

DATA SHEET

Class 1, NP0 50/100/200/500 V Noble Metal Electrode Surface mount ceramic multilayer capacitors

Product specification
Supersedes data of 24th May 2000
File under Discrete Ceramics, ACM2

2000 Sep 11

Surface mount ceramic multilayer capacitors

Class 1, NP0 50/100/200/500 V Noble Metal Electrode

FEATURES

- Seven standard sizes
- High capacitance per unit volume
- Supplied in tape on reel or in bulk case (case sizes 0402, 0603 and 0805 only)
- For high frequency applications
- NiSn terminations (AgPd on request).

APPLICATIONS

- Consumer electronics
- Telecommunications
- Automotive
- Data processing.

DESCRIPTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume.

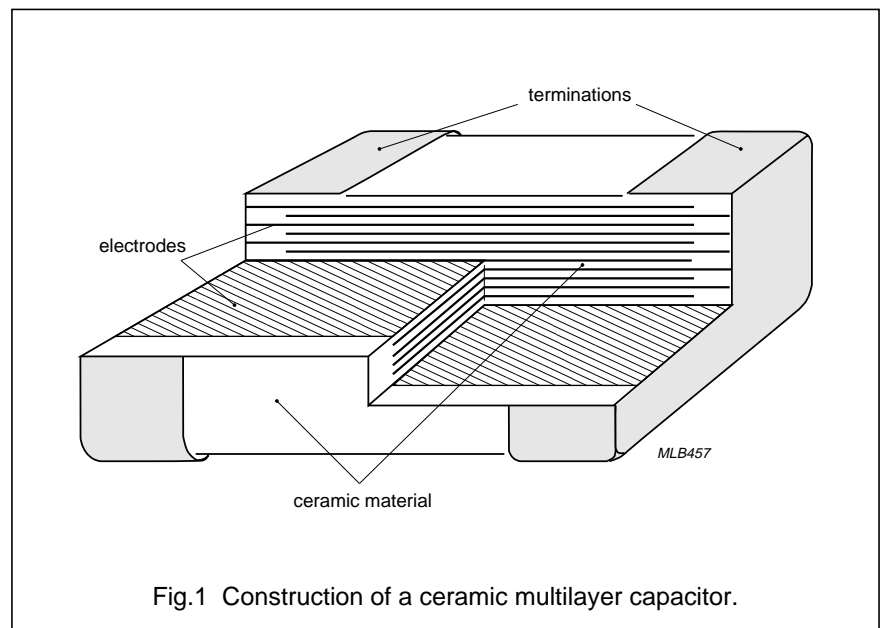
The inner electrodes are connected to the two terminations, either by silver palladium (AgPd) alloy in the ratio 65 : 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (NiSn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

| DESCRIPTION | VALUE |
|--|--|
| Rated voltage U_R (DC) | 50 V, 100 V, 200 V and 500 V (IEC) |
| Capacitance range (E12 series); note 1: 50 V; note 2 100 V 200 V 500 V | 0.47 pF to 47 000 pF 10 pF to 22 nF 10 pF to 5600 pF 10 pF to 3300 pF |
| Tolerance on capacitance: $C \geq 10$ pF $C < 10$ pF | $\pm 5\%$; $\pm 2\%$ ± 0.5 pF; ± 0.25 pF |
| Test voltage (DC) for 1 minute: 50 V and 100 V 200 V 500 V | $2.5 \times U_R$ $3 \times U_R$ $2 \times U_R$ |
| Sectional specifications | IEC 60384-10, second edition 1989-04; also based on CECC 32 100 |
| Detailed specification | based on CECC 32 101-801 |
| Climatic category (IEC 60068) | 55/125/56 |

Notes

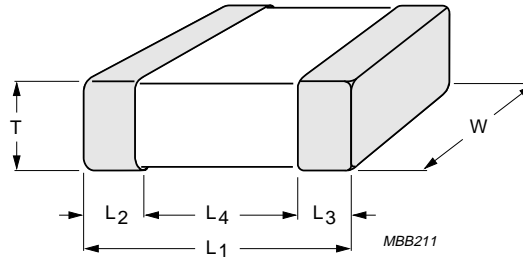
1. Other values below 10 pF and non E12 series are available on request.
2. Also applicable for applications up to 63 V.



