006AT |
| | 4.7 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L475□006PT |
| | 4.7 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L475□006AT |
| | 6.8 | P | 0.5 | 6 | 5 | 0.114 | 0.103 | 0.046 | CA45L685□006PT |
| | 6.8 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L685□006AT |
| | 6.8 | B | 0.5 | 6 | 1.2 | 0.266 | 0.240 | 0.106 | CA45L685□006BT |
| | 10 | P | 0.6 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L106□006PT |
| | 10 | A | 0.6 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L106□006AT |
| | 10 | B | 0.6 | 6 | 1 | 0.292 | 0.262 | 0.117 | CA45L106□006BT |
| | 15 | A | 0.9 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L156□006AT |
| | 15 | B | 0.9 | 6 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L156□006BT |
| | 15 | C | 0.9 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L156□006CT |
| | 22 | A | 1.4 | 6 | 0.9 | 0.289 | 0.260 | 0.115 | CA45L226□006AT |
| | 22 | B | 1.4 | 6 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L226□006BT |
| | 22 | C | 1.4 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L226□006CT |
| | 33 | A | 2.1 | 8 | 0.8 | 0.306 | 0.276 | 0.122 | CA45L336□006AT |
| | 33 | B | 2.1 | 6 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L336□006BT |
| | 33 | C | 2.1 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L336□006CT |
| | 47 | A | 3 | 8 | 0.8 | 0.306 | 0.276 | 0.122 | CA45L476□006AT |
| | 47 | B | 3 | 6 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L476□006BT |
| | 47 | C | 3 | 6 | 0.25 | 0.663 | 0.597 | 0.265 | CA45L476□006CT |
| | 47 | D | 3 | 6 | 0.25 | 0.775 | 0.697 | 0.310 | CA45L476□006DT |
| | 68 | B | 4.3 | 6 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L686□006BT |
| | 68 | C | 4.3 | 6 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L686□006CT |
| | 68 | D | 4.3 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L686□006DT |
| | 100 | B | 6.3 | 8 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L107□006BT |
| | 100 | C | 6.3 | 8 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L107□006CT |
| | 100 | D | 6.3 | 8 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L107□006DT |
| | 150 | C | 9.5 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L157□006CT |
| 150 | D | 9.5 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L157□006DT | |
| 220 | C | 13.9 | 8 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L227□006CT | |
| 220 | D | 13.9 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L227□006DT | |
| 470 | D | 29.6 | 12 | 0.1 | 0.866 | 0.779 | 0.346 | CA45L477□006DT | |

- Note:** 1 All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.
- 2 □ : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|---|------------------------|-----------|--|---|--|-----------------------------------|-------|----------------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 10V _{DC} (at 85°C) ▲ 6.3V _{DC} (at 125°C) | 1 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L105□010PT |
| | 1.5 | P | 0.5 | 6 | 9 | 0.085 | 0.076 | 0.034 | CA45L155□010PT |
| | 1.5 | A | 0.5 | 6 | 6 | 0.112 | 0.101 | 0.045 | CA45L155□010AT |
| | 2.2 | P | 0.5 | 6 | 9 | 0.085 | 0.076 | 0.034 | CA45L225□010PT |
| | 2.2 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L225□010AT |
| | 2.2 | B | 0.5 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L225□010BT |
| | 3.3 | P | 0.5 | 6 | 7 | 0.096 | 0.087 | 0.039 | CA45L335□010PT |
| | 3.3 | A | 0.5 | 6 | 4 | 0.137 | 0.123 | 0.055 | CA45L335□010AT |
| | 3.3 | B | 0.5 | 6 | 2 | 0.206 | 0.186 | 0.082 | CA45L335□010BT |
| | 4.7 | P | 0.5 | 6 | 3 | 0.147 | 0.132 | 0.059 | CA45L475□010PT |
| | 4.7 | A | 0.5 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L475□010AT |
| | 4.7 | B | 0.5 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L475□010BT |
| | 6.8 | A | 0.7 | 6 | 1.8 | 0.204 | 0.184 | 0.082 | CA45L685□010AT |
| | 6.8 | B | 0.7 | 6 | 1.2 | 0.266 | 0.240 | 0.106 | CA45L685□010BT |
| | 10 | P | 1 | 6 | 2 | 0.180 | 0.162 | 0.072 | CA45L106□010PT |
| | 10 | A | 1 | 6 | 1.8 | 0.204 | 0.184 | 0.082 | CA45L106□010AT |
| | 10 | B | 1 | 6 | 0.8 | 0.326 | 0.293 | 0.130 | CA45L106□010BT |
| | 10 | C | 1 | 6 | 0.8 | 0.371 | 0.334 | 0.148 | CA45L106□010CT |
| | 15 | A | 1.5 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L156□010AT |
| | 15 | B | 1.5 | 6 | 0.7 | 0.348 | 0.214 | 0.139 | CA45L156□010BT |
| | 15 | C | 1.5 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L156□010CT |
| | 22 | A | 2.2 | 8 | 0.9 | 0.289 | 0.260 | 0.115 | CA45L226□010AT |
| | 22 | B | 2.2 | 6 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L226□010BT |
| | 22 | C | 2.2 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L226□010CT |
| | 33 | A | 3.3 | 6 | 0.7 | 0.327 | 0.295 | 0.131 | CA45L336□010AT |
| | 33 | B | 3.3 | 6 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L336□010BT |
| | 33 | C | 3.3 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L336□010CT |
| | 33 | D | 3.3 | 6 | 0.25 | 0.775 | 0.697 | 0.310 | CA45L336□010DT |
| 47 | B | 4.7 | 8 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L476□010BT | |
| 47 | C | 4.7 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L476□010CT | |
| 47 | D | 4.7 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L476□010DT | |
| 68 | B | 6.8 | 6 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L686□010BT | |
| 68 | C | 6.8 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L686□010CT | |
| 68 | D | 6.8 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L686□010DT | |
| 100 | C | 10 | 8 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L107□010CT | |
| 100 | D | 10 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L107□010DT | |
| 150 | D | 15 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L157□010DT | |
| 220 | D | 22 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L227□010DT | |
| 16V _{DC} (at 85°C) ▲ 10V _{DC} (at 125°C) | 0.47 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L474□016PT |
| | 0.68 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L684□016PT |
| | 1 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L105□016PT |
| | 1 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L105□016AT |
| | 1.5 | P | 0.5 | 6 | 4 | 0.127 | 0.115 | 0.051 | CA45L155□016PT |
| | 1.5 | A | 0.5 | 6 | 4 | 0.137 | 0.123 | 0.055 | CA45L155□016AT |
| | 2.2 | P | 0.5 | 6 | 7 | 0.096 | 0.087 | 0.039 | CA45L225□016PT |
| | 2.2 | A | 0.5 | 6 | 3 | 0.158 | 0.142 | 0.063 | CA45L225□016AT |
| | 2.2 | B | 0.5 | 6 | 2 | 0.206 | 0.186 | 0.082 | CA45L225□016BT |

