

# SMQ Series

- Downsized from current standard SMG series
- Endurance : 2,000 hours at 85°C
- Non solvent resistant type
- RoHS2 Compliant

SMQ

↑ Downsized  
SMG



## ◆ SPECIFICATIONS

| Items  | Characteristics  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|--|--|--------------------------------------|------|------|------|------|------|------|--------------------------------------|-------------|---------------------------|-------------------|-----------------|------|---|--|
| Category   | -40 to +85°C(6.3 to 400V <sub>dc</sub> ) -25 to +85°C(450V <sub>dc</sub> )   |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Temperature Range  |  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Rated Voltage Range  | 6.3 to 450V <sub>dc</sub>  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Capacitance Tolerance  | ±20% (M) (at 20°C, 120Hz)  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Leakage Current  | 6.3 to 100V <sub>dc</sub>  |                                      |      |      |      |      |      |      |                                      |             | 160 to 450V <sub>dc</sub> |                   |                 |      |   |  |
|  | I=0.03CV or 4µA, whichever is greater.   |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|  |  |                                      |      |      |      |      |      |      |                                      |             | CV≤1,000                  |                   | I=0.1CV+40 max. |      |   |  |
|  |  |                                      |      |      |      |      |      |      |                                      | CV>1,000    |                           | I=0.04CV+100 max. |                 |      |   |  |
| Where, I : Max. leakage current (µA), C : Nominal capacitance (µF), V : Rated voltage (V) (at 20°C after 1 minute) |  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Dissipation Factor (tan δ)   | Rated voltage (V <sub>dc</sub> )   | 6.3V                                 | 10V  | 16V  | 25V  | 35V  | 50V  | 63V  | 100V                                 | 160 to 250V | 315 to 400V               | 450V              |                 |      |   |  |
|  | tan δ (Max.)   | 0.28                                 | 0.24 | 0.20 | 0.16 | 0.14 | 0.12 | 0.09 | 0.08                                 | 0.20        | 0.24                      | 0.24              |                 |      |   |  |
|  | When nominal capacitance exceeds 1,000µF, add 0.02 to the value above for each 1,000µF increase. (at 20°C, 120Hz)  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Low Temperature Characteristics (Max. Impedance Ratio)   | Rated voltage (V <sub>dc</sub> )   | 6.3V                                 | 10V  | 16V  | 25V  | 35V  | 50V  | 63V  | 100V                                 | 160 to 200V | 250V                      | 350V              | 400V            | 450V |   |  |
|  | Z(-25°C)/Z(+20°C)  | ≤φ8                                  | 5    | 4    | 3    | 2    | 2    | 2    | 2                                    | 2           | 3                         | 3                 | 4               | 4    | 6 |  |
|  |  | ≥φ10                                 | 5    | 4    | 3    | 2    | 2    | 2    | 2                                    | 2           | 3                         | 3                 | 4               | 4    | 6 |  |
|  | Z(-40°C)/Z(+20°C)  | ≤φ8                                  | 12   | 10   | 8    | 5    | 4    | 3    | 3                                    | 3           | 8                         | 10                | 8               | 8    | — |  |
|  | ≥φ10   | 12                                   | 10   | 8    | 5    | 4    | 3    | 3    | 3                                    | 4           | 4                         | 6                 | 6               | —    |   |  |
| (at 120Hz)   |  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Endurance  | The following specifications shall be satisfied when the capacitors are restored to 20°C after the rated voltage is applied for 2,000 hours at 85°C.   |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|  | Capacitance change   | ≤ ±20% of the initial value          |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|  | D.F. (tan δ)   | ≤200% of the initial specified value |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|  | Leakage current  | ≤The initial specified value         |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
| Shelf Life   | The following specifications shall be satisfied when the capacitors are restored to 20°C after exposing them for 1,000 hours at 85°C without voltage applied. Before the measurement, the capacitor shall be preconditioned by applying voltage according to Item 4.1 of JIS C 5101-4. |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |
|  | Rated voltage  | 6.3 to 100V <sub>dc</sub>            |      |      |      |      |      |      | 160 to 450V <sub>dc</sub>            |             |                           |                   |                 |      |   |  |
|  | Capacitance change   | ≤ ±20% of the initial value          |      |      |      |      |      |      | ≤ ±20% of the initial value          |             |                           |                   |                 |      |   |  |
|  | D.F. (tan δ)   | ≤200% of the initial specified value |      |      |      |      |      |      | ≤200% of the initial specified value |             |                           |                   |                 |      |   |  |
|  | Leakage current  | ≤The initial specified value         |      |      |      |      |      |      | ≤500% of the initial specified value |             |                           |                   |                 |      |   |  |
|  |  |                                      |      |      |      |      |      |      |                                      |             |                           |                   |                 |      |   |  |