Surface mount ceramic
multilayer capacitors

Class 1, NP0 50/100/200/500 V
Noble Metal Electrode

MECHANICAL DATA



For dimensions see Table 1.

Fig.2 Component outline.

Physical dimensions

Table 1 Capacitor dimensions

| CASE SIZE | L ₁ | W | T | | L ₂ and L ₃ | | L ₄ MIN. |
|----------------------------------|----------------|--------------|-------|-------|-----------------------------------|-------|------------------------|
| | | | MIN. | MAX. | MIN. | MAX. | |
| Dimensions in millimetres | | | | | | | |
| 0402 | 1.0 ±0.05 | 0.5 ±0.05 | 0.45 | 0.55 | 0.20 | 0.30 | 0.40 |
| 0603 | 1.6 ±0.10 | 0.8 ±0.07 | 0.73 | 0.87 | 0.25 | 0.65 | 0.40 |
| 0805 | 2.0 ±0.10 | 1.25 ±0.10 | 0.50 | 1.35 | 0.25 | 0.75 | 0.55 |
| 1206 | 3.2 ±0.15 | 1.6 ±0.15 | 0.50 | 1.75 | 0.25 | 0.75 | 1.40 |
| 1210 | 3.2 ±0.20 | 2.5 ±0.20 | 0.50 | 1.80 | 0.25 | 0.75 | 1.40 |
| 1812 | 4.5 ±0.20 | 3.2 ±0.20 | 0.50 | 1.80 | 0.25 | 0.75 | 2.20 |
| 2220 | 5.7 ±0.20 | 5.0 ±0.20 | 0.50 | 1.80 | 0.25 | 0.75 | 2.90 |
| Dimensions in inches | | | | | | | |
| 0402 | 0.040 ±0.002 | 0.020 ±0.002 | 0.018 | 0.022 | 0.008 | 0.012 | 0.016 |
| 0603 | 0.063 ±0.004 | 0.032 ±0.003 | 0.029 | 0.035 | 0.010 | 0.026 | 0.016 |
| 0805 | 0.079 ±0.004 | 0.049 ±0.004 | 0.020 | 0.053 | 0.010 | 0.030 | 0.022 |
| 1206 | 0.126 ±0.006 | 0.063 ±0.006 | 0.020 | 0.069 | 0.010 | 0.030 | 0.056 |
| 1210 | 0.126 ±0.008 | 0.098 ±0.008 | 0.020 | 0.072 | 0.010 | 0.030 | 0.056 |
| 1812 | 0.177 ±0.008 | 0.126 ±0.008 | 0.020 | 0.072 | 0.010 | 0.030 | 0.088 |
| 2220 | 0.224 ±0.008 | 0.197 ±0.008 | 0.020 | 0.072 | 0.010 | 0.030 | 0.114 |