- Note:** 1 All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.
- 2 □ : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|--|------------------------|-----------|--|---|--|-----------------------------------|-------|----------------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 16V _{DC} (at 85°C) ▲ 10V _{DC} (at 125°C) | 3.3 | A | 0.5 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L335□016AT |
| | 3.3 | B | 0.5 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L335□016BT |
| | 4.7 | A | 0.8 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L475□016AT |
| | 4.7 | B | 0.8 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L475□016BT |
| | 6.8 | A | 1.1 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L685□016AT |
| | 6.8 | B | 1.1 | 6 | 1.2 | 0.266 | 0.240 | 0.106 | CA45L685□016BT |
| | 6.8 | C | 1.1 | 6 | 0.8 | 0.371 | 0.334 | 0.148 | CA45L685□016CT |
| | 10 | A | 1.6 | 8 | 3 | 0.158 | 0.142 | 0.063 | CA45L106□016AT |
| | 10 | B | 1.6 | 6 | 0.8 | 0.326 | 0.293 | 0.130 | CA45L106□016BT |
| | 10 | C | 1.6 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L106□016CT |
| | 15 | B | 2.4 | 6 | 0.8 | 0.326 | 0.293 | 0.130 | CA45L156□016BT |
| | 15 | C | 2.4 | 6 | 0.4 | 0.524 | 0.472 | 0.210 | CA45L156□016CT |
| | 22 | B | 3.5 | 8 | 0.6 | 0.376 | 0.339 | 0.151 | CA45L226□016BT |
| | 22 | C | 3.5 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L226□016CT |
| | 22 | D | 3.5 | 6 | 0.25 | 0.775 | 0.697 | 0.310 | CA45L226□016DT |
| | 33 | C | 5.3 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L336□016CT |
| | 33 | D | 5.3 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L336□016DT |
| | 47 | C | 7.5 | 6 | 0.4 | 0.524 | 0.472 | 0.210 | CA45L476□016CT |
| 47 | D | 7.5 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L476□016DT | |
| 68 | C | 10.9 | 6 | 0.2 | 0.742 | 0.667 | 0.297 | CA45L686□016CT | |
| 68 | D | 10.9 | 6 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L686□016DT | |
| 100 | D | 16 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L107□016DT | |
| 150 | D | 24 | 8 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L157□016DT | |
| 20V _{DC} (at 85°C) ▲ 13V _{DC} (at 125°C) | 0.1 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L104□020PT |
| | 0.15 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L154□020PT |
| | 0.22 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L224□020PT |
| | 0.33 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L334□020PT |
| | 0.47 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L474□020PT |
| | 0.68 | P | 0.5 | 4 | 9 | 0.085 | 0.076 | 0.034 | CA45L684□020PT |
| | 0.68 | A | 0.5 | 4 | 8 | 0.097 | 0.087 | 0.039 | CA45L684□020AT |
| | 1 | P | 0.5 | 4 | 6 | 0.104 | 0.094 | 0.042 | CA45L105□020PT |
| | 1 | A | 0.5 | 4 | 3 | 0.158 | 0.142 | 0.063 | CA45L105□020AT |
| | 1.5 | P | 0.5 | 6 | 5 | 0.114 | 0.103 | 0.046 | CA45L155□020PT |
| | 1.5 | A | 0.5 | 6 | 4 | 0.137 | 0.123 | 0.055 | CA45L155□020AT |
| | 1.5 | B | 0.5 | 6 | 3 | 0.168 | 0.151 | 0.067 | CA45L155□020BT |
| | 2.2 | A | 0.5 | 6 | 3 | 0.158 | 0.142 | 0.063 | CA45L225□020AT |
| | 2.2 | B | 0.5 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L225□020BT |
| | 3.3 | A | 0.7 | 6 | 2.5 | 0.173 | 0.156 | 0.069 | CA45L335□020AT |
| | 3.3 | B | 0.7 | 6 | 1.2 | 0.266 | 0.240 | 0.106 | CA45L335□020BT |
| | 3.3 | C | 0.7 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L335□020CT |
| | 4.7 | A | 0.9 | 6 | 1.8 | 0.204 | 0.184 | 0.082 | CA45L475□020AT |
| | 4.7 | B | 0.9 | 6 | 1 | 0.292 | 0.262 | 0.117 | CA45L475□020BT |
| | 4.7 | C | 0.9 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L475□020CT |
| | 6.8 | B | 1.4 | 6 | 1 | 0.292 | 0.262 | 0.117 | CA45L685□020BT |
| 6.8 | C | 1.4 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L685□020CT | |

