



# Miniature Axial Aluminum Electrolytics

## XAL Series

### FEATURES

- Standard low, medium, and high voltage capacitors
- Low impedance characteristics
- Case sizes are smaller than conventional general purpose capacitors, with very high performance
- RoHS Compliant



### CHARACTERISTICS

| Item                                                       | Characteristics                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| Operating Temperature Range                                | 6.3WV ~ 450WV -40°C ~ +85°C                                                                                                                                                                                                                                                                                            |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Capacitance Tolerance                                      | ±20% at 20°C, 120Hz                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Leakage Current                                            | ≤100V                                                                                                                                                                                                                                                                                                                  | I = 0.02CWV or 3μA whichever is greater after 2 minutes of applied rated DC working voltage at 20°C<br>Where: C = rated capacitance in μF; WV = rated DC working voltage |      |      |      |      |      |      |      |      |      |      |      |      |    |
|                                                            | >100V                                                                                                                                                                                                                                                                                                                  | CWV ≤ 1000 I= 0.03CWV + 15uA; C= rated capacitance in uF<br>CWV > 1000 I= 0.02CWV + 25uA; WV = rated DC working voltage in V                                             |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Dissipation Factor<br>(Tan δ, at 20°C 120Hz)               | Working voltage (WV)                                                                                                                                                                                                                                                                                                   | 6.3                                                                                                                                                                      | 10   | 16   | 25   | 35   | 50   | 63   | 100  | 160  | 200  | 250  | 350  | 450  |    |
|                                                            | Tan δ                                                                                                                                                                                                                                                                                                                  | 0.23                                                                                                                                                                     | 0.20 | 0.17 | 0.15 | 0.12 | 0.10 | 0.09 | 0.08 | 0.12 | 0.14 | 0.17 | 0.20 | 0.24 |    |
|                                                            | For capacitors whose capacitance exceeds 1,000μF, the specification of tan δ is increased by 0.02 for every addition of 1,000μF                                                                                                                                                                                        |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Surge Voltage                                              | Working voltage (WV)                                                                                                                                                                                                                                                                                                   | 6.3                                                                                                                                                                      | 10   | 16   | 25   | 35   | 50   | 63   | 100  | 160  | 200  | 250  | 350  | 450  |    |
|                                                            | Surge voltage (SV)                                                                                                                                                                                                                                                                                                     | 8                                                                                                                                                                        | 13   | 20   | 32   | 44   | 63   | 79   | 125  | 200  | 250  | 300  | 400  | 500  |    |
| Low Temperature<br>Characteristics<br>(Imp. ratio @ 120Hz) | Working voltage (WV)                                                                                                                                                                                                                                                                                                   | 6.3                                                                                                                                                                      | 10   | 16   | 25   | 35   | 50   | 63   | 100  | 160  | 200  | 250  | 350  | 450  |    |
|                                                            | Z(-25°C)/Z(+20°C)                                                                                                                                                                                                                                                                                                      | øD<16                                                                                                                                                                    | 6    | 4    | 3    | 3    | 2    | 2    | 2    | 2    | 3    | 6    | 8    | 12   | 16 |
|                                                            |                                                                                                                                                                                                                                                                                                                        | øD≥16                                                                                                                                                                    | 8    | 6    | 4    | 4    | 3    | 3    | 3    | 3    | 3    | 6    | 8    | 12   | 16 |
|                                                            | Z(-40°C)/Z(+20°C)                                                                                                                                                                                                                                                                                                      | øD<16                                                                                                                                                                    | 10   | 8    | 6    | 6    | 4    | 3    | 3    | 3    | 4    | 8    | 10   | -    | -  |
| øD≥16                                                      |                                                                                                                                                                                                                                                                                                                        | 18                                                                                                                                                                       | 16   | 12   | 10   | 8    | 8    | 6    | 6    | 4    | 8    | 10   | -    | -    |    |
| Life Test                                                  | When returned to +20°C after 2,000 hours application of working voltage at +85°C, the capacitor will meet the following limits: Capacitance change is ≤ ±20% of initial value; tan δ is < 200% of specified value; leakage current is within specified value                                                           |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Shelf Life Test                                            | When returned to +20°C after 1,000 hours at +85°C with no voltage applied, the capacitor will meet the following limits: Capacitance change is ≤ ±20% of initial value; tan δ is < 200% of specified value; leakage current is within specified value for 6.3~100V and less than 200% of specified value for 160V~450V |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |
| Standards                                                  | Satisfies Characteristic W of JIS C5141                                                                                                                                                                                                                                                                                |                                                                                                                                                                          |      |      |      |      |      |      |      |      |      |      |      |      |    |