Surface mount ceramic
multilayer capacitors

Class 1, NP0 50 V
Noble Metal Electrode

SELECTION CHART FOR 50 V

| C (pF) | LAST THREE DIGITS OF 12NC | 50 V | | | | | | | |
|-----------|---------------------------------|---|-----------|-----------|-----------|------------|------------|------------|--|
| | | 0402 | 0603 | 0805 | 1206 | 1210 | 1812 | 2220 | |
| 0.47 | 477 | | | | | | | | |
| 0.56 | 567 | | | | | | | | |
| 0.68 | 687 | | | | | | | | |
| 0.82 | 827 | | | | | | | | |
| 1.0 | 108 | | | | | | | | |
| 1.2 | 128 | | | | | | | | |
| 1.5 | 158 | | | | | | | | |
| 1.8 | 188 | | | | | | | | |
| 2.2 | 228 | | | | | | | | |
| 2.7 | 278 | | | | | | | | |
| 3.3 | 338 | | | | | | | | |
| 3.9 | 398 | | | | | | | | |
| 4.7 | 478 | | | | | | | | |
| 5.6 | 568 | | | | | | | | |
| 6.8 | 688 | | | | | | | | |
| 8.2 | 828 | | | | | | | | |
| 10 | 109 | 0.5 ±0.05 | | | | | | | |
| 12 | 129 | | | | | | | | |
| 15 | 159 | | | | | | | | |
| 18 | 189 | | 0.8 ±0.07 | | | | | | |
| 22 | 229 | | | | | | | | |
| 27 | 279 | | | | | | | | |
| 33 | 339 | | | 0.6 ±0.1 | | | | | |
| 39 | 399 | | | | | | | | |
| 47 | 479 | | | | | | | | |
| 56 | 569 | | | | 0.6 ±0.1 | | | | |
| 68 | 689 | | | | | | | | |
| 82 | 829 | | | | | | | | |
| 100 | 101 | | | | | | | | |
| 120 | 121 | | | | | | | | |
| 150 | 151 | | | | | | | | |
| 180 | 181 | | | | | | | | |
| 220 | 221 | | | | | | | | |
| 270 | 271 | | | | | | | | |
| 330 | 331 | | | | | | | | |
| 390 | 391 | | | | | | | | |
| 470 | 471 | | | | | | S | | |
| 560 | 561 | | | | | | | | |
| 680 | 681 | | | | | | | | |
| 820 | 821 | | | | | 0.5 to 1.0 | | | |
| 1000 | 102 | | | | | | | | |
| 1200 | 122 | | | | | | | | |
| 1500 | 152 | | | 0.85 ±0.1 | | | | | |
| 1800 | 182 | | | | | | | | |
| 2200 | 222 | | | 1.25 ±0.1 | | | 0.5 to 1.0 | | |
| 2700 | 272 | | | | | | | | |
| 3300 | 332 | | | | | | | | |
| 3900 | 392 | | | | 0.85 ±0.1 | | | | |
| 4700 | 472 | | | | | | | | |
| 5600 | 562 | | | | 1.15 ±0.1 | | | | |
| 6800 | 682 | | | | | | | | |
| 8200 | 822 | Values in shaded cells indicate thickness classification. | | | | | | | |
| 10000 | 103 | | | | | | | 0.5 to 1.0 | |
| 12000 | 123 | | | | | | | | |

Surface mount ceramic multilayer capacitors

Class 1, NP0 50 V Noble Metal Electrode

| C (pF) | LAST THREE DIGITS OF 12NC | 50 V | | | | | | |
|-----------|---------------------------------|------|------|------|------|------|------------|------------|
| | | 0402 | 0603 | 0805 | 1206 | 1210 | 1812 | 2220 |
| 15000 | 153 | | | | | | 0.5 to 1.0 | |
| 18000 | 183 | | | | | | 0.9 to 1.3 | |
| 22000 | 223 | | | | | | | 0.5 to 1.0 |
| 27000 | 273 | | | | | | | |
| 33000 | 333 | | | | | | | |
| 39000 | 393 | | | | | | | |
| 47000 | 473 | | | | | | | 0.9 to 1.3 |

Thickness classification and packaging quantities

| THICKNESS CLASSIFICATION (mm) | 8 mm TAPE WIDTH AMOUNT PER REEL | | | | 12 mm TAPE WIDTH AMOUNT PER REEL | | AMOUNT PER BULK CASE | | |
|-------------------------------------|------------------------------------|---------|--------------|---------|-------------------------------------|------|-------------------------|-------|-------|
| | Ø180 mm; 7" | | Ø330 mm; 13" | | Ø180 mm; 7" BLISTER | | | | |
| | PAPER | BLISTER | PAPER | BLISTER | 1812 | 2220 | 0402 | 0603 | 0805 |
| 0.5 ±0.05 | 10000 | – | 50000 | – | – | – | 50000 | – | – |
| 0.6 ±0.1 | 4000 | – | 20000 | – | – | – | – | – | 10000 |
| 0.85 ±0.1 | 4000 | – | 15000 | – | – | – | – | – | 8000 |
| 0.5 to 1.0 | – | 4000 | – | 10000 | 2000 | 1500 | – | – | – |
| 0.8 ±0.07 | 4000 | – | 15000 | – | – | – | – | 15000 | – |
| 0.9 to 1.3 | – | 3000 | – | 10000 | 1500 | – | – | – | – |
| 1.15 ±0.1 | – | 3000 | – | 10000 | – | – | – | – | – |
| 1.25 ±0.1 | – | 3000 | – | 10000 | – | – | – | – | 5000 |