- Note:** 1 All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.
- 2 □ : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|--|------------------------|-----------|--|---|--|-----------------------------------|-------|--------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 20V _{DC} (at 85°C) ▲ 13V _{DC} (at 125°C) | 10 | B | 2 | 8 | 1 | 0.292 | 0.262 | 0.117 | CA45L106□020BT |
| | 10 | C | 2 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L106□020CT |
| | 10 | D | 2 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L106□020DT |
| | 15 | B | 3 | 6 | 0.5 | 0.412 | 0.371 | 0.165 | CA45L156□020BT |
| | 15 | C | 3 | 6 | 0.4 | 0.524 | 0.472 | 0.210 | CA45L156□020CT |
| | 15 | D | 3 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L156□020DT |
| | 22 | B | 4.4 | 8 | 0.4 | 0.461 | 0.415 | 0.184 | CA45L226□020BT |
| | 22 | C | 4.4 | 6 | 0.4 | 0.524 | 0.472 | 0.210 | CA45L226□020CT |
| | 22 | D | 4.4 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L226□020DT |
| | 33 | C | 6.6 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L336□020CT |
| | 33 | D | 6.6 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L336□020DT |
| | 47 | D | 9.4 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L476□020DT |
| | 68 | D | 13.6 | 6 | 0.2 | 0.866 | 0.779 | 0.346 | CA45L686□020DT |
| | 100 | D | 20 | 8 | 0.15 | 1.000 | 0.900 | 0.400 | CA45L107□020DT |
| 25V _{DC} (at 85°C) ▲ 16V _{DC} (at 125°C) | 0.33 | A | 0.5 | 4 | 9 | 0.091 | 0.082 | 0.037 | CA45L334□025AT |
| | 0.47 | A | 0.5 | 4 | 7 | 0.104 | 0.093 | 0.041 | CA45L474□025AT |
| | 0.68 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L684□025AT |
| | 1 | A | 0.5 | 4 | 4 | 0.137 | 0.123 | 0.055 | CA45L105□025AT |
| | 1 | B | 0.5 | 6 | 2 | 0.206 | 0.186 | 0.082 | CA45L105□025BT |
| | 1.5 | A | 0.5 | 6 | 3 | 0.158 | 0.142 | 0.063 | CA45L155□025AT |
| | 1.5 | B | 0.5 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L155□025BT |
| | 2.2 | A | 0.6 | 6 | 2 | 0.194 | 0.174 | 0.077 | CA45L225□025AT |
| | 2.2 | B | 0.6 | 6 | 0.9 | 0.307 | 0.277 | 0.123 | CA45L225□025BT |
| | 2.2 | C | 0.6 | 6 | 1.2 | 0.303 | 0.272 | 0.121 | CA45L225□025CT |
| | 3.3 | A | 0.8 | 6 | 1.5 | 0.224 | 0.201 | 0.089 | CA45L335□025AT |
| | 3.3 | B | 0.8 | 6 | 1.5 | 0.238 | 0.214 | 0.095 | CA45L335□025BT |
| | 3.3 | C | 0.8 | 6 | 1.2 | 0.303 | 0.272 | 0.121 | CA45L335□025CT |
| | 4.7 | B | 1.2 | 6 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L475□025BT |
| | 4.7 | C | 1.2 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L475□025CT |
| | 4.7 | C | 1.2 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L475□025CT |
| | 6.8 | B | 1.7 | 6 | 0.7 | 0.348 | 0.314 | 0.139 | CA45L685□025BT |
| | 6.8 | C | 1.7 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L685□025CT |
| | 6.8 | D | 1.7 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L685□025DT |
| | 10 | C | 2.5 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L106□025CT |
| | 10 | D | 2.5 | 6 | 0.4 | 0.612 | 0.551 | 0.245 | CA45L106□025DT |
| | 15 | C | 3.8 | 6 | 0.3 | 0.606 | 0.545 | 0.242 | CA45L156□025CT |
| | 15 | D | 3.8 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L156□025DT |
| | 22 | C | 5.5 | 6 | 0.4 | 0.524 | 0.472 | 0.210 | CA45L226□025CT |
| | 22 | D | 5.5 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L226□025DT |
| | 33 | D | 8.3 | 6 | 0.3 | 0.707 | 0.363 | 0.283 | CA45L336□025DT |
| | 47 | D | 11.8 | 6 | 0.25 | 0.775 | 0.697 | 0.310 | CA45L476□025DT |

- Note: 1 All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C, 125°C with voltage derating.
- 2 □ : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

