

- 105°C
- IEC 384-4 General Purpose Grade
- 6.3Vd.c. to 100Vd.c.
- 0.47μF to 10 000μF
- Climatic Category 40/105/56



**Applications:** General Purpose

**Rated Voltage UR:** 6.3Vd.c. to 100Vd.c.

**Surge Voltage Us:** The maximum permitted d.c. over-voltage at 20°C for periods not exceeding 30s once every 6 minutes

**Temperature Range:** -40°C to +105°C

**Capacitance Tolerance at 100Hz and 20°C:** ± 20%

**Dissipation Factor:** Maximum values of  $\tan \delta$  at 100Hz and 20°C are shown in Table 6

**ESR.** The nominal values at 100Hz at 20°C in ohms are shown shaded in Table 2. N.B.  $ESR = \frac{\tan \delta \times 10^6}{2 \pi f \mu F}$

**Leakage Current IL at UR and 20°C after 2 minutes.**  
 $< 0.01 C_{UR}$  or  $3 \mu A$

**Impedance - Temperature Characteristic:** See table 7

**Ripple Current IR at 100Hz and 105°C:** See Table 2

**Endurance.** After 1000h at UR and 105°C the electrical parameters shall meet IEC 384-4 G.P. limits, see page 3

**Construction:** All internal and external connections are welded. High grade paper separators are used for long term reliability. The aluminium case is insulated with a heat-shrunk P.V.C. sleeve

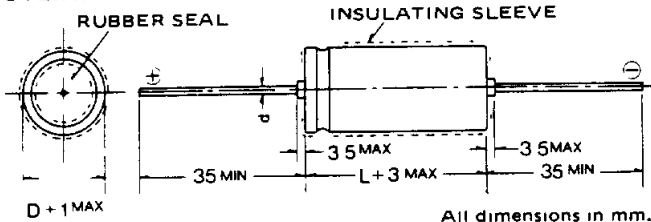
**Venting:** All capacitors have vents in elastomer seal

**Terminations:** Copper clad steel wire, tinned

**Shelf Life:** 500h at 105°C, see page 3

**Packaging.** See page 31

**OUTLINE DRAWINGS**



**LEAD WIRE DIAMETERS**

|    |     |   |   |    |      |     |    |
|----|-----|---|---|----|------|-----|----|
| Dφ | 5   | 6 | 8 | 10 | 12.5 | 16  | 18 |
| dφ | 0.6 |   |   |    |      | 0.8 |    |

**TABLE 1: Range and Dimensions**

φ D x L (mm)

| UR    | 6.3        | 10         | 16         | 25         | 35         | 50         | 63         | 100        | 160      | 250     |
|-------|------------|------------|------------|------------|------------|------------|------------|------------|----------|---------|
| μF    | 8          | 13         | 20         | 32         | 44         | 63         | 79         | 125        | 200      | 300     |
| 0.47  |            |            |            |            |            |            |            | 5 x 12.5   |          |         |
| 1.0   |            |            |            |            |            |            |            | 5 x 12.5   | 6.3 x 16 | 8 x 16  |
| 2.2   |            |            |            |            |            |            |            | 5 x 12.5   | 8 x 16   | 8 x 16  |
| 3.3   |            |            |            |            |            |            | 5 x 12.5   | 6.3 x 12.5 | 8 x 16   | 8 x 16  |
| 4.7   |            |            |            |            |            | 5 x 12.5   | 6.3 x 12.5 | 6.3 x 12.5 | 8 x 20   | 10 x 20 |
| 10    |            |            |            |            | 5 x 12.5   | 6.3 x 12.5 | 6.3 x 16   | 8 x 16     | 10 x 25  | 13 x 25 |
| 15    |            |            | 5 x 12.5   | 6.3 x 12.5 | 6.3 x 12.5 | 6.3 x 16   | 8 x 16     | 8 x 20     | 13 x 25  | 13 x 32 |
| 22    |            | 5 x 12.5   | 6.3 x 12.5 | 6.3 x 12.5 | 6.3 x 16   | 8 x 16     | 8 x 16     | 8 x 20     | 13 x 32  | 16 x 32 |
| 47    | 5 x 12.5   | 6.3 x 12.5 | 6.3 x 12.5 | 6.3 x 16   | 8 x 16     | 8 x 16     | 8 x 20     | 10 x 20    | 16 x 32  | 16 x 40 |
| 100   | 6.3 x 12.5 | 6.3 x 16   | 6.3 x 16   | 8 x 16     | 8 x 20     | 8 x 20     | 10 x 20    | 13 x 25    | 16 x 40  | 18 x 40 |
| 220   | 8 x 16     | 8 x 16     | 8 x 16     | 8 x 20     | 10 x 20    | 10 x 25    | 13 x 25    | 16 x 32    |          |         |
| 330   | 8 x 16     | 8 x 16     | 8 x 20     | 10 x 20    | 10 x 25    | 13 x 25    | 13 x 32    | 16 x 40    |          |         |
| 470   | 8 x 16     | 8 x 20     | 10 x 20    | 10 x 25    | 13 x 25    | 13 x 32    | 16 x 32    | 18 x 40    |          |         |
| 680   | 10 x 20    | 10 x 25    | 13 x 25    | 13 x 32    | 16 x 32    | 16 x 40    | 18 x 40    |            |          |         |
| 2200  | 13 x 25    | 13 x 32    | 16 x 32    | 16 x 40    | 16 x 40    |            |            |            |          |         |
| 3300  | 13 x 32    | 16 x 32    | 16 x 40    | 18 x 40    | 18 x 40    |            |            |            |          |         |
| 4700  | 16 x 32    | 16 x 40    | 18 x 40    |            |            |            |            |            |          |         |
| 6800  | 16 x 40    | 18 x 40    |            |            |            |            |            |            |          |         |
| 10000 | 18 x 40    |            |            |            |            |            |            |            |          |         |

## Ripple Current Ratings

The maximum recommended ripple current ratings at rated temperature and 100Hz are shown in Table 2. These can be exceeded providing a reduced life is acceptable, however the algebraic sum of the applied d.c. and ripple voltages must not exceed UR or -2V. Ripple current ratings at other frequencies and temperatures may be obtained by using the factors in Tables 3 and 4.

