

Radial Leaded Aluminum Electrolytic Capacitors

REF Series



FEATURES

- Super Low Impedance, High ripple current capability
- Endurance: 3000 - 6000 hours at 105°C
- RoHS Compliance and Halogen-free

APPLICATIONS

- Power supplies, general industrial, filtering



LEAD-FREE  
LEAD-FREE COMPATIBLE  
COMPONENT



RoHS  
COMPLIANT

HOW TO ORDER

**Product Type**  
Radial Aluminum

**Series Type**  
See table below

**Case Size**  
See table below

**Capacitance Code**  
µF code: 1st two digits represent significant figures,  
3rd digit represents multiplier (number of zeros to follow)

**Tolerance**  
M = ±20%

**Lead Type**  
" " empty = Standard long lead  
"C"= Lead cut only  
"F"= Lead cut and form

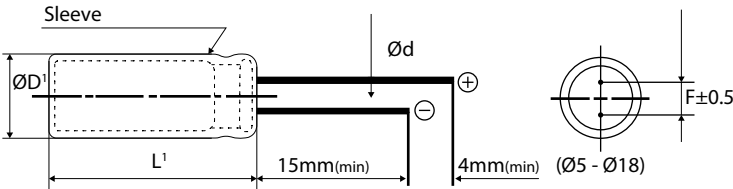
**Packaging**  
K = Ammo Pack  
B = Bulk Pack

**Rated DC Voltage**  
006 = 6.3Vdc    050 = 50Vdc  
010 = 10Vdc    063 = 63Vdc  
016 = 16Vdc    080 = 80Vdc  
025 = 25Vdc    100 = 100Vdc  
035 = 35Vdc    120 = 120Vdc

**Ordering Code:** R EF 0816 471 M 016 K -

CASE DIMENSIONS millimeters (inches)

| Code | D'±0.50<br>(0.020) | L'±2.00<br>(0.079) | d±0.05<br>(0.002) | F±0.50<br>(0.020) | Typical<br>Weight (g) | Code | D'±0.50<br>(0.020) | L'±2.00<br>(0.079) | d±0.05<br>(0.002) | F±0.50<br>(0.020) | Typical<br>Weight (g) |
|------|--------------------|--------------------|-------------------|-------------------|-----------------------|------|--------------------|--------------------|-------------------|-------------------|-----------------------|
| 0511 | 5.00 (0.020)       | 11.00 (0.433)      | 0.50 (0.020)      | 2.00 (0.079)      | 0.43                  | 1216 | 12.50 (0.492)      | 16.00 (0.630)      | 0.60 (0.024)      | 5.00 (0.020)      | 3.11                  |
| 0512 | 5.00 (0.020)       | 12.00 (0.472)      | 0.50 (0.020)      | 2.00 (0.079)      | 1.05                  | 1220 | 12.50 (0.492)      | 20.00 (0.787)      | 0.60 (0.024)      | 5.00 (0.020)      | 3.98                  |
| 0609 | 6.30 (0.248)       | 9.00 (0.354)       | 0.50 (0.020)      | 2.50 (0.098)      | 0.54                  | 1225 | 12.50 (0.492)      | 25.00 (0.984)      | 0.60 (0.024)      | 5.00 (0.020)      | 5.01                  |
| 0611 | 6.30 (0.248)       | 11.00 (0.433)      | 0.50 (0.020)      | 2.50 (0.098)      | 0.61                  | 1230 | 12.50 (0.492)      | 30.00 (1.181)      | 0.60 (0.024)      | 5.00 (0.020)      | 5.95                  |
| 0612 | 6.30 (0.248)       | 12.00 (0.472)      | 0.50 (0.020)      | 2.50 (0.098)      | 0.69                  | 1235 | 12.50 (0.492)      | 35.00 (1.378)      | 0.60 (0.024)      | 5.00 (0.020)      | 6.34                  |
| 0811 | 8.00 (0.315)       | 11.00 (0.433)      | 0.50 (0.020)      | 3.50 (0.138)      | 0.95                  | 1320 | 13.00 (0.512)      | 20.00 (0.787)      | 0.60 (0.024)      | 5.00 (0.020)      | 3.97                  |
| 0812 | 8.00 (0.315)       | 12.00 (0.472)      | 0.50 (0.020)      | 3.50 (0.138)      | 1.02                  | 1620 | 16.00 (0.630)      | 20.00 (0.787)      | 0.80 (0.315)      | 7.50 (0.295)      | 6.85                  |
| 0816 | 8.00 (0.315)       | 16.00 (0.630)      | 0.50 (0.020)      | 3.50 (0.138)      | 1.34                  | 1625 | 16.00 (0.630)      | 25.00 (0.984)      | 0.80 (0.315)      | 7.50 (0.295)      | 8.48                  |
| 0820 | 8.00 (0.315)       | 20.00 (0.787)      | 0.50 (0.020)      | 3.50 (0.138)      | 1.72                  | 1640 | 16.00 (0.630)      | 40.00 (1.575)      | 0.80 (0.315)      | 7.50 (0.295)      | 13.85                 |
| 1009 | 10.00 (0.394)      | 9.00 (0.354)       | 0.60(0.024)       | 5.00 (0.020)      | 1.32                  | 1820 | 18.00 (0.709)      | 20.00 (0.787)      | 0.80 (0.315)      | 7.50 (0.295)      | 9.00                  |
| 1013 | 10.00 (0.394)      | 13.00 (0.512)      | 0.60(0.024)       | 5.00 (0.020)      | 1.65                  | 1825 | 18.00 (0.709)      | 25.00 (0.984)      | 0.80 (0.315)      | 7.50 (0.295)      | 9.60                  |
| 1016 | 10.00 (0.394)      | 16.00 (0.630)      | 0.60(0.024)       | 5.00 (0.020)      | 2.18                  | 1830 | 18.00 (0.709)      | 30.00 (1.181)      | 0.80 (0.315)      | 7.50 (0.295)      | 12.00                 |
| 1020 | 10.00 (0.394)      | 20.00 (0.787)      | 0.60(0.024)       | 5.00 (0.020)      | 2.58                  | 1835 | 18.00 (0.709)      | 35.00 (1.378)      | 0.80 (0.315)      | 7.50 (0.295)      | 12.40                 |
| 1025 | 10.00 (0.394)      | 25.00 (0.984)      | 0.60(0.024)       | 5.00 (0.020)      | 3.11                  | 1840 | 18.00 (0.709)      | 40.00 (1.575)      | 0.80 (0.315)      | 7.50 (0.295)      | 16.00                 |



