

# DATA SHEET

## **030/031 AS**

Aluminum electrolytic capacitors  
Axial Standard

Product specification  
Supersedes data of January 1998  
File under BC Components, BC01

2000 Jan 18

## Aluminum electrolytic capacitors

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#### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped version available for automatic insertion
- Charge and discharge proof
- Useful life: 3000 hours at 85 °C (case ØD = 3.3 mm: 1500 hours)
- Standard dimensions.

#### APPLICATIONS

- General purpose and industrial, automotive, telecommunication, audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Boards with restricted mounting height, vibration and shock resistant.

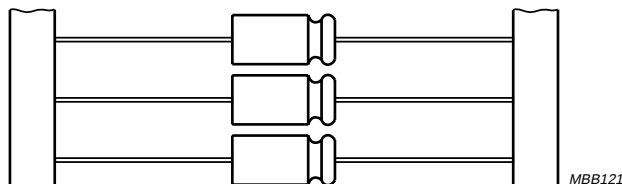
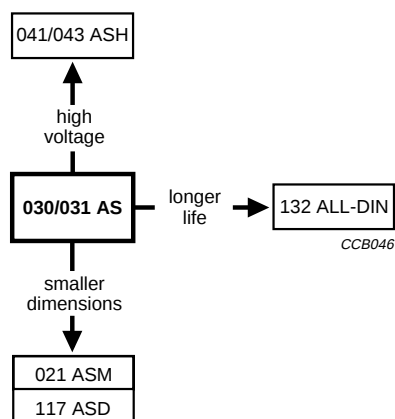


Fig.1 Component outline.



#### QUICK REFERENCE DATA

| DESCRIPTION                                             | VALUE                |                     |
|---------------------------------------------------------|----------------------|---------------------|
| Case sizes (ØD <sub>nom</sub> × L <sub>nom</sub> in mm) | 3.3 × 11             | 4.5 × 10 to 10 × 25 |
| Rated capacitance range, C <sub>R</sub>                 | 0.47 to 1000 µF      |                     |
| Tolerance on C <sub>R</sub>                             | −10 to +50%          |                     |
| Rated voltage range, U <sub>R</sub>                     | 6.3 to 100 V         |                     |
| Category temperature range                              | −40 to +85 °C        |                     |
| Endurance test at 85 °C                                 | 1000 hours           | 2000 hours          |
| Useful life at 85 °C                                    | 1500 hours           | 3000 hours          |
| Useful life at 40 °C, 1.4 × I <sub>R</sub> applied      | 40000 hours          | 80000 hours         |
| Shelf life at 0 V, 85 °C                                | 500 hours            |                     |
| Based on sectional specification                        | IEC 60384-4/EN130300 |                     |
| Climatic category IEC 60068                             | 40/085/56            |                     |

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### Selection chart for $C_R$ , $U_R$ and relevant nominal case sizes ( $\varnothing D \times L$ in mm)

Preferred types in **bold**.

| $C_R$<br>( $\mu F$ )      | $U_R$ (V)                        |                                   |                                   |                                   |                                  |                                   |                                 |
|---------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|---------------------------------|
|                           | 6.3                              | 10                                | 16                                | 25                                | 40                               | 63                                | 100                             |
| 0.47                      | –                                | –                                 | –                                 | –                                 | –                                | –                                 | $4.5 \times 10$                 |
| <b>1.0</b>                | –                                | –                                 | –                                 | –                                 | –                                | <b><math>4.5 \times 10</math></b> | $4.5 \times 10$                 |
|                           | –                                | –                                 | –                                 | –                                 | –                                | $3.3 \times 11$                   | –                               |
| <b>2.2</b>                | –                                | –                                 | –                                 | –                                 | $3.3 \times 11$                  | <b><math>4.5 \times 10</math></b> | $4.5 \times 10$                 |
| 3.3                       | –                                | –                                 | –                                 | –                                 | –                                | $4.5 \times 10$                   | $4.5 \times 10$                 |
| <b>4.7</b>                | –                                | –                                 | $3.3 \times 11$                   | –                                 | –                                | <b><math>4.5 \times 10</math></b> | $6 \times 10$                   |
| 6.8                       | –                                | –                                 | –                                 | –                                 | –                                | $4.5 \times 10$                   | $6 \times 10$                   |
| <b>10</b>                 | $3.3 \times 11$                  | –                                 | –                                 | <b><math>4.5 \times 10</math></b> | $4.5 \times 10$                  | <b><math>6 \times 10</math></b>   | $8 \times 11$                   |
|                           | –                                | –                                 | –                                 | –                                 | –                                | –                                 | $6.5 \times 18$                 |
| 15                        | –                                | –                                 | –                                 | –                                 | $4.5 \times 10$                  | $6 \times 10$                     | –                               |
| <b>22</b>                 | –                                | –                                 | –                                 | <b><math>4.5 \times 10</math></b> | <b><math>6 \times 10</math></b>  | $8 \times 11$                     | <b><math>8 \times 18</math></b> |
|                           | –                                | –                                 | –                                 | –                                 | –                                | $6.5 \times 18$                   | –                               |
| 33                        | –                                | –                                 | <b><math>4.5 \times 10</math></b> | –                                 | $6 \times 10$                    | –                                 | $10 \times 18$                  |
| <b>47</b>                 | –                                | <b><math>4.5 \times 10</math></b> | –                                 | <b><math>6 \times 10</math></b>   | <b><math>8 \times 11</math></b>  | <b><math>8 \times 18</math></b>   | $10 \times 25$                  |
|                           | –                                | –                                 | –                                 | –                                 | $6.5 \times 18$                  | –                                 | –                               |
| 68                        | $4.5 \times 10$                  | –                                 | <b><math>6 \times 10</math></b>   | –                                 | –                                | $10 \times 18$                    | –                               |
| <b>100</b>                | –                                | <b><math>6 \times 10</math></b>   | –                                 | <b><math>8 \times 11</math></b>   | <b><math>8 \times 18</math></b>  | <b><math>10 \times 25</math></b>  | –                               |
|                           | –                                | –                                 | –                                 | $6.5 \times 18$                   | –                                | –                                 | –                               |
| 150                       | $6 \times 10$                    | –                                 | $8 \times 11$                     | $8 \times 18$                     | $10 \times 18$                   | –                                 | –                               |
|                           | –                                | –                                 | $6.5 \times 18$                   | –                                 | –                                | –                                 | –                               |
| <b>220</b>                | –                                | $8 \times 11$                     | $8 \times 18$                     | <b><math>10 \times 18</math></b>  | <b><math>10 \times 25</math></b> | –                                 | –                               |
|                           | –                                | <b><math>6.5 \times 18</math></b> | –                                 | –                                 | –                                | –                                 | –                               |
| 330                       | –                                | $8 \times 18$                     | <b><math>10 \times 18</math></b>  | $10 \times 25$                    | –                                | –                                 | –                               |
| <b>470</b>                | <b><math>8 \times 18</math></b>  | <b><math>10 \times 18</math></b>  | <b><math>10 \times 25</math></b>  | –                                 | –                                | –                                 | –                               |
| 680                       | $10 \times 18$                   | $10 \times 25$                    | –                                 | –                                 | –                                | –                                 | –                               |
| <b>1000<sup>(1)</sup></b> | <b><math>10 \times 25</math></b> | –                                 | –                                 | –                                 | –                                | –                                 | –                               |