Surface mount ceramic multilayer capacitors

Class 1, NP0 50 V Noble Metal Electrode

ORDERING INFORMATION FOR 50 V

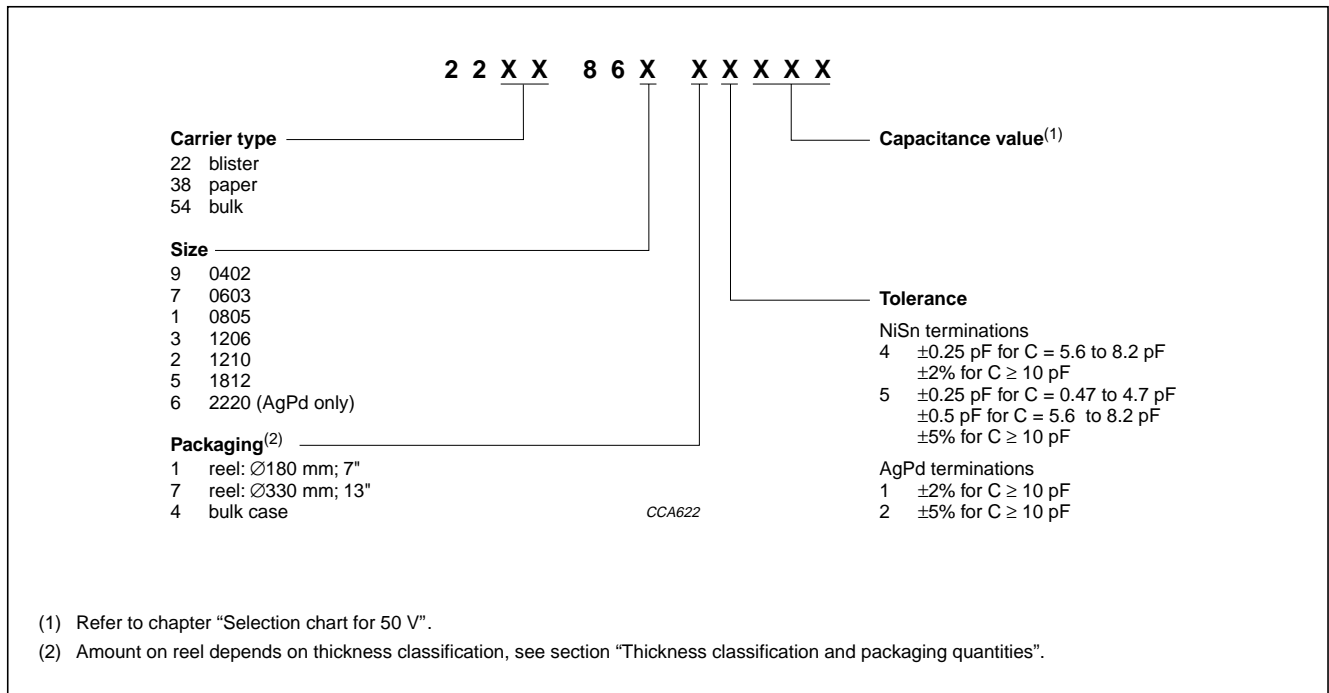
Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

EXAMPLE: 0805CG102J9B200

| SIZE CODE | TEMP. CHAR. | CAPACITANCE | TOL. | VOLTAGE | TERMINATION | PACKAGING | MARKING | SERIES |
|------------------|-------------|---|--------------|----------|----------------------|-------------------------|---|-------------------|
| 0402 | CG = NP0 | 102 = 1000 pF; the third digit signifies the multiplying factor: | C = ±0.25 pF | 9 = 50 V | B = NiSn | 2 = 180 mm; 7" paper | 0 = no marking | 0 = conv. ceramic |
| 0603 | | 8 = × 0.01 | D = ±0.5 pF | | A = AgPd (2220 only) | 3 = 330 mm; 13" paper | 2 = 2-character marking in North America only | |
| 0805 | | 9 = × 0.1 | G = ±2% | | | B = 180 mm; 7" blister | | |
| 1206 | | 0 = × 1 | J = ±5% | | | F = 330 mm; 13" blister | | |
| 1210 | | 1 = × 10 | | | | P = bulk case | | |
| 1812 | | 2 = × 100 | | | | | | |
| 2220 (AgPd only) | | 3 = × 1000 | | | | | | |