Radial Leaded Aluminum Electrolytic  
Capacitors  
REF Series

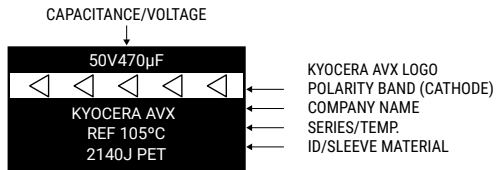


TECHNICAL SPECIFICATIONS

|                             |                                                   |                                                              |
|-----------------------------|---------------------------------------------------|--------------------------------------------------------------|
| Category Temperature Range: | -40°C to +105°C                                   |                                                              |
| Capacitance Range           | At 25°C, 120Hz                                    | 6.8μF to 6800μF                                              |
| Capacitance Tolerance:      | At 25°C, 120Hz                                    | ±20%                                                         |
| Dissipation Factor (%)      | Measurement Frequency: 120Hz at 25°C              | Please see the ratings and part number reference table below |
| Leakage Current:            | After 2 minutes at rated working voltage at 25°C* | $I \leq 0.01CV$ or 3μA, whichever is greater                 |

\* Note: In the case of an anomalous reading, re-measure the leakage current after following voltage treatment:  
Voltage treatment: DC rated voltage to be applied to the capacitors for 120 minutes at 105°C.

MARKING



CAPACITANCE AND RATED VOLTAGE RANGE (FIGURES DENOTES CASE SIZE)

| Capacitance |      | Rated Voltage DC (V <sub>R</sub> ) |              |              |              |              |      |              |              |              |              |
|-------------|------|------------------------------------|--------------|--------------|--------------|--------------|------|--------------|--------------|--------------|--------------|
| μF          | Code | 6.3V                               | 10V          | 16V          | 25V          | 35V          | 50V  | 63V          | 80V          | 100V         | 120V         |
| 6.8         | 6R8  |                                    |              |              |              |              |      |              |              | 0511<br>0609 |              |
| 10          | 100  |                                    |              |              |              |              |      |              |              |              | 0612         |
| 22          | 220  |                                    |              |              |              |              | 0512 |              |              | 0612         | 0812         |
| 27          | 270  |                                    |              |              |              |              |      |              |              | 1009         |              |
| 33          | 330  |                                    |              |              |              | 0512         |      | 0611         |              | 1013         | 0816<br>1013 |
| 47          | 470  |                                    |              |              | 0511         |              |      | 0612         |              | 1013         | 1016         |
| 56          | 560  |                                    |              |              |              |              | 0612 |              |              |              | 1016         |
| 68          | 680  |                                    |              |              |              |              |      |              |              | 1016         | 1020         |
| 82          | 820  |                                    |              |              |              |              |      | 0812<br>1013 |              |              |              |
| 100         | 101  |                                    | 0511<br>0609 | 0511         | 0511<br>0611 | 0612<br>0811 | 0812 | 0812<br>1013 |              | 1016         | 1025         |
| 120         | 121  |                                    |              |              |              |              | 0816 | 0816         |              |              | 1320         |
| 150         | 151  | 0511                               |              |              |              |              | 1013 | 1013         | 1016         | 1020         | 1225         |
| 180         | 181  |                                    |              |              |              |              | 0820 |              |              |              |              |
| 220         | 221  | 0611                               | 0611         | 0611         | 0611<br>0812 | 0812<br>1009 | 1013 | 1016         | 1020         | 1320         | 1230<br>1620 |
| 270         | 271  |                                    |              |              |              |              | 1016 |              |              |              |              |
| 330         | 331  | 0611                               |              | 0812<br>1009 | 0816<br>1013 | 1016         | 1016 | 1020         | 1020         | 1225<br>1620 | 1825         |
| 470         | 471  | 0612                               | 0812         | 0816<br>1013 | 0816         | 1016         | 1020 | 1320         | 1620         | 1625         |              |
| 560         | 561  |                                    |              |              | 1016         |              | 1220 | 1320         |              | 1825         |              |
| 680         | 681  |                                    | 0816<br>1013 | 0820<br>1016 | 1020         | 1220         | 1220 | 1620         | 1825         | 1640<br>1835 |              |
| 820         | 821  |                                    |              |              | 1020         |              | 1620 | 1625         |              | 1840         |              |
| 1000        | 102  | 0816                               | 0820<br>1016 | 1020         | 1216         | 1225         | 1625 | 1625<br>1820 | 1640<br>1835 |              |              |
| 1200        | 122  | 0802<br>1016                       |              | 1025         |              | 1620         |      |              |              |              |              |
| 1500        | 152  | 1016                               |              | 1225         | 1225         | 1235         |      | 1830         |              |              |              |
| 1800        | 182  |                                    |              |              |              |              |      | 1840         |              |              |              |
| 2200        | 222  | 1020                               | 1220         | 1225         | 1225         |              |      |              |              |              |              |
| 2700        | 272  |                                    |              | 1230<br>1620 | 1625         |              |      |              |              |              |              |
| 3300        | 332  | 1220                               | 1225         | 1235<br>1625 |              |              |      |              |              |              |              |
| 3900        | 392  |                                    |              | 1265         |              |              |      |              |              |              |              |
| 4700        | 472  | 1225                               | 1235         |              |              |              |      |              |              |              |              |
| 5600        | 562  |                                    | 1625         |              |              |              |      |              |              |              |              |
| 6800        | 682  | 1625                               |              |              |              |              |      |              |              |              |              |