ELECTRICAL CHARACTERISTICS

| V _R | C _R (μF) | Case Code | Max. I _{LEAK} (μA) <small>Note 1</small> | Max. tan δ (%) <small>Note 1</small> | Max. ESR at 100kHz (Ω) <small>Note 1</small> | Max. I _R at 100kHz (A) | | | Part Number <small>Note 2</small> |
|--|------------------------|-----------|--|---|--|-----------------------------------|-------|----------------|-----------------------------------|
| | | | | | | +25°C | +85°C | +125°C | |
| 35V _{DC} (at 85°C) ▲ 23V _{DC} (at 125°C) | 0.1 | A | 0.5 | 4 | 9 | 0.091 | 0.082 | 0.037 | CA45L104□035AT |
| | 0.15 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L154□035AT |
| | 0.22 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L224□035AT |
| | 0.33 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L334□035AT |
| | 0.47 | A | 0.5 | 4 | 4 | 0.137 | 0.123 | 0.055 | CA45L474□035AT |
| | 0.47 | B | 0.5 | 4 | 2.5 | 0.184 | 0.166 | 0.074 | CA45L474□035BT |
| | 0.68 | A | 0.5 | 4 | 6 | 0.112 | 0.101 | 0.045 | CA45L684□035AT |
| | 0.68 | B | 0.5 | 4 | 2.5 | 0.184 | 0.166 | 0.074 | CA45L684□035BT |
| | 1 | A | 0.5 | 4 | 3 | 0.158 | 0.142 | 0.063 | CA45L105□035AT |
| | 1 | B | 0.5 | 4 | 2 | 0.206 | 0.186 | 0.082 | CA45L105□035BT |
| | 1.5 | A | 0.5 | 6 | 3 | 0.158 | 0.142 | 0.063 | CA45L155□035AT |
| | 1.5 | B | 0.5 | 6 | 2.5 | 0.184 | 0.166 | 0.074 | CA45L155□035BT |
| | 1.5 | C | 0.5 | 6 | 2 | 0.235 | 0.211 | 0.094 | CA45L155□035CT |
| | 2.2 | B | 0.8 | 6 | 2 | 0.206 | 0.186 | 0.082 | CA45L225□035BT |
| | 2.2 | C | 0.8 | 6 | 1 | 0.332 | 0.298 | 0.133 | CA45L225□035CT |
| | 3.3 | B | 1.2 | 6 | 1 | 0.292 | 0.262 | 0.117 | CA45L335□035BT |
| | 3.3 | C | 1.2 | 6 | 0.7 | 0.396 | 0.357 | 0.159 | CA45L335□035CT |
| | 4.7 | B | 1.6 | 6 | 0.1 | 0.206 | 0.186 | 0.082 | CA45L475□035BT |
| | 4.7 | C | 1.6 | 6 | 0.6 | 0.428 | 0.385 | 0.171 | CA45L475□035CT |
| | 4.7 | D | 1.6 | 6 | 0.7 | 0.463 | 0.417 | 0.185 | CA45L475□035DT |
| 6.8 | C | 2.4 | 6 | 0.5 | 0.469 | 0.422 | 0.188 | CA45L685□035CT | |
| 6.8 | D | 2.4 | 6 | 0.5 | 0.548 | 0.493 | 0.219 | CA45L685□035DT | |
| 10 | C | 3.5 | 6 | 1.2 | 0.303 | 0.272 | 0.121 | CA45L106□035CT | |
| 10 | D | 3.5 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L106□035DT | |
| 15 | D | 5.3 | 6 | 0.3 | 0.707 | 0.636 | 0.283 | CA45L156□035DT | |
| 22 | D | 7.7 | 6 | 0.4 | 0.612 | 0.551 | 0.245 | CA45L226□035DT | |
| 50V _{DC} (at 85°C) ▲ 35V _{DC} (at 125°C) | 0.1 | A | 0.5 | 4 | 9 | 0.091 | 0.082 | 0.037 | CA45L104□050AT |
| | 0.15 | A | 0.5 | 4 | 9 | 0.091 | 0.082 | 0.037 | CA45L154□050AT |
| | 0.15 | B | 0.5 | 4 | 9 | 0.097 | 0.087 | 0.039 | CA45L154□050BT |
| | 0.22 | A | 0.5 | 4 | 7 | 0.104 | 0.093 | 0.041 | CA45L224□050AT |
| | 0.22 | B | 0.5 | 4 | 7 | 0.110 | 0.099 | 0.044 | CA45L224□050BT |
| | 0.33 | B | 0.5 | 4 | 2.5 | 0.184 | 0.166 | 0.074 | CA45L334□050BT |
| | 0.47 | B | 0.5 | 4 | 2 | 0.206 | 0.186 | 0.082 | CA45L474□050BT |
| | 0.47 | C | 0.5 | 4 | 1.8 | 0.247 | 0.222 | 0.099 | CA45L474□050CT |
| | 0.68 | B | 0.5 | 4 | 3 | 0.168 | 0.151 | 0.067 | CA45L684□050BT |
| | 0.68 | C | 0.5 | 4 | 1.6 | 0.262 | 0.236 | 0.105 | CA45L684□050CT |
| | 1 | B | 0.5 | 4 | 4 | 0.146 | 0.131 | 0.058 | CA45L105□050BT |
| | 1 | C | 0.5 | 4 | 1.6 | 0.262 | 0.236 | 0.105 | CA45L105□050CT |
| | 1.5 | C | 0.8 | 6 | 2 | 0.235 | 0.211 | 0.094 | CA45L155□050CT |
| | 1.5 | D | 0.8 | 6 | 1 | 0.387 | 0.349 | 0.155 | CA45L155□050DT |
| | 2.2 | C | 1.1 | 6 | 1.5 | 0.271 | 0.244 | 0.108 | CA45L225□050CT |
| | 2.2 | D | 1.1 | 6 | 1.2 | 0.354 | 0.318 | 0.141 | CA45L225□050DT |
| | 3.3 | D | 1.7 | 6 | 0.8 | 0.433 | 0.390 | 0.173 | CA45L335□050DT |
| | 4.7 | D | 2.4 | 6 | 0.7 | 0.463 | 0.417 | 0.185 | CA45L475□050DT |
| | 6.8 | D | 3.4 | 6 | 0.6 | 0.500 | 0.450 | 0.200 | CA45L685□050DT |
| | 10 | D | 5 | 6 | 0.5 | 0.548 | 0.493 | 0.219 | CA45L106□050DT |

- Note:**
- All technical data measured at 25°C. Capacitance and loss test conditions: V = 1.7 to 2.2V, V_{partial} = 0 to 1V (RMS), Measurement frequency: 100 (120)Hz. The leakage current should be measured after 5 minutes application of rated voltage at 85°C. 125°C with voltage derating.
 - : Enter the appropriate capacitance tolerance code. K for ±10 or M for ±20%.