### Note

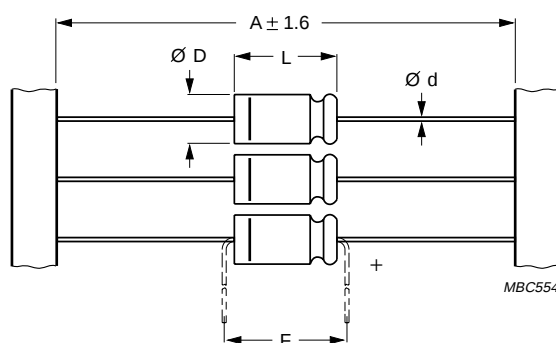
- For larger CV-values see data sheet "021 ASM".

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### MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

**Form BR:** Taped on reel, **non-preferred**.

**Form BA:** Taped in box (ammopack), **preferred**.

**Case  $\varnothing D \times L = 3.3 \times 11$  to  $10 \times 25$  mm.**

For dimensions see Table 1.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.2 Dimensional outline.

**Table 1** Axial; Physical dimensions, mass and packaging quantities; see Fig. 2

| NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | CASE<br>CODE | AXIAL FORM BA and BR    |                |                                |                    |                    | MASS<br>(g)    | PACKAGING QUANTITIES |            |
|----------------------------------------------------------|--------------|-------------------------|----------------|--------------------------------|--------------------|--------------------|----------------|----------------------|------------|
|                                                          |              | $\varnothing d$<br>(mm) | A<br>(mm)      | $\varnothing D_{\max}$<br>(mm) | $L_{\max}$<br>(mm) | $F_{\min}$<br>(mm) |                | FORM<br>BA           | FORM<br>BR |
| $3.3 \times 11$                                          | 1            | 0.6                     | $63.5 \pm 1.5$ | 3.5                            | 12                 | 17.5               | $\approx 0.35$ | 1000                 | 4000       |
| $4.5 \times 10$                                          | 2            | 0.6                     | $63.5 \pm 1.5$ | 5.0                            | 10.5               | 15                 | $\approx 0.5$  | 1000                 | 3000       |
| $6 \times 10$                                            | 3            | 0.6                     | $63.5 \pm 1.5$ | 6.3                            | 10.5               | 15                 | $\approx 0.7$  | 1000                 | 1000       |
| $8 \times 11$                                            | 5a           | 0.6                     | $63.5 \pm 1.5$ | 8.5                            | 11.5               | 15                 | $\approx 1.1$  | 500                  | 500        |
| $6.5 \times 18$                                          | 4            | 0.8                     | $73 \pm 1.6$   | 6.9                            | 18.5               | 25                 | $\approx 1.3$  | 1000                 | 1000       |
| $8 \times 18$                                            | 5            | 0.8                     | $73 \pm 1.6$   | 8.5                            | 18.5               | 25                 | $\approx 1.7$  | 500                  | 500        |
| $10 \times 18$                                           | 6            | 0.8                     | $73 \pm 1.6$   | 10.5                           | 18.5               | 25                 | $\approx 2.5$  | 500                  | 500        |
| $10 \times 25$                                           | 7            | 0.8                     | $73 \pm 1.6$   | 10.5                           | 25.0               | 30                 | $\approx 3.3$  | 500                  | 500        |

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Ordering example

Electrolytic capacitor 031 series  
330 µF/10 V; –10/+50%  
Nominal case size: Ø8 × 18 mm; Form BA  
Catalogue number: 2222 031 34331.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C,  
P = 86 to 106 kPa, RH = 45 to 75%.

| SYMBOL          | DESCRIPTION                                                                                       |
|-----------------|---------------------------------------------------------------------------------------------------|
| C <sub>R</sub>  | rated capacitance at 100 Hz, tolerance –10 to +50%                                                |
| I <sub>R</sub>  | rated RMS ripple current at 100 Hz, 85 °C                                                         |
| I <sub>L1</sub> | max. leakage current after 1 minute at U <sub>R</sub>                                             |
| I <sub>L5</sub> | max. leakage current after 5 minutes at U <sub>R</sub>                                            |
| Tan δ           | max. dissipation factor at 100 Hz                                                                 |
| ESR             | equivalent series resistance at 100 Hz (calculated from tan δ <sub>max</sub> and C <sub>R</sub> ) |
| Z               | max. impedance at 10 kHz                                                                          |

Table 2 Electrical data and ordering information; preferred types in **bold**

| U <sub>R</sub><br>(V) | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>ØD × L<br>(mm) | CASE<br>CODE | I <sub>R</sub><br>100 Hz<br>85 °C<br>(mA) | I <sub>L1</sub><br>1 min<br>(µA) | I <sub>L5</sub><br>5 min<br>(µA) | Tan δ<br>100 Hz | ESR<br>100 Hz<br>(Ω) | Z<br>10 kHz<br>(Ω) | CATALOGUE NUMBER 2222 ... .. |                         |
|-----------------------|----------------------------------|----------------------------------------|--------------|-------------------------------------------|----------------------------------|----------------------------------|-----------------|----------------------|--------------------|------------------------------|-------------------------|
|                       |                                  |                                        |              |                                           |                                  |                                  |                 |                      |                    | TAPED ON REEL<br>FORM BR     | TAPED IN BOX<br>FORM BA |
| 6.3                   | 10                               | 3.3 × 11                               | 1            | 15                                        | 5                                | 5                                | 0.30            | 47.8                 | 20                 | 030 23109                    | 030 33109               |
|                       | 68                               | 4.5 × 10                               | 2            | 75                                        | 22                               | 5.9                              | 0.25            | 5.86                 | 2.9                | 030 23689                    | 030 33689               |
|                       | 150                              | 6 × 10                                 | 3            | 120                                       | 10                               | 6.9                              | 0.25            | 2.66                 | 1.3                | 030 23151                    | 030 33151               |
|                       | <b>470</b>                       | <b>8 × 18</b>                          | <b>5</b>     | 330                                       | 22                               | 11                               | 0.25            | 0.85                 | 0.43               | 031 23471                    | <b>031 33471</b>        |
|                       | 680                              | 10 × 18                                | 6            | 430                                       | 30                               | 14                               | 0.25            | 0.59                 | 0.29               | 031 23681                    | 031 33681               |
|                       | <b>1000</b>                      | <b>10 × 25</b>                         | <b>7</b>     | 560                                       | 42                               | 18                               | 0.25            | 0.40                 | 0.20               | 031 23102                    | <b>031 33102</b>        |
| 10                    | <b>47</b>                        | <b>4.5 × 10</b>                        | <b>2</b>     | 70                                        | 24                               | 5.9                              | 0.20            | 6.78                 | 3.4                | 030 24479                    | <b>030 34479</b>        |
|                       | <b>100</b>                       | <b>6 × 10</b>                          | <b>3</b>     | 10                                        | 110                              | 7                                | 0.20            | 3.19                 | 1.6                | 030 24101                    | <b>030 34101</b>        |
|                       | 220                              | 8 × 11                                 | 5a           | 210                                       | 18                               | 9.4                              | 0.20            | 1.45                 | 0.73               | 030 24221                    | 030 34221               |
|                       | <b>220</b>                       | <b>6.5 × 18</b>                        | <b>4</b>     | 210                                       | 18                               | 9.4                              | 0.20            | 1.45                 | 0.73               | 031 24221                    | <b>031 34221</b>        |
|                       | 330                              | 8 × 18                                 | 5            | 310                                       | 24                               | 12                               | 0.20            | 0.97                 | 0.48               | 031 24331                    | 031 34331               |
|                       | <b>470</b>                       | <b>10 × 18</b>                         | <b>6</b>     | 410                                       | 33                               | 14                               | 0.20            | 0.68                 | 0.34               | 031 24471                    | <b>031 34471</b>        |
|                       | 680                              | 10 × 25                                | 7            | 510                                       | 45                               | 19                               | 0.20            | 0.47                 | 0.24               | 031 24681                    | 031 34681               |