Released ratings

# Radial Leaded Aluminum Electrolytic Capacitors

## REF Series



### RATINGS & PART NUMBER REFERENCE

| Part No.        | Case Size | Capacitance (μF) | Rated Voltage (V) | DF Max. (%) | Impedance Max. at 20°C @100kHz (Ω) | 100kHz RMS Current (mA) / 105°C |
|-----------------|-----------|------------------|-------------------|-------------|------------------------------------|---------------------------------|
| 6.3 Volt        |           |                  |                   |             |                                    |                                 |
| REF0511151M006* | 0511      | 150              | 6.3               | 15          | 0.290                              | 300                             |
| REF0611221M006* | 0611      | 220              | 6.3               | 15          | 0.205                              | 377                             |
| REF0611331M006* | 0611      | 330              | 6.3               | 15          | 0.120                              | 455                             |
| REF0612471M006* | 0612      | 470              | 6.3               | 15          | 0.100                              | 510                             |
| REF0816102M006* | 0816      | 1000             | 6.3               | 15          | 0.052                              | 1000                            |
| REF0820122M006* | 0820      | 1200             | 6.3               | 15          | 0.040                              | 1300                            |
| REF1016122M006* | 1016      | 1200             | 6.3               | 15          | 0.037                              | 1480                            |
| REF1016152M006* | 1016      | 1500             | 6.3               | 15          | 0.037                              | 1480                            |
| REF1020222M006* | 1020      | 2200             | 6.3               | 15          | 0.021                              | 2200                            |
| REF1220332M006* | 1220      | 3300             | 6.3               | 15          | 0.020                              | 2410                            |
| REF1225472M006* | 1225      | 4700             | 6.3               | 15          | 0.015                              | 3340                            |
| REF1625682M006B | 1625      | 6800             | 6.3               | 15          | 0.015                              | 3510                            |
| 10 Volt         |           |                  |                   |             |                                    |                                 |
| REF0511101M010* | 0511      | 100              | 10                | 14          | 0.290                              | 300                             |
| REF0609101M010* | 0609      | 100              | 10                | 14          | 0.290                              | 300                             |
| REF0611221M010* | 0611      | 220              | 10                | 14          | 0.120                              | 455                             |
| REF0812471M010* | 0812      | 470              | 10                | 14          | 0.071                              | 810                             |
| REF0816681M010* | 0816      | 680              | 10                | 14          | 0.055                              | 1046                            |
| REF1013681M010* | 1013      | 680              | 10                | 14          | 0.052                              | 1080                            |
| REF0820102M010* | 0820      | 1000             | 10                | 14          | 0.040                              | 1300                            |
| REF1016102M010* | 1016      | 1000             | 10                | 14          | 0.037                              | 1480                            |
| REF1220222M010* | 1220      | 2200             | 10                | 14          | 0.020                              | 2410                            |
| REF1225332M010* | 1225      | 3300             | 10                | 14          | 0.020                              | 2820                            |
| REF1235472M010B | 1235      | 4700             | 10                | 14          | 0.021                              | 3450                            |
| REF1625562M010B | 1625      | 5600             | 10                | 14          | 0.015                              | 3510                            |
| 16 Volt         |           |                  |                   |             |                                    |                                 |
| REF0511101M016* | 0511      | 100              | 16                | 12          | 0.210                              | 320                             |
| REF0611221M016* | 0611      | 220              | 16                | 12          | 0.084                              | 721                             |
| REF0812331M016* | 0812      | 330              | 16                | 12          | 0.071                              | 810                             |
| REF1009331M016* | 1009      | 330              | 16                | 12          | 0.092                              | 680                             |
| REF0816471M016* | 0816      | 470              | 16                | 12          | 0.055                              | 1045                            |
| REF1013471M016* | 1013      | 470              | 16                | 12          | 0.052                              | 1080                            |
| REF0820681M016* | 0820      | 680              | 16                | 12          | 0.040                              | 1300                            |
| REF1016681M016* | 1016      | 680              | 16                | 12          | 0.040                              | 1480                            |
| REF1020102M016* | 1020      | 1000             | 16                | 12          | 0.023                              | 1870                            |
| REF1025122M016* | 1025      | 1200             | 16                | 12          | 0.021                              | 2200                            |
| REF1220152M016* | 1220      | 1500             | 16                | 12          | 0.029                              | 2410                            |
| REF1225222M016* | 1225      | 2200             | 16                | 12          | 0.021                              | 2200                            |
| REF1230272M016* | 1230      | 2700             | 16                | 12          | 0.015                              | 3340                            |
| REF1620272M016B | 1620      | 2700             | 16                | 12          | 0.017                              | 3190                            |
| REF1235332M016B | 1235      | 3300             | 16                | 12          | 0.014                              | 3450                            |
| REF1625332M016B | 1625      | 3300             | 16                | 12          | 0.016                              | 3350                            |
| REF1625392M016B | 1625      | 3900             | 16                | 12          | 0.015                              | 3510                            |
| 25 Volt         |           |                  |                   |             |                                    |                                 |
| REF0511470M025* | 0511      | 47               | 25                | 10          | 0.290                              | 300                             |
| REF0511101M025* | 0511      | 100              | 25                | 10          | 0.260                              | 320                             |
| REF0611101M025* | 0611      | 100              | 25                | 10          | 0.140                              | 455                             |
| REF0611221M025* | 0611      | 220              | 25                | 10          | 0.150                              | 455                             |
| REF0812221M025* | 0812      | 220              | 25                | 10          | 0.078                              | 810                             |
| REF0816331M025* | 0816      | 330              | 25                | 10          | 0.055                              | 1045                            |
| REF1013331M025* | 1013      | 330              | 25                | 10          | 0.052                              | 1080                            |
| REF0816471M025* | 0816      | 470              | 25                | 10          | 0.045                              | 1120                            |
| REF1016561M025* | 1016      | 560              | 25                | 10          | 0.030                              | 1675                            |
| REF1020681M025* | 1020      | 680              | 25                | 10          | 0.036                              | 1870                            |
| REF1020821M025* | 1020      | 820              | 25                | 10          | 0.035                              | 1900                            |
| REF1216102M025* | 1216      | 1000             | 25                | 10          | 0.028                              | 1920                            |
| REF1225152M025* | 1225      | 1500             | 25                | 10          | 0.030                              | 2750                            |
| REF1225222M025* | 1225      | 2200             | 25                | 10          | 0.027                              | 2820                            |
| REF1625272M025B | 1625      | 2700             | 25                | 10          | 0.015                              | 3510                            |
| 35 Volt         |           |                  |                   |             |                                    |                                 |
| REF0512330M035* | 0512      | 33               | 35                | 10          | 0.570                              | 300                             |