## ◆ DIMENSIONS [mm]

- Terminal Code : E



| φ D  | 5          | 6.3 | 8   | 10  | 12.5 | 16  | 18  |
|------|------------|-----|-----|-----|------|-----|-----|
| φ d  | 0.5        | 0.5 | 0.6 | 0.6 | 0.6  | 0.8 | 0.8 |
| F    | 2.0        | 2.5 | 3.5 | 5.0 | 5.0  | 7.5 | 7.5 |
| φ D' | φD+0.5max. |     |     |     |      |     |     |
| L'   | L+1.5max.  |     |     |     |      |     |     |

## ◆ PART NUMBERING SYSTEM



Please refer to "Product code guide (radial lead type)"

**◆STANDARD RATINGS**

| WV<br>(V <sub>dc</sub> ) | Cap<br>(µF) | Case size<br>φD×L(mm) | tan δ | Rated ripple<br>current<br>(mArms/<br>85°C, 120Hz) | Part No.           | WV<br>(V <sub>dc</sub> ) | Cap<br>(µF) | Case size<br>φD×L(mm) | tan δ    | Rated ripple<br>current<br>(mArms/<br>85°C, 120Hz) | Part No.           |
|--------------------------|-------------|-----------------------|-------|--|--------------------|--------------------------|-------------|-----------------------|----------|--|--------------------|
| 6.3                      | 1,000       | 8 × 11.5              | 0.28  | 540  | ESMQ6R3E□□102MHB5D | 63                       | 33          | 6.3 × 11              | 0.09     | 140  | ESMQ630E□□330MF11D |
|                          | 2,200       | 10 × 16               | 0.30  | 890  | ESMQ6R3E□□222MJ16S |                          | 47          | 6.3 × 11              | 0.09     | 170  | ESMQ630E□□470MF11D |
|                          | 3,300       | 10 × 20               | 0.32  | 1,190  | ESMQ6R3E□□332MJ20S |                          | 68          | 8 × 11.5              | 0.09     | 220  | ESMQ630E□□680MHB5D |
|                          | 4,700       | 12.5 × 20             | 0.34  | 1,550  | ESMQ6R3E□□472MK20S |                          | 100         | 8 × 11.5              | 0.09     | 280  | ESMQ630E□□101MHB5D |
|                          | 6,800       | 12.5 × 25             | 0.38  | 1,920  | ESMQ6R3E□□682MK25S |                          | 220         | 10 × 16               | 0.09     | 490  | ESMQ630E□□221MJ16S |
|                          | 10,000      | 16 × 25               | 0.46  | 2,350  | ESMQ6R3E□□103ML25S |                          | 330         | 10 × 20               | 0.09     | 710  | ESMQ630E□□331MJ20S |
|                          | 15,000      | 16 × 31.5             | 0.56  | 2,550  | ESMQ6R3E□□153MLN3S |                          | 470         | 12.5 × 20             | 0.09     | 900  | ESMQ630E□□471MK20S |
|                          | 22,000      | 18 × 35.5             | 0.70  | 3,200  | ESMQ6R3E□□223MMP1S |                          | 1,000       | 16 × 25               | 0.09     | 1,300  | ESMQ630E□□102ML25S |
| 10                       | 220         | 5 × 11                | 0.24  | 240  | ESMQ100E□□221ME11D | 100                      | 2,200       | 18 × 35.5             | 0.11     | 2,300  | ESMQ630E□□222MMP1S |
|                          | 330         | 6.3 × 11              | 0.24  | 290  | ESMQ100E□□331MF11D |                          | 1.0         | 5 × 11                | 0.08     | 21   | ESMQ101E□□1R0ME11D |
|                          | 470         | 6.3 × 11              | 0.24  | 350  | ESMQ100E□□471MF11D |                          | 2.2         | 5 × 11                | 0.08     | 30   | ESMQ101E□□2R2ME11D |
|                          | 1,000       | 10 × 12.5             | 0.24  | 650  | ESMQ100E□□102MJC5S |                          | 3.3         | 5 × 11                | 0.08     | 40   | ESMQ101E□□3R3ME11D |
|                          | 2,200       | 10 × 16               | 0.26  | 990  | ESMQ100E□□222MJ16S |                          | 4.7         | 5 × 11                | 0.08     | 45   | ESMQ101E□□4R7ME11D |
|                          | 3,300       | 12.5 × 20             | 0.28  | 1,450  | ESMQ100E□□332MK20S |                          | 10          | 5 × 11                | 0.08     | 70   | ESMQ101E□□100ME11D |