PRODUCT MARKING

| Marking | | | Details | |
|---------------------|---------------------|--------------------|----------------|--|
| P-CASE | A-CASE | B / C / D / E-CASE | No. | Description |
| | | | 1 | Polarity (+) Anode side |
| | | | 2 | Rated voltage (Code or voltage value) |
| | | | 3 | Capacitance (Code) |
| 16V ▲ 0.47μF | 35V ▲ 0.47μF | 16V ▲ 47μF | Example | |

RATED VOLTAGE CODE MARKING ▲ P-CASE AND A-CASE

| Code | E | G | J | A | C | D | E | V | T |
|--------------------------------|------|----|------|-----|-----|-----|-----|-----|-----|
| Rated Voltage V_R at 85°C | 2.5V | 4V | 6.3V | 10V | 16V | 20V | 25V | 35V | 50V |

CAPACITANCE CODE MARKING ▲ P-CASE

| Code | <u>A</u> | <u>E</u> | <u>J</u> | <u>N</u> | s | W | A | E |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Capacitance | 0.1μF | 0.15μF | 0.22μF | 0.33μF | 0.47μF | 0.68μF | 1μF | 1.5μF |
| Code | J | N | S | W | <u>Ā</u> | <u>Ē</u> | <u>J</u> | <u>N</u> |
| Capacitance | 2.2μF | 3.3μF | 4.7μF | 6.8μF | 10μF | 15μF | 22μF | 33μF |

PRODUCT CODE

Example: CA45L series ▲ 10μF ▲ 16V_{DC} ▲ ±10% ▲ Case Code B = 3.5 x 2.8mm ▲ Tape and Reel

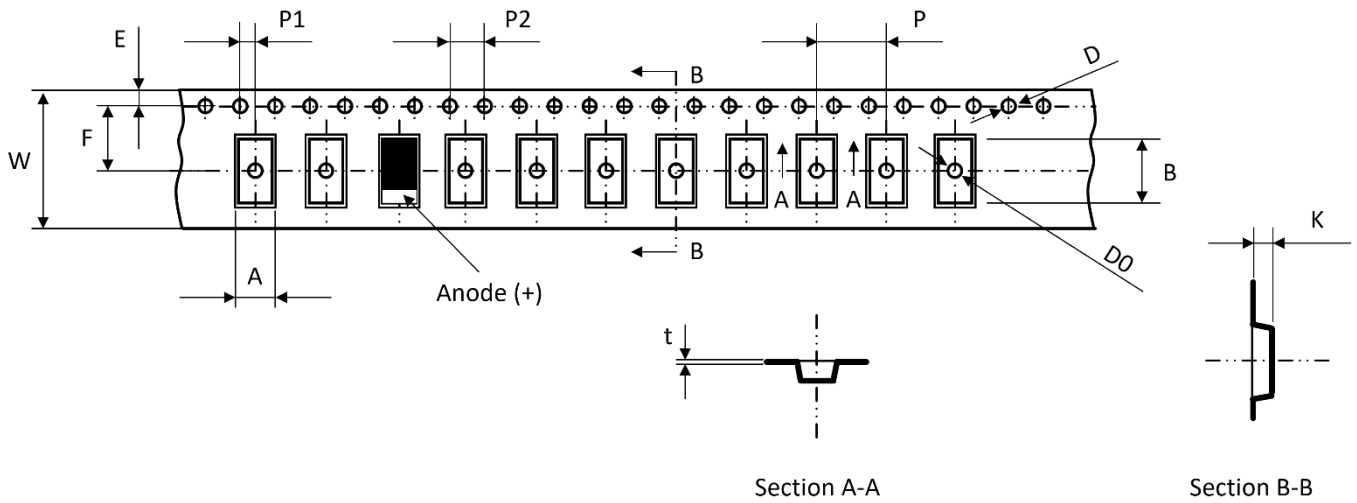
| CA45 | | 106 | | K | | 016 | | B | | T | |
|--------|--------|---|------|---------------------------|------|----------------------------------|-----|----------------------------|-----------|----------------|-------------|
| Series | | Capacitance Code ^{Note1} (pF) | | Capacitance Tolerance (%) | | Rated Voltage (V _{DC}) | | Case Code ^{Note2} | | Packaging Type | |
| Code | Series | Code | μF | Code | Tol. | Code | VDC | Code | Size | Code | Type |
| CA45L | CA45L | 104 | 0.1 | K | ±10 | 002 | 2.5 | P | 2.0 x 1.2 | T | Tape & Reel |
| | | 564 | 0.56 | M | ±20 | 004 | 4 | A | 3.2 x 1.6 | | |
| | | 225 | 2.2 | | | 006 | 6.3 | B | 3.5 x 2.8 | | |
| | | 686 | 68 | | | 010 | 10 | C | 6.0 x 3.2 | | |
| | | 337 | 330 | | | 016 | 16 | D | 7.3 x 4.3 | | |
| | | 108 | 1000 | | | 020 | 20 | E | 7.3 x 4.3 | | |
| | | | | | | 025 | 25 | | | | |
| | | | | | | 035 | 35 | | | | |
| | | | | 050 | 50 | | | | | | |

Note: 1 Capacitance code expressed in pF. The first two digits represent significant figures. The last digit specifies the total number of zeros to be added.