### PART NUMBERING SYSTEM

|          |          |          |          |          |          |                         |          |          |                                  |          |          |                            |          |          |
|----------|----------|----------|----------|----------|----------|-------------------------|----------|----------|----------------------------------|----------|----------|----------------------------|----------|----------|
| <b>1</b> | <b>4</b> | <b>0</b> | <b>X</b> | <b>A</b> | <b>L</b> | <b>5</b>                | <b>0</b> | <b>V</b> | <b>1</b>                         | <b>0</b> | <b>0</b> | -                          | <b>R</b> | <b>C</b> |
| Prefix   |          |          | Series   |          |          | Voltage<br>Actual Value |          |          | Capacitance (μF)<br>Actual Value |          |          | Suffix<br>(RoHS Compliant) |          |          |

### RIPPLE CURRENT AND FREQUENCY MULTIPLIERS

| Capacitance (μF) | Frequency (Hz) |     |     |      |      |
|------------------|----------------|-----|-----|------|------|
|                  | 60 (50)        | 120 | 500 | 1K   | ≥10K |
| <100             | 0.70           | 1.0 | 1.3 | 1.4  | 1.5  |
| 100 ~ 1000       | 0.75           | 1.0 | 1.2 | 1.3  | 1.35 |
| >1000            | 0.80           | 1.0 | 1.1 | 1.12 | 1.15 |

### RIPPLE CURRENT AND TEMPERATURE MULTIPLIERS

|                  |      |     |
|------------------|------|-----|
| Temperature (°C) | 70   | 85  |
| Multiplier       | 1.40 | 1.0 |



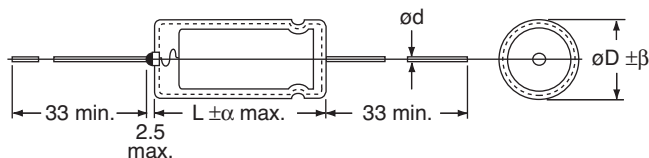
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# Miniature Axial Aluminum Electrolytics

## XAL Series

### ■ DIMENSIONS AND PERMISSIBLE RIPPLE CURRENT



Lead Spacing and Diameter (mm)

| øD | 5   | 6.3 | 8   | 10  | 13  | 16  | 18  | 22  | 25  |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ød | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 | 1.0 | 1.0 |
| α  | 1.5 | 1.5 | 1.5 | 1.5 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| β  | 0.5 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

| Value<br>(μF) | Working Voltage; Dimensions: øD x L (mm); Ripple Current: mA/RMS @ 120Hz, 85°C |      |          |      |          |      |          |      |          |      |          |      |          |      |          |      |
|---------------|--------------------------------------------------------------------------------|------|----------|------|----------|------|----------|------|----------|------|----------|------|----------|------|----------|------|
|               | 6.3                                                                            |      | 10       |      | 16       |      | 25       |      | 35       |      | 50       |      | 63       |      | 100      |      |
|               | øD x L                                                                         | mA   | øD x L   | mA   | øD x L   | mA   | øD x L   | mA   | øD x L   | mA   | øD x L   | mA   | øD x L   | mA   | øD x L   | mA   |
| 0.1           |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 1.5  | 5 x 12   | 3.0  | 5 x 12   | 3.0  |
| 0.22          |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 3.5  | 5 x 12   | 4.5  | 5 x 12   | 4.5  |
| 0.33          |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 5.0  | 5 x 12   | 7.5  | 5 x 12   | 7.5  |
| 0.47          |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 6.0  | 5 x 12   | 9.0  | 5 x 12   | 9.0  |
| 1             |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 10   | 5 x 12   | 15   | 5 x 12   | 15   |
| 2.2           |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 20   | 5 x 12   | 30   | 5 x 12   | 30   |
| 3.3           |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 30   | 5 x 12   | 36   | 5 x 12   | 41   |
| 4.7           |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 42   | 5 x 12   | 44   | 6.3 x 13 | 50   |
| 6.8           |                                                                                |      |          |      |          |      |          |      |          |      | 5 x 12   | 50   | 6 x 13   | 55   |          |      |
| 10            |                                                                                |      |          |      |          |      |          |      | 5 x 12   | 55   | 5 x 12   | 65   | 6.3 x 13 | 68   | 8 x 16   | 72   |
| 22            |                                                                                |      |          |      | 5 x 12   | 71   | 5 x 12   | 76   | 6.3 x 13 | 88   | 6.3 x 13 | 96   | 6.3 x 13 | 109  | 8 x 16   | 133  |
| 33            |                                                                                |      | 5 x 12   | 78   | 5 x 12   | 88   | 6.3 x 13 | 100  | 6.3 x 13 | 115  | 6.3 x 13 | 126  | 8 x 13   | 154  | 10 x 17  | 190  |
| 47            | 5 x 12                                                                         | 87   | 5 x 12   | 94   | 6.3 x 13 | 111  | 6.3 x 13 | 119  | 6.3 x 13 | 138  | 8 x 13   | 174  | 8 x 16   | 214  | 10 x 21  | 237  |
| 100           | 6.3 x 13                                                                       | 136  | 6.3 x 13 | 145  | 6.3 x 13 | 174  | 8 x 13   | 215  | 8 x 16   | 232  | 10 x 17  | 296  | 10 x 21  | 326  | 13 x 22  | 377  |
| 220           | 6.3 x 13                                                                       | 215  | 6.3 x 13 | 231  | 8 x 13   | 298  | 8 x 16   | 319  | 10 x 17  | 401  | 10 x 21  | 459  | 13 x 22  | 527  | 16 x 27  | 625  |
| 330           | 8 x 16                                                                         | 305  | 8 x 16   | 327  | 8 x 16   | 365  | 10 x 17  | 454  | 10 x 21  | 514  | 13 x 22  | 613  | 13 x 22  | 675  | 16 x 33  | 793  |
| 470           | 8 x 16                                                                         | 364  | 8 x 16   | 390  | 8 x 16   | 460  | 10 x 17  | 524  | 10 x 21  | 613  | 13 x 27  | 731  | 13 x 27  | 780  | 16 x 37  | 942  |
| 1000          | 10 x 17                                                                        | 662  | 10 x 17  | 671  | 10 x 21  | 775  | 13 x 22  | 873  | 13 x 27  | 955  | 16 x 33  | 1111 | 18 x 37  | 1249 | 22 x 43  | 1359 |
| 2200          | 13 x 22                                                                        | 929  | 13 x 22  | 1051 | 13 x 22  | 1125 | 16 x 27  | 1344 | 16 x 33  | 1421 | 18 x 40  | 1699 | 22 x 43  | 1744 |          |      |
| 3300          | 13 x 27                                                                        | 1150 | 13 x 27  | 1288 | 16 x 27  | 1454 | 16 x 33  | 1611 | 16 x 37  | 1640 | 22 x 43  | 2027 | 25 x 52  | 2309 |          |      |
| 4700          | 13 x 27                                                                        | 1354 | 16 x 28  | 1552 | 16 x 33  | 1650 | 18 x 37  | 1881 | 22 x 43  | 2208 | 25 x 52  | 2347 |          |      |          |      |
| 10000         | 16 x 37                                                                        | 2062 | 18 x 36  | 2122 | 22 x 43  | 2503 | 22 x 43  | 2893 |          |      |          |      |          |      |          |      |
| 22000         | 22 x 43                                                                        | 3097 |          |      |          |      |          |      |          |      |          |      |          |      |          |      |