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| U <sub>R</sub><br>(V) | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>ØD × L<br>(mm) | CASE<br>CODE | I <sub>R</sub><br>100 Hz<br>85 °C<br>(mA) | I <sub>L1</sub><br>1 min<br>(μA) | I <sub>L5</sub><br>5 min<br>(μA) | Tan δ<br>100 Hz | ESR<br>100 Hz<br>(Ω) | Z<br>10 kHz<br>(Ω) | CATALOGUE NUMBER 2222 ... .. |                         |
|-----------------------|----------------------------------|----------------------------------------|--------------|-------------------------------------------|----------------------------------|----------------------------------|-----------------|----------------------|--------------------|------------------------------|-------------------------|
|                       |                                  |                                        |              |                                           |                                  |                                  |                 |                      |                    | TAPED ON REEL<br>FORM BR     | TAPED IN BOX<br>FORM BA |
| 16                    | 4.7                              | 3.3 × 11                               | 1            | 15                                        | 5                                | 5                                | 0.20            | 67.8                 | 26                 | 030 25478                    | 030 35478               |
|                       | <b>33</b>                        | <b>4.5 × 10</b>                        | <b>2</b>     | 65                                        | 27                               | 6.1                              | 0.16            | 7.72                 | 3.6                | 030 25339                    | <b>030 35339</b>        |
|                       | <b>68</b>                        | <b>6 × 10</b>                          | <b>3</b>     | 110                                       | 11                               | 7.2                              | 0.16            | 3.75                 | 1.8                | 030 25689                    | <b>030 35689</b>        |
|                       | 150                              | 8 × 11                                 | 5a           | 200                                       | 19                               | 9.8                              | 0.16            | 1.70                 | 0.80               | 030 25151                    | 030 35151               |
|                       | 150                              | 6.5 × 18                               | 4            | 200                                       | 19                               | 9.8                              | 0.16            | 1.70                 | 0.80               | 031 25151                    | 031 35151               |
|                       | 220                              | 8 × 18                                 | 5            | 270                                       | 26                               | 12                               | 0.16            | 1.16                 | 0.55               | 031 25221                    | 031 35221               |
|                       | <b>330</b>                       | <b>10 × 18</b>                         | <b>6</b>     | 410                                       | 36                               | 16                               | 0.16            | 0.78                 | 0.36               | 031 25331                    | <b>031 35331</b>        |
|                       | <b>470</b>                       | <b>10 × 25</b>                         | <b>7</b>     | 480                                       | 49                               | 20                               | 0.16            | 0.55                 | 0.26               | 031 25471                    | <b>031 35471</b>        |
| 25                    | <b>10</b>                        | <b>4.5 × 10</b>                        | <b>2</b>     | 50                                        | 13                               | 5.5                              | 0.14            | 22.3                 | 9                  | 030 26109                    | <b>030 36109</b>        |
|                       | <b>22</b>                        | <b>4.5 × 10</b>                        | <b>2</b>     | 60                                        | 28                               | 6.1                              | 0.14            | 10.2                 | 4.1                | 030 26229                    | <b>030 36229</b>        |
|                       | <b>47</b>                        | <b>6 × 10</b>                          | <b>3</b>     | 100                                       | 12                               | 7.4                              | 0.14            | 4.8                  | 1.9                | 030 26479                    | <b>030 36479</b>        |
|                       | <b>100</b>                       | <b>8 × 11</b>                          | <b>5a</b>    | 160                                       | 19                               | 10                               | 0.14            | 2.23                 | 0.90               | 030 26101                    | <b>030 36101</b>        |
|                       | 100                              | 6.5 × 18                               | 4            | 160                                       | 19                               | 10                               | 0.14            | 2.23                 | 0.90               | 031 26101                    | 031 36101               |
|                       | 150                              | 8 × 18                                 | 5            | 240                                       | 27                               | 13                               | 0.14            | 1.49                 | 0.60               | 031 26151                    | 031 36151               |
|                       | <b>220</b>                       | <b>10 × 18</b>                         | <b>6</b>     | 350                                       | 37                               | 16                               | 0.14            | 1.02                 | 0.41               | 031 26221                    | <b>031 36221</b>        |
|                       | 330                              | 10 × 25                                | 7            | 460                                       | 54                               | 22                               | 0.14            | 0.68                 | 0.27               | 031 26331                    | 031 36331               |
| 40                    | 2.2                              | 3.3 × 11                               | 1            | 15                                        | 5                                | 5                                | 0.15            | 109                  | 32                 | 030 27228                    | 030 37228               |
|                       | 10                               | 4.5 × 10                               | 2            | 50                                        | 20                               | 5.8                              | 0.11            | 17.6                 | 7                  | 030 27109                    | 030 37109               |
|                       | 15                               | 4.5 × 10                               | 2            | 55                                        | 30                               | 6.2                              | 0.11            | 11.7                 | 4.7                | 030 27159                    | 030 37159               |
|                       | <b>22</b>                        | <b>6 × 10</b>                          | <b>3</b>     | 75                                        | 9                                | 6.8                              | 0.11            | 8.0                  | 3.2                | 030 27229                    | <b>030 37229</b>        |
|                       | 33                               | 6 × 10                                 | 3            | 95                                        | 12                               | 7.7                              | 0.11            | 5.31                 | 2.1                | 030 27339                    | 030 37339               |
|                       | <b>47</b>                        | <b>8 × 11</b>                          | <b>5a</b>    | 150                                       | 16                               | 8.8                              | 0.11            | 3.73                 | 1.5                | 030 27479                    | <b>030 37479</b>        |
|                       | 47                               | 6.5 × 18                               | 4            | 150                                       | 16                               | 8.8                              | 0.11            | 3.73                 | 1.5                | 031 27479                    | 031 37479               |
|                       | <b>100</b>                       | <b>8 × 18</b>                          | <b>5</b>     | 220                                       | 28                               | 13                               | 0.11            | 1.75                 | 0.70               | 031 27101                    | <b>031 37101</b>        |
|                       | 150                              | 10 × 18                                | 6            | 300                                       | 40                               | 17                               | 0.11            | 1.17                 | 0.47               | 031 27151                    | 031 37151               |
|                       | <b>220</b>                       | <b>10 × 25</b>                         | <b>7</b>     | 430                                       | 57                               | 23                               | 0.11            | 0.80                 | 0.32               | 031 27221                    | <b>031 37221</b>        |