Ordering code 12NC



Surface mount ceramic
multilayer capacitors

Class 1, NP0 100 V
Noble Metal Electrode

SELECTION CHART FOR 100 V

| C (pF) | LAST TWO DIGITS OF 12NC | 100 V | | | | |
|-----------|-------------------------------|---|-----------|-----------|------------|------|
| | | 0603 | 0805 | 1206 | 1210 | 1812 |
| 10 | 23 | | | | | |
| 12 | 24 | | | | | |
| 15 | 25 | | | | | |
| 18 | 26 | | | | | |
| 22 | 27 | | | | | |
| 27 | 28 | | | | | |
| 33 | 29 | | | | | |
| 39 | 31 | | | | | |
| 47 | 32 | | | | | |
| 56 | 33 | | | | | |
| 68 | 34 | | | | | |
| 82 | 35 | 0.8 ±0.07 | | | | |
| 100 | 36 | | | | | |
| 120 | 37 | | 0.6 ±0.1 | | | |
| 150 | 38 | | | | | |
| 180 | 39 | | | | | |
| 220 | 41 | | | 0.6 ±0.1 | | |
| 270 | 42 | | | | | |
| 330 | 43 | | | | | |
| 390 | 44 | | | | | |
| 470 | 45 | | | | | |
| 560 | 46 | | | | | |
| 680 | 47 | | | | | |
| 820 | 48 | | | | | |
| 1000 | 49 | | | | | |
| 1200 | 51 | | | | | |
| 1500 | 52 | | 0.85 ±0.1 | | | |
| 1800 | 53 | | | | | |
| 2200 | 54 | | 1.25 ±0.1 | | | |
| 2700 | 55 | | | | | |
| 3300 | 56 | | | | | |
| 3900 | 57 | | | 0.85 ±0.1 | | |
| 4700 | 58 | | | | | |
| 5600 | 59 | | | 1.15 ±0.1 | | |
| 6800 | 61 | | | | | |
| 8200 | 62 | Values in shaded cells indicate thickness classification. | | | 0.5 to 1.0 | |
| 10000 | 63 | | | | | |
| 12000 | 64 | | | | 0.5 to 1.0 | |
| 15000 | 65 | | | | | |
| 18000 | 66 | | | | 0.9 to 1.3 | |
| 22000 | 67 | | | | | |
| 27000 | 68 | | | | | |
| 33000 | 69 | | | | | |
| 39000 | 71 | | | | | |
| 47000 | 72 | | | | | |

Surface mount ceramic multilayer capacitors

Class 1, NP0 100 V Noble Metal Electrode

Thickness classification and packaging quantities

| THICKNESS CLASSIFICATION (mm) | 8 mm TAPE WIDTH AMOUNT PER REEL | | | | 12 mm TAPE WIDTH AMOUNT PER REEL | AMOUNT PER BULK CASE | |
|-------------------------------|---------------------------------|---------|--------------|---------|----------------------------------|----------------------|-------|
| | Ø180 mm; 7" | | Ø330 mm; 13" | | Ø180 mm; 7" BLISTER | 0603 | 0805 |
| | PAPER | BLISTER | PAPER | BLISTER | 1812 | | |
| 0.6 ±0.1 | 4000 | – | 20000 | – | – | – | 10000 |
| 0.85 ±0.1 | 4000 | – | 15000 | – | – | – | 8000 |
| 0.5 to 1.0 | – | 4000 | – | 10000 | 2000 | – | – |
| 0.8 ±0.07 | 4000 | – | 15000 | – | – | 15000 | – |
| 0.9 to 1.3 | – | 3000 | – | 10000 | 1500 | – | – |
| 1.15 ±0.1 | – | 3000 | – | 10000 | – | – | – |
| 1.25 ±0.1 | – | 3000 | – | 10000 | – | – | 5000 |