**TABLE 2: Ripple Current Ratings in mA at 100Hz and 105°C**  
ESR at 100Hz and 20°C, Nominal Values in Ω are shaded

| UR      | 6.3 | 10 | 16 | 25 | 35 | 50 | 63 | 100  | 160  | 250  |
|---------|-----|----|----|----|----|----|----|------|------|------|
| Us      | 8   | 13 | 20 | 32 | 44 | 63 | 79 | 125  | 200  | 300  |
| 0.47    |     |    |    |    |    |    |    | 9    |      |      |
| 1.0     |     |    |    |    |    |    |    | 230  |      |      |
| 2.2     |     |    |    |    |    |    |    | 17   | 19   | 21   |
| 3.3     |     |    |    |    |    |    |    | 110  | 160  | 160  |
| 4.7     |     |    |    |    |    |    |    | 27   | 30   | 32   |
| 10      |     |    |    |    |    |    |    | 49   | 73   | 73   |
| 22      |     |    |    |    |    |    |    | 44   | 44   | 45   |
| 33      |     |    |    |    |    |    |    | 41   | 33   | 49   |
| 47      |     |    |    |    |    |    |    | 35   | 35   | 55   |
| 100     |     |    |    |    |    |    |    | 29   | 23   | 43   |
| 220     |     |    |    |    |    |    |    | 60   | 61   | 100  |
| 330     |     |    |    |    |    |    |    | 16   | 14   | 16   |
| 470     |     |    |    |    |    |    |    | 75   | 80   | 100  |
| 1000    |     |    |    |    |    |    |    | 11   | 9.1  | 7.3  |
| 2200    |     |    |    |    |    |    |    | 66   | 100  | 140  |
| 3300    |     |    |    |    |    |    |    | 8.1  | 6.9  | 6.1  |
| 4700    |     |    |    |    |    |    |    | 78   | 83   | 130  |
| 10000   |     |    |    |    |    |    |    | 130  | 150  | 200  |
| 22000   |     |    |    |    |    |    |    | 240  | 260  | 340  |
| 33000   |     |    |    |    |    |    |    | 320  | 340  | 460  |
| 47000   |     |    |    |    |    |    |    | 420  | 440  | 580  |
| 100000  |     |    |    |    |    |    |    | 550  | 550  | 730  |
| 220000  |     |    |    |    |    |    |    | 800  | 800  | 1100 |
| 330000  |     |    |    |    |    |    |    | 950  | 950  | 1300 |
| 470000  |     |    |    |    |    |    |    | 1100 | 1200 | 1300 |
| 680000  |     |    |    |    |    |    |    | 1200 | 1300 | 1300 |
| 1000000 |     |    |    |    |    |    |    | 1300 | 1300 | 1300 |

**TABLE 3: Ripple Current as Function of Frequency**

| FREQUENCY Hz | MULTIPLYING FACTOR |
|--------------|--------------------|
| 50           | 0.8                |
| 100          | 1.0                |
| 400          | 1.2                |
| 800          | 1.3                |
| 2400         | 1.4                |
| ≥5000        | 1.5                |

**TABLE 4: Ripple Current as Function of Temperature**

| TEMPERATURE °C | MULTIPLYING FACTOR |
|----------------|--------------------|
| 20             | 2.1                |
| 40             | 2.0                |
| 60             | 1.9                |
| 70             | 1.7                |
| 85             | 1.3                |
| 105            | 1.0                |

**TABLE 5: Leakage Current as Function of Applied Voltage**

| % RATED VOLTAGE | MULTIPLYING FACTOR |
|-----------------|--------------------|
| 100             | 1.0                |
| 90              | 0.5                |
| 80              | 0.2                |
| 60              | 0.15               |
| 40              | 0.10               |
| 20              | 0.07               |

**TABLE 6: Dissipation Factor Limits at 100Hz and 20°C**

| UR | 6.3  | 10   | 16   | 25   | 35   | 50   | 63   | 100  | 160  | 200  | 250  |
|----|------|------|------|------|------|------|------|------|------|------|------|
|    | 0.24 | 0.20 | 0.17 | 0.15 | 0.12 | 0.10 | 0.10 | 0.08 | 0.12 | 0.12 | 0.12 |

\*NOTE Add 0.02 per 1000μF for values above 1000μF

**TABLE 7: Impedance Ratio at 100Hz as Function of Voltage**

| UR    | 6.3 | 10 | 16 | 25 | 35 | 50 | 63 | 100 | 160 | 200 | 250 |
|-------|-----|----|----|----|----|----|----|-----|-----|-----|-----|
| 20°C  | 4   | 3  | 2  | 2  | 2  | 2  | 2  | 2   | 2   | 2   | 2   |
| 105°C | 8   | 6  | 4  | 3  | 3  | 3  | 3  | 3   | 3   | 3   | 3   |

|                      |      |                |         |                        |
|----------------------|------|----------------|---------|------------------------|
| Ordering information | WTU  | 33             | 16      | Example shown 33μF 16V |
|                      | Type | Capacitance μF | Voltage |                        |