# Radial Leaded Aluminum Electrolytic Capacitors

## REF Series



| Part No.        | Case Size | Capacitance (μF) | Rated Voltage (V) | DF Max. (%) | Impedance Max. at 20°C @100kHz (Ω) | 100kHz RMS Current (mA) / 105°C |
|-----------------|-----------|------------------|-------------------|-------------|------------------------------------|---------------------------------|
| REF0612101M035* | 0612      | 100              | 35                | 10          | 0.450                              | 440                             |
| REF0811101M035* | 0811      | 100              | 35                | 10          | 0.200                              | 632                             |
| REF0812221M035* | 0812      | 220              | 35                | 10          | 0.100                              | 810                             |
| REF1009221M035* | 1009      | 220              | 35                | 10          | 0.120                              | 720                             |
| REF1016331M035* | 1016      | 330              | 35                | 10          | 0.037                              | 1480                            |
| REF1016471M035* | 1016      | 470              | 35                | 10          | 0.055                              | 1526                            |
| REF1220681M035* | 1220      | 680              | 35                | 10          | 0.045                              | 2410                            |
| REF1225102M035* | 1225      | 1000             | 35                | 10          | 0.025                              | 2820                            |
| REF1620122M035B | 1620      | 1200             | 35                | 10          | 0.017                              | 3190                            |
| REF1235152M035B | 1235      | 1500             | 35                | 10          | 0.014                              | 3450                            |
| 50 Volt         |           |                  |                   |             |                                    |                                 |
| REF0512220M050* | 0512      | 22               | 50                | 8           | 0.540                              | 288                             |
| REF0612560M050* | 0612      | 56               | 50                | 8           | 0.300                              | 435                             |
| REF0812101M050* | 0812      | 100              | 50                | 8           | 0.160                              | 774                             |
| REF0816121M050* | 0816      | 120              | 50                | 8           | 0.130                              | 1000                            |
| REF1013151M050* | 1013      | 150              | 50                | 8           | 0.110                              | 1029                            |
| REF0820181M050* | 0820      | 180              | 50                | 8           | 0.085                              | 1240                            |
| REF1013221M050* | 1013      | 220              | 50                | 8           | 0.130                              | 1029                            |
| REF1016271M050* | 1016      | 270              | 50                | 8           | 0.090                              | 1020                            |
| REF1016331M050* | 1016      | 330              | 50                | 8           | 0.045                              | 1150                            |
| REF1020471M050* | 1020      | 470              | 50                | 8           | 0.036                              | 1500                            |
| REF1220561M050* | 1220      | 560              | 50                | 8           | 0.035                              | 2150                            |
| REF1220681M050* | 1220      | 680              | 50                | 8           | 0.040                              | 2100                            |
| REF1620821M050B | 1620      | 820              | 50                | 8           | 0.022                              | 2780                            |
| REF1625102M050B | 1625      | 1000             | 50                | 8           | 0.025                              | 3060                            |
| 63 Volt         |           |                  |                   |             |                                    |                                 |
| REF0611330M063* | 0611      | 33               | 63                | 8           | 1.200                              | 126                             |
| REF0612470M063* | 0612      | 47               | 63                | 8           | 0.800                              | 150                             |
| REF0812820M063* | 0812      | 82               | 63                | 8           | 0.480                              | 320                             |
| REF1013820M063* | 1013      | 82               | 63                | 8           | 0.420                              | 420                             |
| REF0812101M063* | 0812      | 100              | 63                | 8           | 0.500                              | 280                             |
| REF1013101M063* | 1013      | 100              | 63                | 8           | 0.300                              | 420                             |
| REF0816121M063* | 0816      | 120              | 63                | 8           | 0.350                              | 350                             |
| REF1013151M063* | 1013      | 150              | 63                | 8           | 0.300                              | 400                             |
| REF1016221M063* | 1016      | 220              | 63                | 8           | 0.160                              | 480                             |
| REF1020331M063* | 1020      | 330              | 63                | 8           | 0.160                              | 640                             |
| REF1320471M063B | 1320      | 470              | 63                | 8           | 0.100                              | 880                             |
| REF1320561M063B | 1320      | 560              | 63                | 8           | 0.086                              | 1180                            |
| REF1620681M063B | 1620      | 680              | 63                | 8           | 0.085                              | 1250                            |
| REF1625821M063B | 1625      | 820              | 63                | 8           | 0.057                              | 1570                            |
| REF1625102M063B | 1625      | 1000             | 63                | 8           | 0.045                              | 1800                            |
| REF1820102M063B | 1820      | 1000             | 63                | 8           | 0.050                              | 1780                            |