ORDERING INFORMATION FOR 100 V

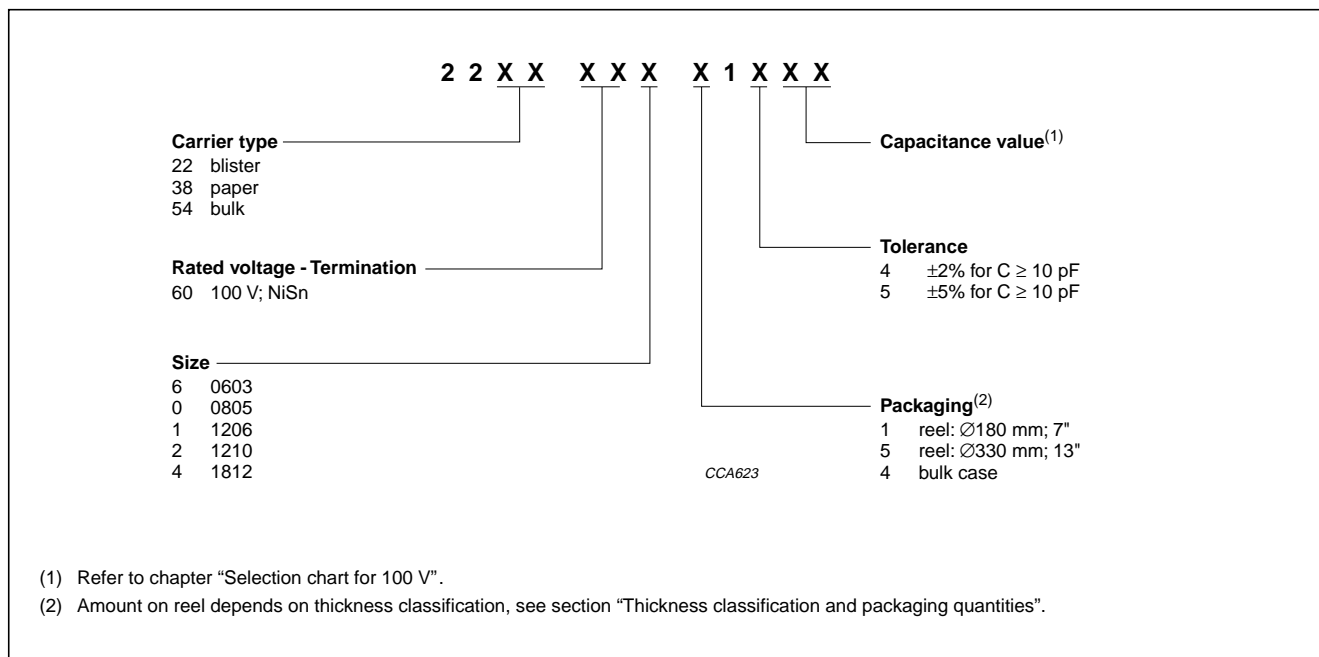
Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

EXAMPLE: 0805CG102G0B200

| SIZE CODE | TEMP. CHAR. | CAPACITANCE | TOL. | VOLTAGE | TERMINATION | PACKAGING | MARKING | SERIES |
|--------------------------------------|-------------|--|--------------------|-----------|-------------|---|---|-------------------|
| 0603 0805 1206 1210 1812 | CG = NP0 | 102 = 1000 pF; the third digit signifies the multiplying factor: 0 = × 1 1 = × 10 2 = × 100 3 = × 1000 | G = ±2% J = ±5% | 0 = 100 V | B = NiSn | 2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case | 0 = no marking 2 = 2-character marking in North America only | 0 = conv. ceramic |

Ordering code 12NC



Surface mount ceramic
multilayer capacitorsClass 1, NP0 200 V and 500 V
Noble Metal Electrode