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| U <sub>R</sub><br>(V) | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>ØD × L<br>(mm) | CASE<br>CODE | I <sub>R</sub><br>100 Hz<br>85 °C<br>(mA) | I <sub>L1</sub><br>1 min<br>(μA) | I <sub>L5</sub><br>5 min<br>(μA) | Tan δ<br>100 Hz | ESR<br>100 Hz<br>(Ω) | Z<br>10 kHz<br>(Ω) | CATALOGUE NUMBER 2222 ... .. |                         |
|-----------------------|----------------------------------|----------------------------------------|--------------|-------------------------------------------|----------------------------------|----------------------------------|-----------------|----------------------|--------------------|------------------------------|-------------------------|
|                       |                                  |                                        |              |                                           |                                  |                                  |                 |                      |                    | TAPED ON REEL<br>FORM BR     | TAPED IN BOX<br>FORM BA |
| 63                    | 1.0                              | 3.3 × 11                               | 1            | 10                                        | 5                                | 5                                | 0.12            | 191                  | 55                 | 030 90067                    | 030 90068               |
|                       | <b>1.0</b>                       | <b>4.5 × 10</b>                        | <b>2</b>     | 13                                        | 5                                | 5                                | 0.09            | 143                  | 55                 | 030 28108                    | <b>030 38108</b>        |
|                       | <b>2.2</b>                       | <b>4.5 × 10</b>                        | <b>2</b>     | 25                                        | 7                                | 5.3                              | 0.09            | 65.2                 | 25                 | 030 28228                    | <b>030 38228</b>        |
|                       | 3.3                              | 4.5 × 10                               | 2            | 35                                        | 11                               | 5.4                              | 0.09            | 46.5                 | 17                 | 030 28338                    | 030 38338               |
|                       | <b>4.7</b>                       | <b>4.5 × 10</b>                        | <b>2</b>     | 40                                        | 15                               | 5.6                              | 0.09            | 30.5                 | 12                 | 030 28478                    | <b>030 38478</b>        |
|                       | 6.8                              | 4.5 × 10                               | 2            | 46                                        | 22                               | 5.9                              | 0.09            | 21.1                 | 8.1                | 030 28688                    | 030 38688               |
|                       | <b>10</b>                        | <b>6 × 10</b>                          | <b>3</b>     | 70                                        | 7                                | 6.3                              | 0.08            | 12.8                 | 5.5                | 030 28109                    | <b>030 38109</b>        |
|                       | 15                               | 6 × 10                                 | 3            | 79                                        | 10                               | 6.9                              | 0.08            | 8.5                  | 3.7                | 030 28159                    | 030 38159               |
|                       | 22                               | 8 × 11                                 | 5a           | 110                                       | 13                               | 7.8                              | 0.08            | 5.79                 | 2.5                | 030 28229                    | 030 38229               |
|                       | 22                               | 6.5 × 18                               | 4            | 110                                       | 13                               | 7.8                              | 0.08            | 5.79                 | 2.5                | 031 28229                    | 031 38229               |
|                       | <b>47</b>                        | <b>8 × 18</b>                          | <b>5</b>     | 190                                       | 22                               | 11                               | 0.08            | 2.71                 | 1.2                | 031 28479                    | <b>031 38479</b>        |
|                       | 68                               | 10 × 18                                | 6            | 250                                       | 30                               | 14                               | 0.08            | 1.88                 | 0.81               | 031 28689                    | 031 38689               |
|                       | <b>100</b>                       | <b>10 × 25</b>                         | <b>7</b>     | 300                                       | 42                               | 18                               | 0.08            | 1.28                 | 0.55               | 031 28101                    | <b>031 38101</b>        |
| 100                   | 0.47                             | 4.5 × 10                               | 2            | 9                                         | 5                                | 5                                | 0.08            | 271                  | 96                 | 030 29477                    | 030 39477               |
|                       | 1.0                              | 4.5 × 10                               | 2            | 20                                        | 5                                | 5                                | 0.08            | 128                  | 45                 | 030 29108                    | 030 39108               |
|                       | 2.2                              | 4.5 × 10                               | 2            | 30                                        | 11                               | 11                               | 0.08            | 57.9                 | 21                 | 030 29228                    | 030 39228               |
|                       | 3.3                              | 4.5 × 10                               | 2            | 40                                        | 17                               | 17                               | 0.08            | 38.6                 | 14                 | 030 29338                    | 030 39338               |
|                       | 4.7                              | 6 × 10                                 | 3            | 50                                        | 22                               | 22                               | 0.07            | 23.7                 | 9.6                | 030 29478                    | 030 39478               |
|                       | 6.8                              | 6 × 10                                 | 3            | 70                                        | 34                               | 34                               | 0.07            | 16.4                 | 6.6                | 030 29688                    | 030 39688               |
|                       | 10                               | 8 × 11                                 | 5a           | 90                                        | 50                               | 50                               | 0.07            | 11.2                 | 4.5                | 030 29109                    | 030 39109               |
|                       | 10                               | 6.5 × 18                               | 4            | 90                                        | 50                               | 50                               | 0.07            | 11.2                 | 4.5                | 031 29109                    | 031 39109               |
|                       | <b>22</b>                        | <b>8 × 18</b>                          | <b>5</b>     | 120                                       | 80                               | 80                               | 0.07            | 5.07                 | 2.1                | 031 29229                    | <b>031 39229</b>        |
|                       | 33                               | 10 × 18                                | 6            | 200                                       | 119                              | 119                              | 0.07            | 3.38                 | 1.4                | 031 29339                    | 031 39339               |
|                       | 47                               | 10 × 25                                | 7            | 260                                       | 33                               | 33                               | 0.07            | 2.37                 | 0.96               | 031 29479                    | 031 39479               |