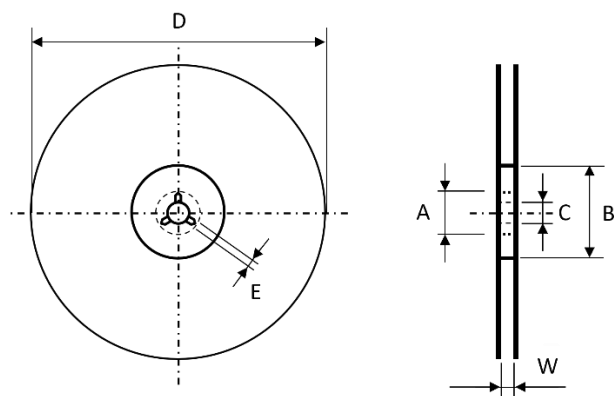
2 Size L x W in mm

TECHNICAL SPECIFICATION

| No. | Category | Specification | | | | | | | | | |
|------------|--------------------|---|---|--|-------|----------------------|------------------------|----------------------|----------------------|------------------------|--------|
| 1 | Scope | This specification applies to LOW ESR CHIP TANTALUM CAPACITORS for electronics applications. Reference standards: EIA 535BAAC ▲ QC300801 ▲ Q/YHC 45-01 | | | | | | | | | |
| 2 | Product Name | Molded low ESR chip tantalum capacitors, Type CA45L | | | | | | | | | |
| 3 | Testing Conditions | Room temperature | 25°C | | | | | | | | |
| | | Relative humidity | 60% to 70% | | | | | | | | |
| | | Air pressure | 800mbar to 1060mbar | | | | | | | | |
| 4 | Handling | It is mandatory to fully discharge capacitor to avoid failure test results. The product is a polarized component. It is prohibited to connect positive poles and negative poles reversely to avoid product performance failure. | | | | | | | | | |
| 5 | Checking List | Item | Characteristics | Testing Method | | | | | | | |
| | | Drawing and dimension | See package outline and case dimensions | Measured with gauge | | | | | | | |
| | | Appearance | Complete marking, clear, centered | Visual | | | | | | | |
| | | Leakage current (I_{LEAK}) | Less than 0.01·C·V or 0.5μA (whichever I greater) | Pressurize related voltage between two poles (Series connection with 1kΩ current limiting resistor). Read value. | | | | | | | |
| | | Capacitance tolerance (ΔC) | ± 10% (K); ± 20% (M) | Measurement frequency: 100 (120)Hz Voltage: 0.3 ± 0.02V | | | | | | | |
| | | Dissipation factor ($\tan \delta$) | See electrical characteristics of the individual item | Measurement frequency: 100 (120)Hz | | | | | | | |
| | | ESR | See electrical characteristics of the individual item | Measurement frequency: 100 (120)Hz | | | | | | | |
| | | Solderability | Soldering coverage rate ≥ 95% | Dip capacitor into flux for two seconds, then remove excessive amount of flux, dip capacitor into 245±3°C welding slot with 10mm depth for three seconds, withdraw capacitor, clean capacitor with proper amount of solution, use ten times the microscope to observe. | | | | | | | |
| | | Temperature performance | Capacitance (μF) | Change of Capacitance (ΔC) (%) | | | Max. $\tan \delta$ (%) | | | Max. I_{LEAK} (μA) | |
| | | | | | -55°C | +85°C | +125°C | -55°C | +25°C | +85°C | +125°C |
| ≤ 1.0 | -10 | | | +10 | +12 | < 1.5 x (25°C value) | See individual item | < 1.5 x (25°C value) | 10 · $I_{LEAK,25°C}$ | 12.5 · $I_{LEAK,25°C}$ | |
| 1.5 to 68 | | | | | | | | | | | |
| 100 to 220 | | | | | | | | | | | |
| 330 to 470 | | | | | | | | | | | |
| > 470 | | | | | | | | | | | |