|                          | 4,700       | 12.5 × 25             | 0.30  | 1,800  | ESMQ100E□□472MK25S |                          | 22          | 6.3 × 11              | 0.08     | 130  | ESMQ101E□□220MF11D |
|                          | 6,800       | 16 × 25               | 0.34  | 2,250  | ESMQ100E□□682ML25S |                          | 33          | 8 × 11.5              | 0.08     | 180  | ESMQ101E□□330MHB5D |
|                          | 10,000      | 16 × 31.5             | 0.42  | 2,550  | ESMQ100E□□103MLN3S |                          | 47          | 8 × 11.5              | 0.08     | 200  | ESMQ101E□□470MHB5D |
|                          | 15,000      | 16 × 35.5             | 0.52  | 2,880  | ESMQ100E□□153MLP1S |                          | 68          | 10 × 12.5             | 0.08     | 270  | ESMQ101E□□680MJC5S |
| 16                       | 22,000      | 18 × 40               | 0.66  | 3,400  | ESMQ100E□□223MM40S | 100                      | 10 × 16     | 0.08                  | 340      | ESMQ101E□□101MJ16S                                 |                    |
|                          | 220         | 6.3 × 11              | 0.20  | 260  | ESMQ160E□□221MF11D | 220                      | 12.5 × 20   | 0.08                  | 550      | ESMQ101E□□221MK20S                                 |                    |
|                          | 330         | 6.3 × 11              | 0.20  | 320  | ESMQ160E□□331MF11D | 330                      | 12.5 × 25   | 0.08                  | 760      | ESMQ101E□□331MK25S                                 |                    |
|                          | 470         | 8 × 11.5              | 0.20  | 440  | ESMQ160E□□471MHB5D | 470                      | 16 × 25     | 0.08                  | 1,000    | ESMQ101E□□471ML25S                                 |                    |
|                          | 1,000       | 10 × 12.5             | 0.20  | 700  | ESMQ160E□□102MJC5S | 1,000                    | 18 × 35.5   | 0.08                  | 1,350    | ESMQ101E□□102MMP1S                                 |                    |
|                          | 2,200       | 10 × 20               | 0.22  | 1,000  | ESMQ160E□□222MJ20S | 160                      | 10          | 8 × 11.5              | 0.20     | 80   | ESMQ161E□□100MHB5D |
|                          | 3,300       | 12.5 × 25             | 0.24  | 1,700  | ESMQ160E□□332MK25S |                          | 22          | 10 × 12.5             | 0.20     | 130  | ESMQ161E□□220MJC5S |
|                          | 4,700       | 16 × 25               | 0.26  | 2,100  | ESMQ160E□□472ML25S |                          | 33          | 10 × 16               | 0.20     | 180  | ESMQ161E□□330MJ16S |
|                          | 6,800       | 16 × 25               | 0.30  | 2,250  | ESMQ160E□□682ML25S |                          | 47          | 10 × 20               | 0.20     | 210  | ESMQ161E□□470MJ20S |
|                          | 10,000      | 16 × 35.5             | 0.38  | 2,710  | ESMQ160E□□103MLP1S |                          | 68          | 12.5 × 20             | 0.20     | 350  | ESMQ161E□□680MK20S |
| 15,000                   | 18 × 40     | 0.48                  | 3,100 | ESMQ160E□□153MM40S                                 | 100                |                          | 12.5 × 25   | 0.20                  | 430      | ESMQ161E□□101MK25S                                 |                    |
| 25                       | 100         | 5 × 11                | 0.16  | 180  | ESMQ250E□□101ME11D |                          | 220         | 16 × 31.5             | 0.20     | 760  | ESMQ161E□□221MLN3S |
|                          | 220         | 6.3 × 11              | 0.16  | 280  | ESMQ250E□□221MF11D |                          | 330         | 18 × 35.5             | 0.20     | 995  | ESMQ161E□□331MMP1S |
|                          | 330         | 8 × 11.5              | 0.16  | 440  | ESMQ250E□□331MHB5D |                          | 470         | 18 × 40               | 0.20     | 1,200  | ESMQ161E□□471MM40S |