# Aluminum electrolytic capacitors

## Axial Standard

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### Additional electrical data

| PARAMETER                          | CONDITIONS                                                                                                                                                                        | VALUE                                                                                                                                                                                                                                                                            |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Voltage</b>                     |                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                  |
| Surge voltage                      |                                                                                                                                                                                   | $U_S \leq 1.15 \times U_R$                                                                                                                                                                                                                                                       |
| Reverse voltage                    |                                                                                                                                                                                   | $U_{rev} \leq 1 \text{ V}$                                                                                                                                                                                                                                                       |
| <b>Current</b>                     |                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                  |
| Leakage current                    | after 1 minute at $U_R$ :<br>case $\varnothing D \times L = 3.3 \times 11$ and $4.5 \times 10$ mm<br>case $\varnothing D \times L = 6 \times 10$ to $10 \times 25$ mm             | $I_{L1} \leq 0.05C_R \times U_R$ or $5 \mu\text{A}$ , whichever is greater<br>$I_{L1}$ for $CV \leq 1000 \mu\text{C}$ : $\leq 0.01C_R \times U_R$ or $1 \mu\text{A}$ , whichever is greater<br>$I_{L1}$ for $CV > 1000 \mu\text{C}$ : $\leq 0.006C_R \times U_R + 4 \mu\text{A}$ |
|                                    | after 5 minutes:<br>$U_R = 6.3$ to $63 \text{ V}$<br>$U_R = 100 \text{ V}$                                                                                                        | $I_{L5} \leq 0.002C_R \times U_R + 5 \mu\text{A}$<br>$I_{L5} \leq 0.006C_R \times U_R + 4 \mu\text{A}$                                                                                                                                                                           |
| <b>Inductance</b>                  |                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                  |
| Equivalent series inductance (ESL) | case $\varnothing D \times L$ mm:<br>$3.3 \times 11$<br>$4.5 \times 10$<br>$6 \times 10$<br>$8 \times 11$<br>$6.5 \times 18$<br>$8 \times 18$<br>$10 \times 18$<br>$10 \times 25$ | typ. 11 nH<br>typ. 10 nH<br>typ. 22 nH<br>typ. 85 nH<br>typ. 25 nH<br>typ. 40 nH<br>typ. 61 nH<br>typ. 38 nH                                                                                                                                                                     |

### MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (not for case code 1)
- Rated voltage (in V)
- Group number (030 or 031)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal (not for case sizes  $L < 18 \text{ mm}$ ).

# Aluminum electrolytic capacitors

## Axial Standard

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### Capacitance (C)

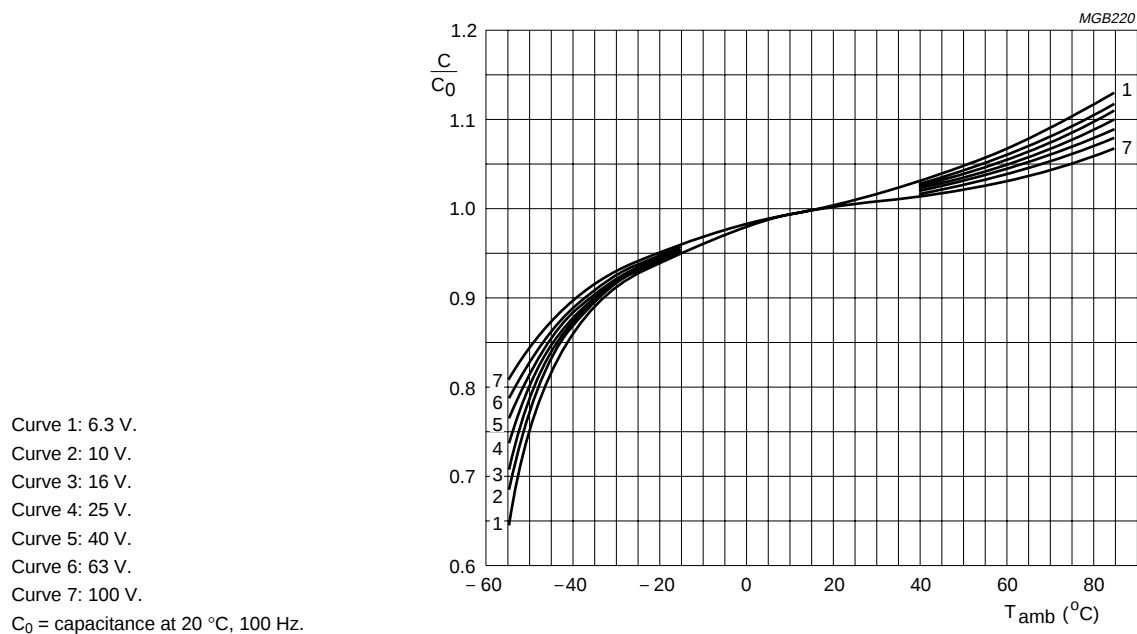


Fig.3 Typical multiplier of capacitance as a function of ambient temperature.