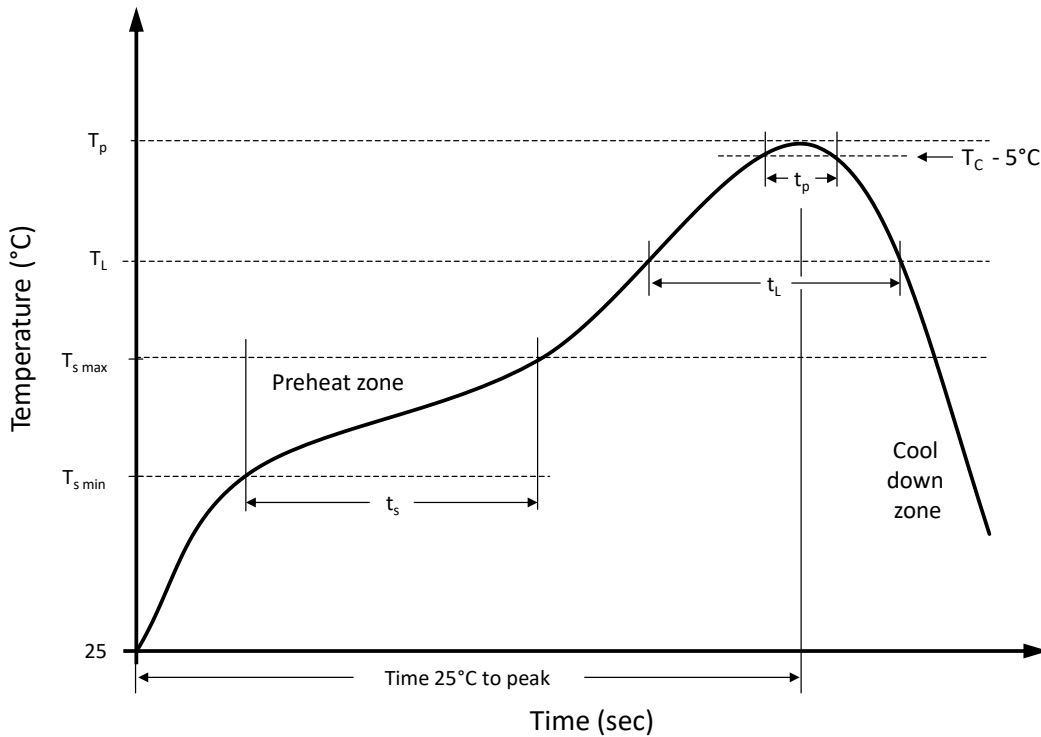
TAPE DIMENSIONS ▲ All dimensions in mm


| Case Code | W ± 0.3 | F ± 0.1 | E ± 0.1 | P ± 0.1 | P1 ± 0.1 | P2 ± 0.1 | D + 0.1 | D _{0MIN} | t ± 0.3 | A ± 0.2 | B ± 0.2 | K ± 0.2 |
|-----------|---------|---------|---------|---------|----------|----------|---------|-------------------|---------|---------|---------|---------|
| P | 8 | 3.5 | 1.75 | 4 | 2 | 4 | ∅1.5 | ∅1.0 | 0.2 | 1.4 | 2.2 | 1.2 |
| A | 8 | 3.5 | 1.75 | 4 | 2 | 4 | ∅1.5 | ∅1.0 | 0.2 | 1.9 | 3.5 | 1.9 |
| B | 8 | 3.5 | 1.75 | 4 | 2 | 4 | ∅1.5 | ∅1.0 | 0.3 | 3.3 | 3.8 | 2.1 |
| C | 12 | 5.5 | 1.75 | 8 | 2 | 4 | ∅1.5 | ∅1.5 | 0.3 | 3.7 | 6.4 | 3.0 |
| D | 12 | 5.5 | 1.75 | 8 | 2 | 4 | ∅1.5 | ∅1.5 | 0.3 | 4.8 | 7.7 | 3.3 |
| E | 12 | 5.5 | 1.75 | 8 | 2 | 4 | ∅1.5 | ∅1.5 | 0.3 | 4.8 | 7.7 | 4.1 |

REEL DIMENSIONS ▲ All dimensions in mm


| Case Code | A | B | C | D | E | W | QTY /Reel |
|-----------|----------|----|----|---------|---|-----------|-----------|
| P | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 8.4 + 1.5 | 3000 |
| A | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 8.4 + 1.5 | 2000 |
| B | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 8.4 + 1.5 | 2000 |
| C | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 12.4 + 2 | 500 |
| D | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 12.4 + 2 | 500 |
| E | 21 ± 0.5 | 50 | 13 | 178 ± 2 | 2 | 12.4 + 2 | 400 |

RECOMMENDED REFLOW SOLDERING PROFILE



Recommended reflow soldering conditions ▲ Refer to JEDEC J-STD-020E

| Profile Features | | Sn-Pb Eutetic Assembly | Pb-Free Assembly |
|--|--------------|------------------------|------------------|
| Preheat temperature min. | $T_{s \min}$ | 100 °C | 150 °C |
| Preheat temperature max. | $T_{s \max}$ | 150 °C | 200 °C |
| Preheat time t_s from $T_{s \min}$ to $T_{s \max}$ | t_s | 120 seconds | 120 seconds |
| Ramp-up rate (T_L to T_p) | | max. 3 °C/second | max. 3 °C/second |
| Liquidous temperature | T_L | 183 °C | 217 °C |
| Time t_L maintained above T_L | t_L | 150 seconds max. | 150 seconds max. |
| Peak package body temperature | T_p | 235°C | 260°C |
| Timeframe of within 5°C below and up to max actual peak body temperature | t_p | 20 seconds max. | 30 seconds max. |
| Ramp-down rate (T_L to T_p) | | max. 6 °C/second | max. 6 °C/second |
| Time 25°C to peak temperature | | max. 6 minutes | max. 8 minutes |