| REF1830152M063B | 1830      | 1500             | 63                | 8           | 0.036                              | 2150                            |
| REF1840182M063B | 1840      | 1800             | 63                | 8           | 0.032                              | 2280                            |
| 80 Volt         |           |                  |                   |             |                                    |                                 |
| REF1016151M080* | 1016      | 150              | 80                | 8           | 0.240                              | 600                             |
| REF1020221M080* | 1020      | 220              | 80                | 8           | 0.150                              | 680                             |
| REF1220331M080* | 1220      | 330              | 80                | 8           | 0.120                              | 750                             |
| REF1620471M080B | 1620      | 470              | 80                | 8           | 0.007                              | 1150                            |
| REF1825681M080B | 1825      | 680              | 80                | 8           | 0.036                              | 1750                            |
| REF1640102M080B | 1640      | 1000             | 80                | 8           | 0.029                              | 2200                            |
| REF1835102M080B | 1835      | 1000             | 80                | 8           | 0.027                              | 2200                            |
| 100 Volt        |           |                  |                   |             |                                    |                                 |
| REF05116R8M100* | 0511      | 6.8              | 100               | 8           | 1.400                              | 86                              |
| REF06096R8M100* | 0609      | 6.8              | 100               | 8           | 1.800                              | 80                              |
| REF0612220M100* | 0612      | 22               | 100               | 8           | 1.000                              | 235                             |
| REF1009270M100* | 1009      | 27               | 100               | 8           | 0.470                              | 320                             |
| REF1013330M100* | 1013      | 33               | 100               | 8           | 0.450                              | 320                             |
| REF1013470M100* | 1013      | 47               | 100               | 8           | 0.320                              | 480                             |
| REF1016680M100* | 1016      | 68               | 100               | 8           | 0.220                              | 600                             |
| REF1016101M100* | 1016      | 100              | 100               | 8           | 0.200                              | 750                             |
| REF1020151M100* | 1020      | 150              | 100               | 8           | 0.170                              | 850                             |
| REF1320221M100B | 1320      | 220              | 100               | 8           | 0.150                              | 860                             |
| REF1225331M100* | 1225      | 330              | 100               | 8           | 0.100                              | 1000                            |
| REF1620331M100B | 1620      | 330              | 100               | 8           | 0.070                              | 1350                            |

# Radial Leaded Aluminum Electrolytic Capacitors

## REF Series



| Part No.        | Case Size | Capacitance (μF) | Rated Voltage (V) | DF Max. (%) | Impedance Max. at 20°C @100kHz (Ω) | 100kHz RMS Current (mA) / 105°C |
|-----------------|-----------|------------------|-------------------|-------------|------------------------------------|---------------------------------|
| REF1625471M100B | 1625      | 470              | 100               | 8           | 0.045                              | 1640                            |
| REF1825561M100B | 1825      | 560              | 100               | 8           | 0.050                              | 1800                            |
| REF1640681M100B | 1640      | 680              | 100               | 8           | 0.034                              | 2200                            |
| REF1835681M100B | 1835      | 680              | 100               | 8           | 0.034                              | 2200                            |
| REF1840821M100B | 1840      | 820              | 100               | 8           | 0.032                              | 2700                            |
| <b>120 Volt</b> |           |                  |                   |             |                                    |                                 |
| REF0612100M120* | 0612      | 10               | 120               | 12          | 5.500                              | 80                              |
| REF0812220M120* | 0812      | 22               | 120               | 12          | 3.500                              | 130                             |
| REF0816330M120* | 0816      | 33               | 120               | 12          | 3.000                              | 220                             |
| REF1013330M120* | 1013      | 33               | 120               | 12          | 3.000                              | 220                             |
| REF1016470M120* | 1016      | 47               | 120               | 12          | 2.500                              | 270                             |
| REF1016560M120* | 1016      | 56               | 120               | 12          | 2.200                              | 285                             |
| REF1020680M120* | 1020      | 68               | 120               | 12          | 1.800                              | 300                             |
| REF1025101M120* | 1025      | 100              | 120               | 12          | 1.500                              | 380                             |
| REF1320121M120B | 1320      | 120              | 120               | 12          | 1.300                              | 620                             |
| REF1225151M120* | 1225      | 150              | 120               | 12          | 1.000                              | 570                             |
| REF1230221M120* | 1230      | 220              | 120               | 12          | 0.800                              | 750                             |
| REF1620221M120B | 1620      | 220              | 120               | 12          | 0.600                              | 760                             |
| REF1825331M120B | 1825      | 330              | 120               | 12          | 0.420                              | 860                             |

\* Used to denote packing type: "K" for Ammo Pack or "B" for Bulk Pack.