|                          | 470         | 10 × 12.5             | 0.16  | 550  | ESMQ250E□□471MJC5S |                          | 200         | 1.0                   | 6.3 × 11 | 0.20   | 22                 |
|                          | 1,000       | 10 × 16               | 0.16  | 860  | ESMQ250E□□102MJ16S | 2.2                      |             | 6.3 × 11              | 0.20     | 33   | ESMQ201E□□2R2MF11D |
|                          | 2,200       | 12.5 × 25             | 0.18  | 1,550  | ESMQ250E□□222MK25S | 3.3                      |             | 6.3 × 11              | 0.20     | 40   | ESMQ201E□□3R3MF11D |
|                          | 3,300       | 16 × 25               | 0.20  | 1,980  | ESMQ250E□□332ML25S | 4.7                      |             | 6.3 × 11              | 0.20     | 50   | ESMQ201E□□4R7MF11D |
|                          | 4,700       | 16 × 25               | 0.22  | 2,200  | ESMQ250E□□472ML25S | 10                       |             | 8 × 11.5              | 0.20     | 80   | ESMQ201E□□100MHB5D |
|                          | 6,800       | 16 × 35.5             | 0.26  | 2,600  | ESMQ250E□□682MLP1S | 22                       |             | 10 × 16               | 0.20     | 150  | ESMQ201E□□220MJ16S |
|                          | 10,000      | 18 × 40               | 0.34  | 2,800  | ESMQ250E□□103MM40S | 33                       |             | 10 × 20               | 0.20     | 205  | ESMQ201E□□330MJ20S |
| 35                       | 47          | 5 × 11                | 0.14  | 130  | ESMQ350E□□470ME11D | 47                       |             | 12.5 × 20             | 0.20     | 270  | ESMQ201E□□470MK20S |
|                          | 68          | 6.3 × 11              | 0.14  | 160  | ESMQ350E□□680MF11D | 68                       |             | 12.5 × 25             | 0.20     | 350  | ESMQ201E□□680MK25S |
|                          | 100         | 6.3 × 11              | 0.14  | 210  | ESMQ350E□□101MF11D | 100                      |             | 16 × 25               | 0.20     | 475  | ESMQ201E□□101ML25S |
|                          | 220         | 8 × 11.5              | 0.14  | 385  | ESMQ350E□□221MHB5D | 220                      | 16 × 35.5   | 0.20                  | 700      | ESMQ201E□□221MLP1S                                 |                    |
|                          | 330         | 10 × 12.5             | 0.14  | 490  | ESMQ350E□□331MJC5S | 330                      | 18 × 40     | 0.20                  | 950      | ESMQ201E□□331MM40S                                 |                    |
|                          | 470         | 10 × 16               | 0.14  | 650  | ESMQ350E□□471MJ16S | 250                      | 3.3         | 6.3 × 11              | 0.20     | 40   | ESMQ251E□□3R3MF11D |
|                          | 1,000       | 12.5 × 20             | 0.14  | 1,150  | ESMQ350E□□102MK20S |                          | 4.7         | 6.3 × 11              | 0.20     | 50   | ESMQ251E□□4R7MF11D |
|                          | 2,200       | 16 × 25               | 0.16  | 1,800  | ESMQ350E□□222ML25S |                          | 10          | 10 × 12.5             | 0.20     | 100  | ESMQ251E□□3R3MJC5S |
|                          | 3,300       | 16 × 31.5             | 0.18  | 2,100  | ESMQ350E□□332MLN3S |                          | 22          | 10 × 20               | 0.20     | 170  | ESMQ251E□□220MJ20S |
|                          | 4,700       | 16 × 35.5             | 0.20  | 2,500  | ESMQ350E□□472MLP1S |                          | 33          | 10 × 20               | 0.20     | 200  | ESMQ251E□□330MJ20S |
| 6,800                    | 18 × 40     | 0.24                  | 2,800 | ESMQ350E□□682MM40S                                 | 47                 |                          | 12.5 × 20   | 0.20                  | 270      | ESMQ251E□□470MK20S                                 |                    |