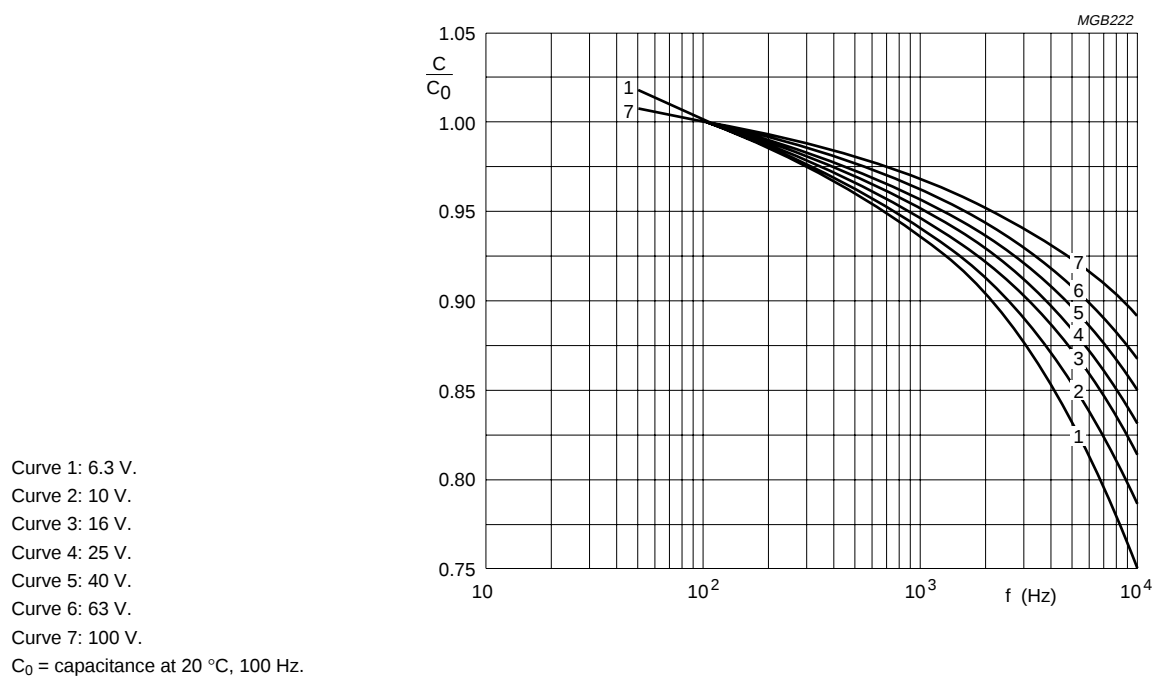
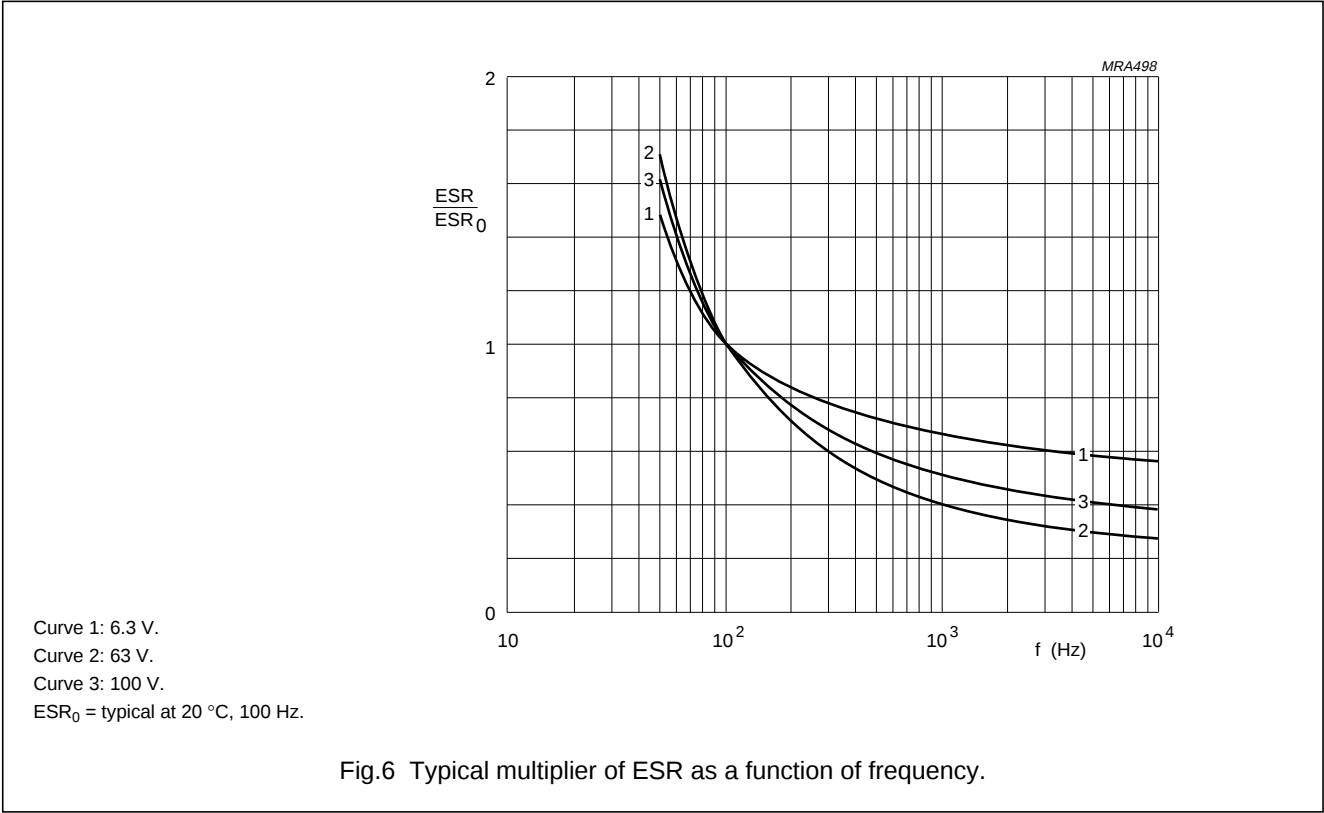
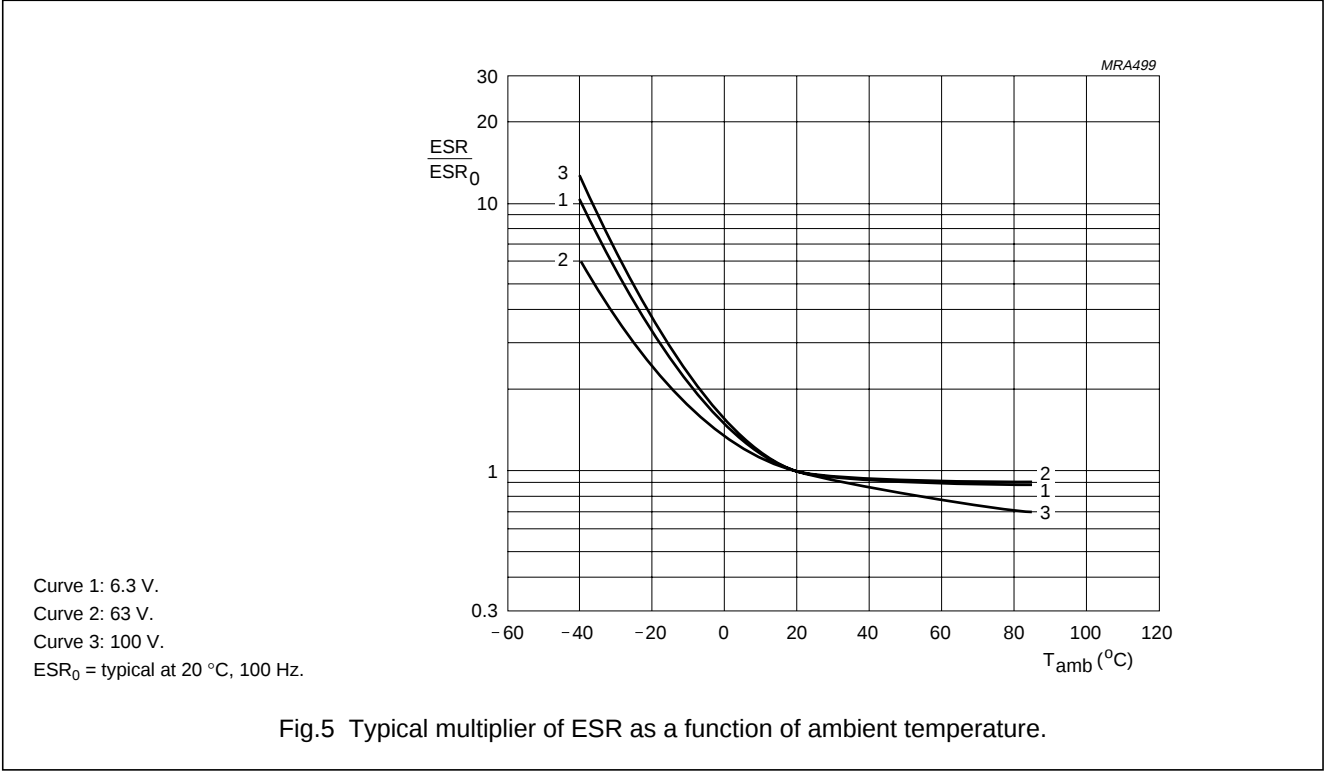


Fig.4 Typical multiplier of capacitance as a function of frequency.