SELECTION CHART FOR 200 V AND 500 V

| C (pF) | LAST TWO DIGITS OF 12NC | 200 V | | | | 500 V | | | |
|-----------|-------------------------------|---|-----------|------------|------------|-----------|-------------|------------|--|
| | | 0805 | 1206 | 1210 | 1812 | 1206 | 1210 | 1812 | |
| 10 | 23 | | | | | | | | |
| 12 | 24 | | | | | | | | |
| 15 | 25 | | | | | | | | |
| 18 | 26 | | | | | | | | |
| 22 | 27 | | | | | | | | |
| 27 | 28 | | | | | | | | |
| 33 | 29 | | | | | | | | |
| 39 | 31 | | | | | 0.6 ±0.1 | | | |
| 47 | 32 | 0.6 ±0.1 | | | | | | | |
| 56 | 33 | | | | | | | | |
| 68 | 34 | | 0.6 ±0.1 | | | | | | |
| 82 | 35 | | | | | | | | |
| 100 | 36 | | | | | | | | |
| 120 | 37 | | | | | | | | |
| 150 | 38 | | | | | | | | |
| 180 | 39 | | | | | | | | |
| 220 | 41 | | | | | | 0.8 to 1.0 | | |
| 270 | 42 | | | | | | | | |
| 330 | 43 | 0.85 ±0.1 | | | | | | | |
| 390 | 44 | | | | | | | | |
| 470 | 45 | | | | | | | | |
| 560 | 46 | 1.25 ±0.1 | | | | 0.85 ±0.1 | | | |
| 680 | 47 | | | | | | | | |
| 820 | 48 | | | | | 1.15 ±0.1 | | | |
| 1000 | 49 | | 0.85 ±0.1 | | | | | | |
| 1200 | 51 | | | | | | 0.9 to 1.3 | | |
| 1500 | 52 | | 1.15 ±0.1 | | | | | | |
| 1800 | 53 | | | 0.8 to 1.0 | | | 1.2 to 1.75 | | |
| 2200 | 54 | | | | | | | | |
| 2700 | 55 | | | 0.9 to 1.3 | | | | 0.9 to 1.3 | |
| 3300 | 56 | | | | | | | | |
| 3900 | 57 | | | | 0.8 to 1.0 | | | | |
| 4700 | 58 | | | | 0.9 to 1.3 | | | | |
| 5600 | 59 | | | | | | | | |
| 6800 | 61 | Values in shaded cells indicate thickness classification. | | | | | | | |
| 8200 | 62 | | | | | | | | |
| 10000 | 63 | | | | | | | | |

Thickness classification and packaging quantities

| THICKNESS CLASSIFICATION (mm) | 8 mm TAPE WIDTH AMOUNT PER REEL | | | | 12 mm TAPE WIDTH AMOUNT PER REEL | AMOUNT PER BULK CASE |
|-------------------------------------|------------------------------------|---------|--------------|---------|-------------------------------------|-------------------------|
| | Ø180 mm; 7" | | Ø330 mm; 13" | | Ø180 mm; 7" BLISTER | |
| | PAPER | BLISTER | PAPER | BLISTER | 1812 | |
| 0.6 ±0.1 | 4000 | – | 20000 | – | – | 10000 |
| 0.85 ±0.1 | 4000 | – | 15000 | – | – | 8000 |
| 0.8 to 1.0 | – | 4000 | – | 10000 | 2000 | – |
| 0.9 to 1.3 | – | 3000 | – | 10000 | 1500 | – |
| 1.15 ±0.1 | – | 3000 | – | 10000 | – | – |
| 1.25 ±0.1 | – | 3000 | – | 10000 | – | 5000 |
| 1.2 to 1.75 | – | 2500 | – | 7000 | 1200 | – |

Surface mount ceramic
multilayer capacitors

Class 1, NP0 200 V and 500 V
Noble Metal Electrode

ORDERING INFORMATION FOR 200 V AND 500 V

Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

EXAMPLE: 1206CG102GBB200

| SIZE CODE | TEMP. CHAR. | CAPACITANCE | TOL. | VOLTAGE | TERMINATION | PACKAGING | MARKING | SERIES |
|------------------------------|-------------|---|--------------------|------------------------|-------------|---|---|----------------------|
| 0805 1206 1210 1812 | CG = NP0 | 102 = 1000 pF; the third digit signifies the multiplying factor: 0 = × 1 1 = × 10 2 = × 100 3 = × 1000 | G = ±2% J = ±5% | B = 200 V D = 500 V | B = NiSn | 2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case | 0 = no marking 2 = 2-character marking in North America only | 0 = conv. ceramic |

Ordering code 12NC

2 2 X X X X X X 1 X X X

Carrier type

- 22 blister
- 38 paper
- 54 bulk

Rated voltage - Termination

- 93 200 V; NiSn
- 97 500 V; NiSn

Size

- 0 0805
- 1 1206
- 2 1210
- 4 1812

Capacitance value⁽¹⁾

Tolerance

- 4 ±2%
- 5 ±5%

Packaging⁽²⁾

- 1 reel: Ø180 mm; 7"
- 5 reel: Ø330 mm; 13"
- 4 bulk case

CCA624

(1) Refer to chapter "Selection chart for 200 V and 500 V".
 (2) Amount on reel depends on thickness classification, see section "Thickness classification and packaging quantities".