| 50                       | 1.0         | 5 × 11                | 0.12  | 17   | ESMQ500E□□1R0ME11D |                          | 68          | 16 × 25               | 0.20     | 380  | ESMQ251E□□680ML25S |
|                          | 2.2         | 5 × 11                | 0.12  | 28   | ESMQ500E□□2R2ME11D |                          | 100         | 16 × 25               | 0.20     | 440  | ESMQ251E□□101ML25S |
|                          | 3.3         | 5 × 11                | 0.12  | 35   | ESMQ500E□□3R3ME11D |                          | 220         | 18 × 35.5             | 0.20     | 680  | ESMQ251E□□221MMP1S |
|                          | 4.7         | 5 × 11                | 0.12  | 41   | ESMQ500E□□4R7ME11D |                          | 350         | 2.2                   | 6.3 × 11 | 0.24   | 30                 |
|                          | 10          | 5 × 11                | 0.12  | 60   | ESMQ500E□□100ME11D | 3.3                      |             | 8 × 11.5              | 0.24     | 46   | ESMQ351E□□3R3MHB5D |
|                          | 22          | 5 × 11                | 0.12  | 95   | ESMQ500E□□220ME11D | 4.7                      |             | 8 × 11.5              | 0.24     | 55   | ESMQ351E□□4R7MHB5D |
|                          | 33          | 5 × 11                | 0.12  | 125  | ESMQ500E□□330ME11D | 10                       |             | 10 × 12.5             | 0.24     | 90   | ESMQ351E□□100MJC5S |
|                          | 47          | 6.3 × 11              | 0.12  | 155  | ESMQ500E□□470MF11D | 22                       |             | 12.5 × 20             | 0.24     | 185  | ESMQ351E□□220MK20S |
|                          | 68          | 6.3 × 11              | 0.12  | 210  | ESMQ500E□□680MF11D | 33                       |             | 12.5 × 25             | 0.24     | 240  | ESMQ351E□□330MK25S |
|                          | 100         | 8 × 11.5              | 0.12  | 260  | ESMQ500E□□101MHB5D | 47                       |             | 16 × 25               | 0.24     | 325  | ESMQ351E□□470ML25S |
| 220                      | 10 × 12.5   | 0.12                  | 430   | ESMQ500E□□221MJC5S                                 | 68                 | 16 × 25                  |             | 0.24                  | 400      | ESMQ351E□□680ML25S                                 |                    |
| 330                      | 10 × 16     | 0.12                  | 590   | ESMQ500E□□331MJ16S                                 | 100                | 18 × 31.5                |             | 0.24                  | 530      | ESMQ351E□□101MMN3S                                 |                    |
| 470                      | 10 × 20     | 0.12                  | 760   | ESMQ500E□□471MJ20S                                 | 400                | 1.0                      |             | 6.3 × 11              | 0.24     | 22   | ESMQ401E□□1R0MF11D |
| 1,000                    | 12.5 × 25   | 0.12                  | 1,350 | ESMQ500E□□102MK25S                                 |                    | 2.2                      | 8 × 11.5    | 0.24                  | 38       | ESMQ401E□□2R2MHB5D                                 |                    |
| 2,200                    | 16 × 31.5   | 0.14                  | 1,980 | ESMQ500E□□222MLN3S                                 |                    | 3.3                      | 8 × 11.5    | 0.24                  | 48       | ESMQ401E□□3R3MHB5D                                 |                    |
| 3,300                    | 18 × 35.5   | 0.16                  | 2,500 | ESMQ500E□□332MMP1S                                 |                    | 4.7                      | 10 × 12.5   | 0.24                  | 60       | ESMQ401E□□4R7MJC5S                                 |                    |
| 63                       | 22          | 5 × 11                | 0.09  | 100  | ESMQ630E□□220ME11D | 10                       | 10 × 16     | 0.24                  | 90       | ESMQ401E□□100MJ16S                                 |                    |