Aluminum electrolytic capacitors  
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Equivalent series resistance (ESR)



Aluminum electrolytic capacitors

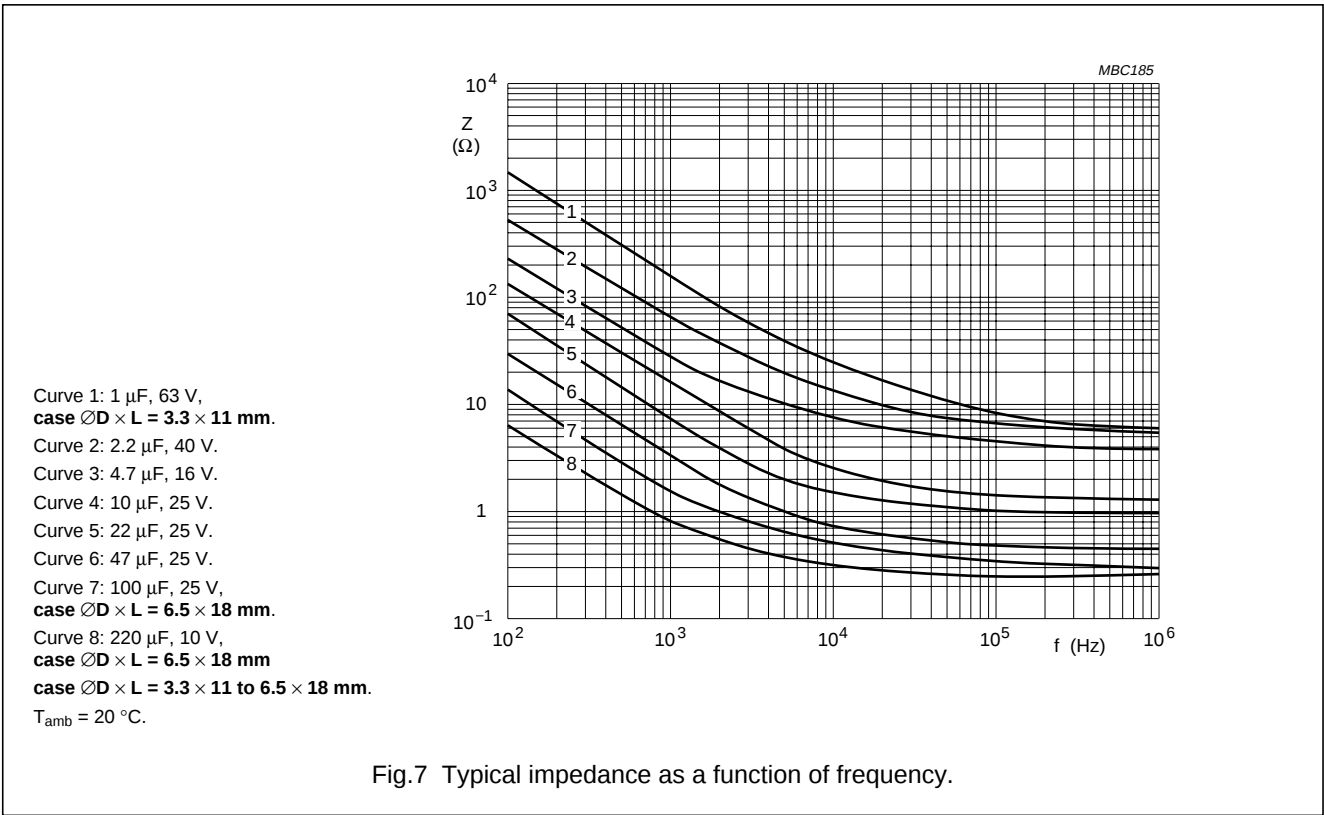
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Impedance (Z)

Table 3 Impedance × capacitance values at 10 kHz

| T <sub>amb</sub> | Z × C <sub>R</sub> (Ω × μF) at 10 kHz |       |       |       |      |      |       |
|------------------|---------------------------------------|-------|-------|-------|------|------|-------|
|                  | 6.3 V                                 | 10 V  | 16 V  | 25 V  | 40 V | 63 V | 100 V |
| +20 °C           | ≤200                                  | ≤160  | ≤120  | ≤90   | ≤70  | ≤55  | ≤45   |
| −25 °C           | ≤1200                                 | ≤750  | ≤560  | ≤400  | ≤300 | ≤180 | ≤130  |
| −40 °C           | ≤3200                                 | ≤2000 | ≤1500 | ≤1100 | ≤900 | ≤500 | ≤350  |



# Aluminum electrolytic capacitors

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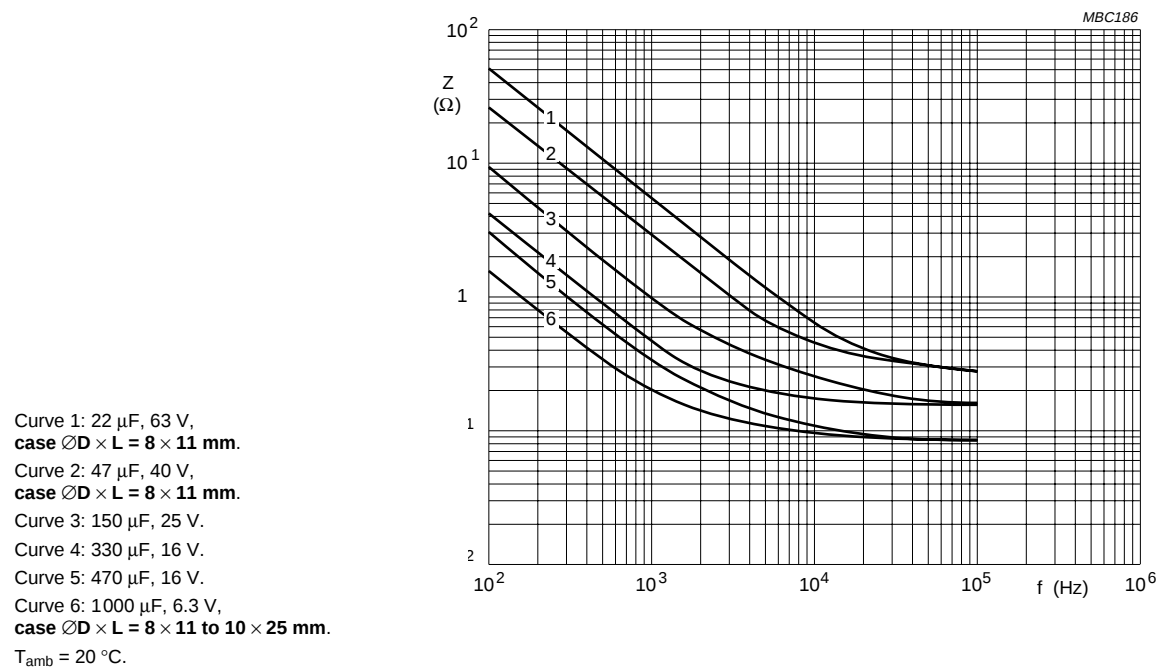