DF = When nominal capacitance exceeds 1000μF, add 0.02 to the value above for each 1000μF increase.

All technical data relates to an ambient temperature of +25°C. Capacitance and DF are measured at 120Hz, 0.5RMS with DC bias of 2.2 volts. DCL is measured at rated voltage after 2 minutes

### RATED RIPPLE CURRENT MULTIPLIERS (FREQUENCY CORRECTION FACTOR FOR RIPPLE CURRENT)

| Cap.(μF) \ Freq.(Hz) | 120  | 1K   | 10K  | 100K |
|----------------------|------|------|------|------|
| C < 220              | 0.40 | 0.75 | 0.90 | 1.00 |
| 220 ≤ C < 680        | 0.50 | 0.85 | 0.94 | 1.00 |
| 680 ≤ C < 2200       | 0.60 | 0.87 | 0.95 | 1.00 |
| 2200 ≤ C < 4700      | 0.75 | 0.90 | 0.95 | 1.00 |
| C ≥ 4700             | 0.85 | 0.95 | 0.98 | 1.00 |

### QUALIFICATION TABLE

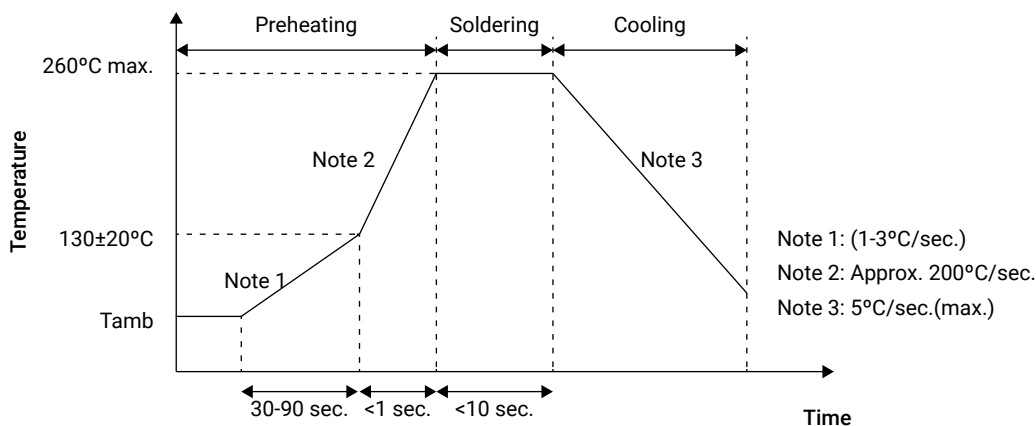
| Test                                                  | REF Series (Temperature Range -40°C to +105°C)                                                                                                                                          |                    |                                       |    |    |        |     |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------|----|----|--------|-----|
|                                                       | Condition                                                                                                                                                                               | Characteristics    |                                       |    |    |        |     |
| Low Temperature Characteristic (Max. Impedance Ratio) | 120Hz                                                                                                                                                                                   | Rated Voltage (V)  | 6.3                                   | 10 | 16 | 25-100 | 120 |
|                                                       |                                                                                                                                                                                         | Z(-25°C) / Z(20°C) | 5                                     | 4  | 3  | 3      | 3   |
|                                                       |                                                                                                                                                                                         | Z(-40°C) / Z(20°C) | 10                                    | 8  | 5  | 4      | 6   |
| Endurance                                             | The following specifications shall be satisfied when the capacitors are restored to 20°C after DC voltage plus rated ripple current is applied for a specified period of time at 105°C. | Visual examination | no visible damage                     |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ΔC/C               | ≤ ±25% of the initial limit           |    |    |        |     |
|                                                       |                                                                                                                                                                                         | DF:                | ≤ 200% of the initial specified limit |    |    |        |     |
|                                                       |                                                                                                                                                                                         | DCL:               | ≤ Initial specified limit             |    |    |        |     |
| Load Life                                             | The following specifications shall be satisfied when the capacitors are restored to 20°C after DC voltage plus rated ripple current is applied for a specified period of time at 105°C. | Diameter (mm)      | Load life (hours)                     |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ØD≤6.3             | 3000                                  |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ØD=8               | 4000                                  |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ØD=10              | 5000                                  |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ØD≥12.5            | 6000                                  |    |    |        |     |
| Shelf Life                                            | The following specifications shall be satisfied when the capacitors are restored to 20°C after leaving them under no load at 105°C for 1000 hours.                                      | Visual examination | no visible damage                     |    |    |        |     |
|                                                       |                                                                                                                                                                                         | ΔC/C               | ≤ ±25% of the initial limit           |    |    |        |     |
|                                                       |                                                                                                                                                                                         | DF:                | ≤ 200% of the initial specified limit |    |    |        |     |
|                                                       |                                                                                                                                                                                         | DCL:               | ≤ 200% of the initial specified limit |    |    |        |     |