| Value<br>(μF) | Working Voltage; Dimensions: øD x L (mm); Ripple Current: mA/RMS @ 120Hz, 85°C |     |          |     |         |     |         |     |         |     |
|---------------|--------------------------------------------------------------------------------|-----|----------|-----|---------|-----|---------|-----|---------|-----|
|               | 160                                                                            |     | 200      |     | 250     |     | 350     |     | 450     |     |
|               | øD x L                                                                         | mA  | øD x L   | mA  | øD x L  | mA  | øD x L  | mA  | øD x L  | mA  |
| 1             | 6.3 x 12                                                                       | 7   | 6.3 x 16 | 9   | 8 x 12  | 12  | 8 x 16  | 13  | 8 x 16  | 15  |
| 2.2           | 6.3 x 12                                                                       | 15  | 8 x 16   | 16  | 8 x 12  | 17  | 8 x 20  | 19  | 10 x 17 | 23  |
| 3.3           | 8 x 16                                                                         | 21  | 8 x 16   | 26  | 8 x 16  | 31  | 8 x 20  | 33  | 10 x 21 | 36  |
| 4.7           | 8 x 16                                                                         | 31  | 8 x 16   | 33  | 8 x 16  | 38  | 10 x 21 | 44  | 10 x 21 | 46  |
| 10            | 10 x 17                                                                        | 60  | 10 x 21  | 66  | 10 x 17 | 72  | 13 x 22 | 77  | 13 x 27 | 82  |
| 22            | 10 x 21                                                                        | 121 | 13 x 22  | 121 | 13 x 21 | 126 | 13 x 32 | 132 | 16 x 37 | 143 |
| 33            | 13 x 22                                                                        | 154 | 13 x 27  | 167 | 16 x 27 | 178 | 16 x 33 | 186 | 16 x 31 | 201 |
| 47            | 13 x 27                                                                        | 198 | 16 x 32  | 214 | 16 x 33 | 241 | 16 x 42 | 253 | 18 x 36 | 402 |
| 100           | 16 x 33                                                                        | 345 | 16 x 37  | 368 | 18 x 43 | 391 | 18 x 40 | 402 | 25 x 52 | 448 |
| 220           | 18 x 42                                                                        | 586 | 22 x 43  | 609 | 22 x 43 | 632 |         |     |         |     |
| 330           | 22 x 43                                                                        | 632 |          |     |         |     |         |     |         |     |



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