□□ : Enter the appropriate lead forming or taping code.

**◆STANDARD RATINGS**

| WV (V <sub>dc</sub> ) | Cap (μF) | Case size φD×L(mm) | tan δ | Rated ripple current (mA <sub>rms</sub> /85°C, 120Hz) | Part No.           | WV (V <sub>dc</sub> ) | Cap (μF) | Case size φD×L(mm) | tan δ | Rated ripple current (mA <sub>rms</sub> /85°C, 120Hz) | Part No.           |
|-----------------------|----------|--------------------|-------|---|--------------------|-----------------------|----------|--------------------|-------|---|--------------------|
| 400                   | 22       | 12.5 × 25          | 0.24  | 205   | ESMQ401E□□220MK25S | 450                   | 4.7      | 10 × 12.5          | 0.24  | 46  | ESMQ451E□□4R7MJC5S |
|                       | 33       | 16 × 25            | 0.24  | 275   | ESMQ401E□□330ML25S |                       | 10       | 10 × 20            | 0.24  | 80  | ESMQ451E□□100MJ20S |
|                       | 47       | 16 × 25            | 0.24  | 280   | ESMQ401E□□470ML25S |                       | 22       | 12.5 × 25          | 0.24  | 140   | ESMQ451E□□220MK25S |
|                       | 68       | 16 × 31.5          | 0.24  | 340   | ESMQ401E□□680MLN3S |                       | 33       | 16 × 25            | 0.24  | 180   | ESMQ451E□□330ML25S |
|                       | 100      | 18 × 35.5          | 0.24  | 440   | ESMQ401E□□101MMP1S |                       | 47       | 16 × 31.5          | 0.24  | 220   | ESMQ451E□□470MLN3S |
| 450                   | 2.2      | 8 × 11.5           | 0.24  | 28  | ESMQ451E□□2R2MHB5D |                       | 68       | 18 × 35.5          | 0.24  | 260   | ESMQ451E□□680MMP1S |
|                       | 3.3      | 10 × 12.5          | 0.24  | 40  | ESMQ451E□□3R3MJC5S |                       | 100      | 18 × 40            | 0.24  | 280   | ESMQ451E□□101MM40S |

□□ : Enter the appropriate lead forming or taping code.

**◆RATED RIPPLE CURRENT MULTIPLIERS**

## ● Frequency Multipliers

| Capacitance(μF) | Frequency(Hz) | 50   | 120  | 300  | 1k   | 10k  | 100k |
|-----------------|---------------|------|------|------|------|------|------|
| 1.0 to 4.7      |               | 0.65 | 1.00 | 1.35 | 1.75 | 2.30 | 2.50 |
| 10 to 68        |               | 0.75 | 1.00 | 1.25 | 1.50 | 1.75 | 1.80 |
| 100 to 1,000    |               | 0.80 | 1.00 | 1.15 | 1.30 | 1.40 | 1.50 |
| 2,200 to        |               | 0.85 | 1.00 | 1.03 | 1.05 | 1.08 | 1.08 |

The endurance of capacitors is reduced with internal heating produced by ripple current at the rate of halving the lifetime with every 5°C rise. When long life performance is required in actual use, the rms ripple current has to be reduced.