Radial Leaded Aluminum Electrolytic Capacitors  
REF Series



SOLDERING

1. When soldering with a soldering iron:
- Soldering conditions (temperature and time) should be within the limits prescribed in the catalogs or the product specifications.
  - If the terminal spacing of a capacitor does not fit the terminal hole spacing of the PC board, reform the terminals in a manner to minimize a mechanical stress into the body of the capacitor.
  - Remove the capacitors from the PC board, after the solder is completely melted, reworking by using a soldering iron minimizes the mechanical stress to the capacitors.
  - Do not touch the capacitor body with the hot tip of the soldering iron.
2. Flow Soldering:
- Do not dip the body of a capacitor into the solder bath, only dip the terminals in. The soldering must be done on the reverse side of PC board.
  - Do not apply flux to any part of capacitors other than their terminals.
  - Make sure the capacitors do not come into contact with any other components while soldering.
  - Soldering conditions (preheat, solder temperature and dipping time) should be within the limits prescribed in the picture below.



STORAGE

- Store with the temperature range between 5 to 35°C (If between 35 to 85°C, it should be less than three months), and the relative humidity of 75% without direct sunshine and store in the package states if possible.
- It is recommended that you open the bag just before use and use up as early as possible.
- Store the capacitors in places free from water, oil or salt water or in condensation status.
- Never store in any area filled with poisonous gases (including hydrogen sulfide, sulfurous acid, nitrous acid, chlorine and ammonia).
- Store the capacitors in places free from ozone, ultraviolet rays or radiation:  
(Radial Lead Type)  
Before unseal: within 1 year after delivery  
After opening: within 1 month

PACKING

| Size Code | Bulk Pack |           |             |                |                  | Ammo Pack |                |                    |             |              |
|-----------|-----------|-----------|-------------|----------------|------------------|-----------|----------------|--------------------|-------------|--------------|
|           | Bags      | Inner Box |             | Carton         |                  | Inner Box |                | Carton             |             |              |
|           |           | (LxWxH)   |             | (LxWxH)        |                  | Quantity  | Inner Box Size | Inner Box Quantity | Carton Size | Whole Pieces |
|           |           | Quantity  | Bags Number | Quantity / pcs | Inner Box Number |           |                |                    |             |              |
| 0511      | 1000      | 12        | 12,000      | 4              | 48,000           | 2000      | 320x230x50     | 10                 | 485x345x275 | 20,000       |
| 0512      | 1000      | 12        | 12,000      | 4              | 48,000           | 2000      | 320x230x50     | 10                 | 485x345x275 | 20,000       |
| 0609      | 1000      | 8         | 8000        | 4              | 32,000           | 2000      | 340x290x48     | 10                 | 600x354x265 | 20,000       |
| 0611      | 1000      | 8         | 8000        | 4              | 32,000           | 2000      | 340x290x48     | 10                 | 600x354x265 | 20,000       |
| 0612      | 500       | 10        | 5000        | 4              | 20,000           | 2000      | 340x290x48     | 10                 | 600x354x265 | 20,000       |

# Radial Leaded Aluminum Electrolytic Capacitors

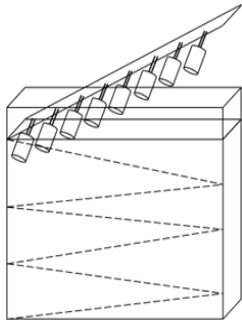
## REF Series



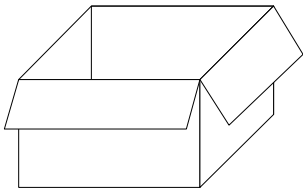
|      |     |    |      |   |        |     |            |   |             |      |
|------|-----|----|------|---|--------|-----|------------|---|-------------|------|
| 0811 | 500 | 10 | 5000 | 4 | 20,000 | 950 | 320x230x50 | 6 | 485x345x275 | 5700 |
| 0812 | 500 | 10 | 5000 | 4 | 20,000 | 950 | 320x230x50 | 6 | 485x345x275 | 5700 |
| 0816 | 300 | 10 | 3000 | 4 | 12,000 | 950 | 320x230x55 | 6 | 485x345x300 | 5700 |
| 0820 | 300 | 10 | 3000 | 4 | 12,000 | 950 | 320x230x55 | 6 | 485x345x300 | 5700 |
| 1009 | 250 | 12 | 3000 | 4 | 12,000 | 600 | 320x230x50 | 6 | 485x345x275 | 3600 |
| 1013 | 250 | 10 | 2500 | 4 | 10,000 | 600 | 320x230x50 | 6 | 485x345x275 | 3600 |
| 1016 | 250 | 10 | 2500 | 4 | 10,000 | 600 | 320x230x55 | 6 | 485x345x300 | 3600 |
| 1020 | 200 | 10 | 2000 | 4 | 8000   | 600 | 320x230x55 | 6 | 485x345x300 | 3600 |
| 1025 | 150 | 10 | 1500 | 4 | 6000   | 600 | 320x230x68 | 8 | 485x345x300 | 4800 |
| 1216 | 100 | 14 | 1400 | 4 | 5600   | 500 | 320x290x60 | 5 | 330x300x350 | 2500 |
| 1220 | 100 | 12 | 1200 | 4 | 4800   | 500 | 320x290x60 | 5 | 330x300x350 | 2500 |
| 1225 | 100 | 10 | 1000 | 4 | 4000   | 500 | 320x290x60 | 5 | 330x300x350 | 2500 |
| 1230 | 100 | 10 | 1000 | 4 | 4000   | 500 | 330x230x68 | 4 | 330x310x350 | 2000 |
| 1320 | 100 | 12 | 1200 | 4 | 4800   | -   | -          | - | -           | -    |
| 1620 | 100 | 5  | 500  | 4 | 2000   | -   | -          | - | -           | -    |
| 1820 | 100 | 5  | 500  | 4 | 2000   | -   | -          | - | -           | -    |