Fig.8 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors

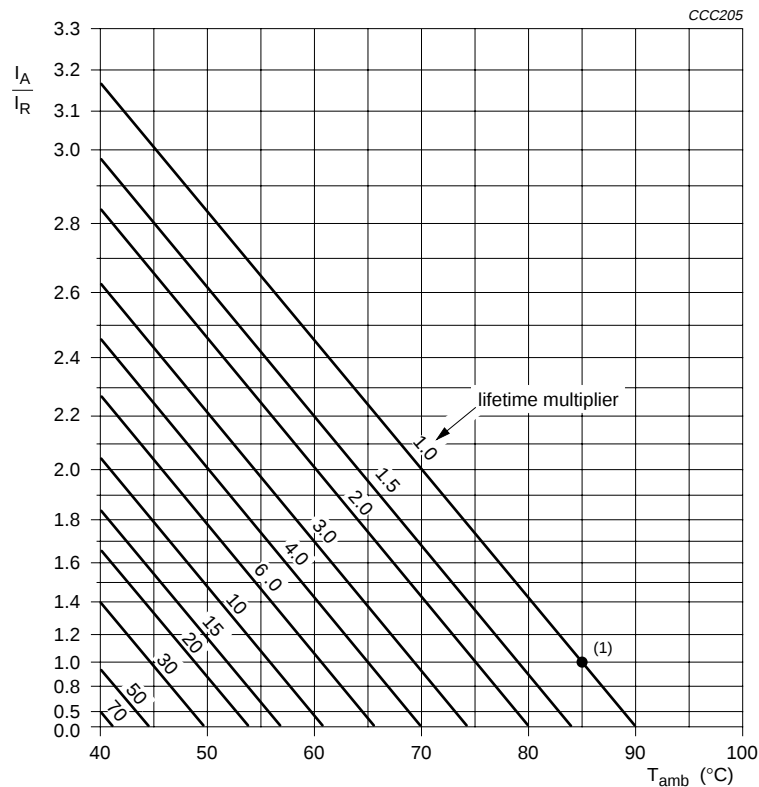
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RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current ( $I_R$ ) as a function of frequency

| FREQUENCY<br>(Hz) | $I_R$ MULTIPLIER                     |                                     |                                      |
|-------------------|--------------------------------------|-------------------------------------|--------------------------------------|
|                   | $U_R = 6.3 \text{ to } 10 \text{ V}$ | $U_R = 16 \text{ to } 25 \text{ V}$ | $U_R = 40 \text{ to } 100 \text{ V}$ |
| 50                | 0.95                                 | 0.9                                 | 0.85                                 |
| 100               | 1.0                                  | 1.0                                 | 1.0                                  |
| 300               | 1.07                                 | 1.12                                | 1.2                                  |
| 1000              | 1.12                                 | 1.2                                 | 1.3                                  |
| 3000              | 1.15                                 | 1.25                                | 1.35                                 |
| $\geq 10000$      | 1.2                                  | 1.3                                 | 1.4                                  |



$I_A$  = actual ripple current at 100 Hz.  
 $I_R$  = rated ripple current at 100 Hz, 85 °C.  
(1) Useful life at 85 °C and  $I_R$  applied:  
case  $\varnothing D \times L = 3.3 \times 11 \text{ mm}$ : 1500 hours  
case  $\varnothing D \times L = 4.5 \times 10 \text{ to } 10 \times 25 \text{ mm}$ : 3000 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

# Aluminum electrolytic capacitors

## Axial Standard

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### SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, section “Tests and Requirements”.

**Table 5** Test procedures and requirements

| TEST                                                               |                                          | PROCEDURE<br>(quick reference)                                                                                                                                        | REQUIREMENTS                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME OF TEST                                                       | REFERENCE                                |                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                      |
| Case $\varnothing D \times L = 3.3 \times 11$ mm                   |                                          |                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                      |
| Endurance                                                          | IEC 384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>1000 hours                                                                                                 | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                                                                                 |
| Useful life                                                        | CECC 30301<br>subclause 1.8.1            | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>1500 hours                                                                                       | $\Delta C/C: \pm 50\%$<br>$\tan \delta \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit<br>total failure percentage: $\leq 3\%$                                                                             |
| Shelf life<br>(storage at<br>high temperature)                     | IEC 384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 hours<br><br>after test: $U_R$ to be applied for 30 minutes,<br>24 to 48 hours before measurement | $\Delta C/C, \tan \delta, Z$ :<br>for requirements<br>see 'Endurance test' above<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                        |
| Case $\varnothing D \times L = 4.5 \times 10$ to $10 \times 25$ mm |                                          |                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                      |
| Endurance                                                          | IEC 384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>2 000 hours                                                                                                | $U_R \leq 6.3\text{ V}$ ; $\Delta C/C: +15/-30\%$<br>$U_R > 6.3\text{ V}$ ; $\Delta C/C: \pm 15\%$<br>$\tan \delta \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                   |
| Useful life                                                        | CECC 30301<br>subclause 1.8.1            | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>3000 hours                                                                                       | $U_R \leq 6.3\text{ V}$ ; $\Delta C/C: +45/-50\%$<br>$U_R > 6.3\text{ V}$ ; $\Delta C/C: \pm 45\%$<br>$\tan \delta \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit<br>total failure percentage: $\leq 1\%$ |
| Shelf life<br>(storage at<br>high temperature)                     | IEC 384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 85\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>500 hours<br><br>after test: $U_R$ to be applied for 30 minutes,<br>24 to 48 hours before measurement | $\Delta C/C, \tan \delta, Z$ :<br>for requirements<br>see 'Endurance test' above<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                        |