CORRECT USE OF CHIP TANTALUM CAPACITORS

| No. | Category | Specification | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|---|---|-----------|--|------|-------|-------|-------|---------------------------------------|-------|---|-------|---|-------|-------|--------|--------|------|------------------|------|------|------|------|---------|------|------|------|------|
| 1 | Ripple Current and Ripple Voltage | <p>If ripple current is applied, heat is generated within capacitor by Joule’s heat (power dissipation) and it may affect to reliability of the capacitor.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <p>Power dissipation</p> <p>The actual power dissipated in capacitor is calculated using the formula: $P = I^2 \cdot ESR$ Where: P: Power dissipation (W) I: Ripple current (A rms) ESR: Equivalent Series Resistance</p> <table border="1"> <thead> <tr> <th colspan="2">Table 1 ▲ Max. power dissipation</th> </tr> <tr> <th>Case code</th> <th>Max. power dissipation at 100kHz/25°C (W)</th> </tr> </thead> <tbody> <tr> <td>P</td> <td>0.025</td> </tr> <tr> <td>A</td> <td>0.075</td> </tr> <tr> <td>B</td> <td>0.085</td> </tr> <tr> <td>C</td> <td>0.110</td> </tr> <tr> <td>D</td> <td>0.150</td> </tr> <tr> <td>E</td> <td>0.150</td> </tr> </tbody> </table> | Table 1 ▲ Max. power dissipation | | Case code | Max. power dissipation at 100kHz/25°C (W) | P | 0.025 | A | 0.075 | B | 0.085 | C | 0.110 | D | 0.150 | E | 0.150 | | | | | | | | | | | | |
| | | Table 1 ▲ Max. power dissipation | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Case code | Max. power dissipation at 100kHz/25°C (W) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | P | 0.025 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | A | 0.075 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | B | 0.085 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | C | 0.110 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | D | 0.150 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | E | 0.150 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Ripple current</p> <p>Using P_{MAX} from Table 1, maximum ripple current (A rms) may be determined as follow: $I = \sqrt{\frac{P}{ESR}} \cdot K \cdot F$ Where: K: Temperature derating factor (Table 2) F: Frequency derating factor (Table 3) ESR: Refer to individual item ratings</p> <table border="1"> <thead> <tr> <th colspan="2">Table 2 ▲ Temperature derating factor K</th> </tr> <tr> <th>Temperature</th> <th>Temperature derating factor K</th> </tr> </thead> <tbody> <tr> <td>25°C</td> <td>1</td> </tr> <tr> <td>85°C</td> <td>0.9</td> </tr> <tr> <td>125°C</td> <td>0.4</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="5">Table 3 ▲ Frequency derating factor F</th> </tr> <tr> <th>Type</th> <th>10kHz</th> <th>100kHz</th> <th>500kHz</th> <th>1MHz</th> </tr> </thead> <tbody> <tr> <td>MnO₂</td> <td>0.80</td> <td>1.00</td> <td>1.15</td> <td>1.20</td> </tr> <tr> <td>Polymer</td> <td>0.75</td> <td>1.00</td> <td>1.10</td> <td>1.30</td> </tr> </tbody> </table> | Table 2 ▲ Temperature derating factor K | | Temperature | Temperature derating factor K | 25°C | 1 | 85°C | 0.9 | 125°C | 0.4 | Table 3 ▲ Frequency derating factor F | | | | | Type | 10kHz | 100kHz | 500kHz | 1MHz | MnO ₂ | 0.80 | 1.00 | 1.15 | 1.20 | Polymer | 0.75 | 1.00 | 1.10 | 1.30 |
| Table 2 ▲ Temperature derating factor K | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temperature | Temperature derating factor K | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25°C | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 85°C | 0.9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 125°C | 0.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Table 3 ▲ Frequency derating factor F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type | 10kHz | 100kHz | 500kHz | 1MHz | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MnO ₂ | 0.80 | 1.00 | 1.15 | 1.20 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Polymer | 0.75 | 1.00 | 1.10 | 1.30 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Ripple voltage</p> <p>Ripple voltage E is calculated using the formula $E = Z \cdot I$ Where: E: Ripple voltage Z: Impedance at specified frequency</p> <p>The ripple voltage that may be applied is limited by three criteria:</p> <table border="1"> <tbody> <tr> <td>[a]</td> <td>The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in table 1.</td> </tr> <tr> <td>[b]</td> <td>The sum of DC voltage and peak value of the ripple voltage must not exceed the rated voltage.</td> </tr> <tr> <td>[c]</td> <td>The negative peak value of the ripple voltage must not exceed the permissible reverse voltage value specified in the following section, Reverse Voltage.</td> </tr> </tbody> </table> | [a] | The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in table 1. | [b] | The sum of DC voltage and peak value of the ripple voltage must not exceed the rated voltage. | [c] | The negative peak value of the ripple voltage must not exceed the permissible reverse voltage value specified in the following section, Reverse Voltage. | | | | | | | | | | | | | | | | | | | | | | | | |
| [a] | The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in table 1. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [b] | The sum of DC voltage and peak value of the ripple voltage must not exceed the rated voltage. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [c] | The negative peak value of the ripple voltage must not exceed the permissible reverse voltage value specified in the following section, Reverse Voltage. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

CORRECT USE OF CHIP TANTALUM CAPACITORS

| No. | Category | Specification | |
|-----|-----------------------------|--|--|
| 2 | Reverse Voltage | Because the solid tantalum capacitor is a polarized type, do not apply a reverse voltage to it. If reverse voltage cannot be avoided, it must be applied for a short time and must not exceed the following values: | |
| | | 25°C | 10% max. of rated voltage or $1V_{DC}$, whichever is smaller |
| | | 85°C | 5% max. of rated voltage or $0.5V_{DC}$, whichever is smaller |
| | | 125°C | 1% max. of rated voltage or $0.1V_{DC}$, whichever is smaller |
| | | The capacitors should not be operated continuously in reverse mode, even within these limits. | |
| 3 | Applied Voltage | (1) For general application, apply 70% or less of the rated voltage to the capacitor. | |
| | | (2) When the capacitor is used in a power line or a low impedance circuit, keep the applied voltage within 30% of the rated voltage to avoid the adverse influence of inrush current. | |
| | | (3) Derated voltage at 85°C or more. | |
| | | (4) When using a Chip type capacitor at a temperature of 85°C or higher, calculate reduced voltage V_T from the following expression. Note, however, that the ambient temperature must not exceed 125°C $V_T = (V_R - V_C) \cdot \frac{(T - 85^\circ C)}{40^\circ C}$ Where: V_R : Rated voltage (V) at $\leq 85^\circ C$ V_C : Derated voltage at 125°C (V) V_T : Derated voltage between 85°C to 125°C T : Ambient temperature (°C) | |
| 4 | Current (Series Resistance) | Reliability of tantalum capacitor is increased by inserting a series resistance of at least $3\Omega/V$ into circuits where current flow is momentary (switching circuit, charge/discharge circuits, etc) .If the capacitor is in a low impedance circuit, the voltage applied to the capacitor should be less than 1/2 to 1/3 of DC rated voltage. | |
| 5 | Risk of Short Circuit | Manganese oxide tantalum capacitor (conventional tantalum capacitor) is heated and may generate fire and be burned depending upon its excess current, time and other factors. When design the circuit, provide as much margin as possible to maintain capacitor reliability. | |
| 6 | Product Soldering | SMT Tantalum capacitors are suitable for reflow soldering and not suitable for wave flow soldering or hand soldering. See details in our recommended reflow soldering profile. | |

REVISION TABLE

| Revision | Date | Status | Notes |
|----------|------------|-----------------|---------------------|
| 001 | 26/06/2022 | Initial release | Initial publication |
| | | | |
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