| Size Code | Bulk Pack |                |                    |             |              |
|-----------|-----------|----------------|--------------------|-------------|--------------|
|           | Inner Box |                | Carton             |             |              |
|           | Quantity  | Inner Box Size | Inner Box Quantity | Carton Size | Whole Pieces |
|           |           | (LxWxH)        |                    | (LxWxH)     |              |
| 1235      | 440       | 340x235x50     | 5                  | 365x260x315 | 2200         |
| 1625      | 250       | 340x235x50     | 5                  | 365x260x290 | 1250         |
| 1640      | 200       | 340x235x50     | 5                  | 365x260x290 | 1000         |
| 1825      | 250       | 340x235x50     | 5                  | 365x260x290 | 1250         |
| 1830      | 230       | 340x235x50     | 5                  | 365x260x290 | 1150         |
| 1835      | 200       | 340x235x50     | 5                  | 365x260x290 | 1000         |
| 1840      | 180       | 340x235x50     | 5                  | 365x260x290 | 900          |

### AMMO PACKING



### BULK PACKING



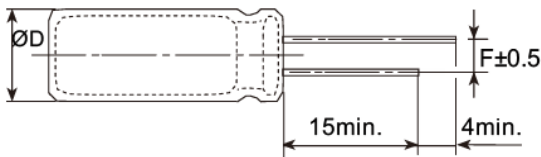
# Radial Leaded Aluminum Electrolytic Capacitors

## REF Series

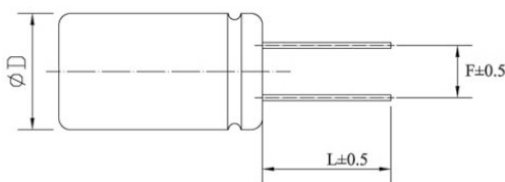


### TERMINATION TYPE

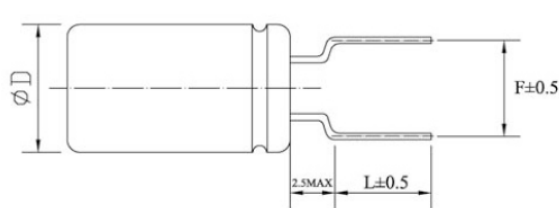
Letter “ ”: Empty = Standard Long lead.



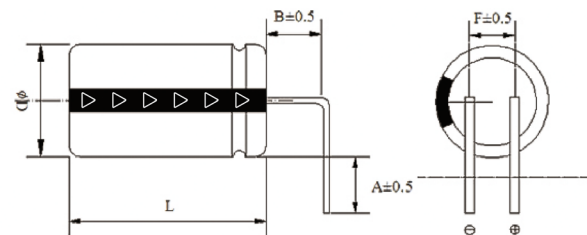
Letter “C”: Lead cut only.



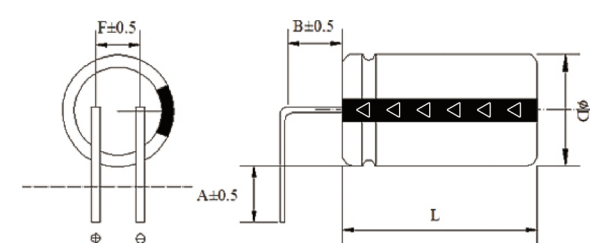
Letter “F”: Lead cut and form.



Letter “R”: Lead cut and bend (Right).



Letter “L”: Lead cut and bend (Left).



| Letter | Termination Type   | Dø | 4ø   | 5ø   | 6.3ø | 8ø   | 10ø  | 12.5ø | 13ø  | 16ø  | 18ø  |
|--------|--------------------|----|------|------|------|------|------|-------|------|------|------|
|        | Standard long lead | F  | 1.50 | 2.00 | 2.50 | 3.50 | 5.00 | 5.00  | 5.00 | 7.50 | 7.50 |
| C      | Lead cut only      | F  | 1.50 | 2.00 | 2.50 | 3.50 | 5.00 | 5.00  | 5.00 | 7.50 | 7.50 |
|        |                    | L  | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60  | 3.60 | 3.60 | 3.60 |
| F      | Lead cut and form  | F  | 5.00 | 5.00 | 5.00 | 5.00 |      |       |      |      |      |
|        |                    | L  | 3.50 | 3.50 | 3.50 | 3.50 |      |       |      |      |      |
| R / L  | Lead cut and bend  | F  |      |      |      |      | 5.00 | 5.00  | 5.00 | 7.50 | 7.50 |
|        |                    | A  |      |      |      |      | 3.50 | 3.50  | 3.50 | 3.50 | 3.50 |
|        |                    | B  |      |      |      |      | 2.50 | 2.50  | 2.50 | 2.50 | 2.50 |

\*All dimensions in mm.