Surface mount ceramic multilayer capacitors

Class 1, NP0 50/100/200/500 V Noble Metal Electrode

ELECTRICAL CHARACTERISTICS

Class 1 capacitors; NP0 dielectric; NiSn terminations

Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

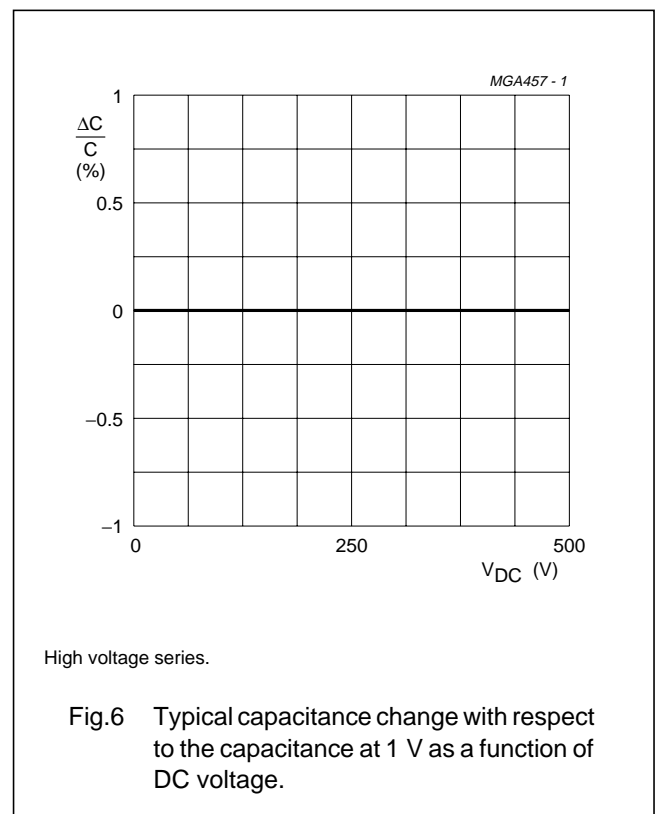
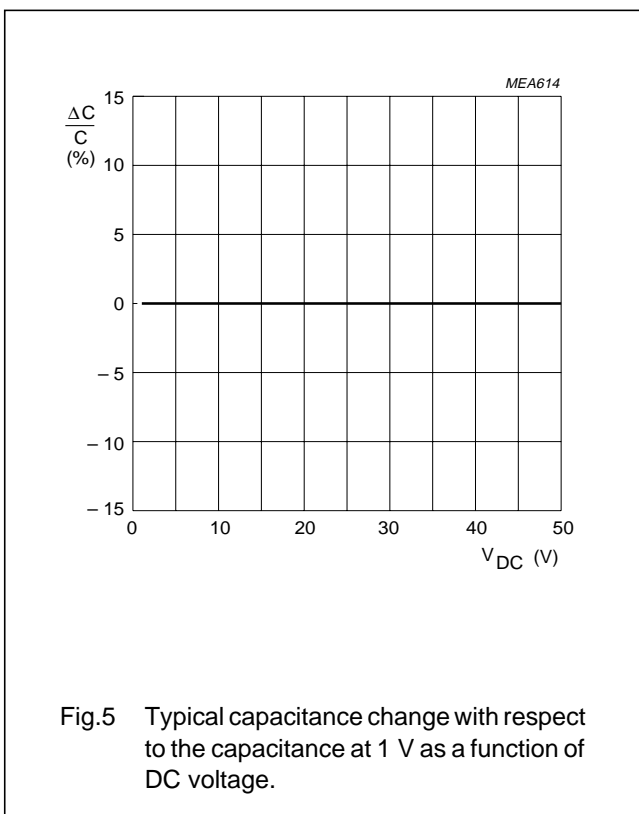
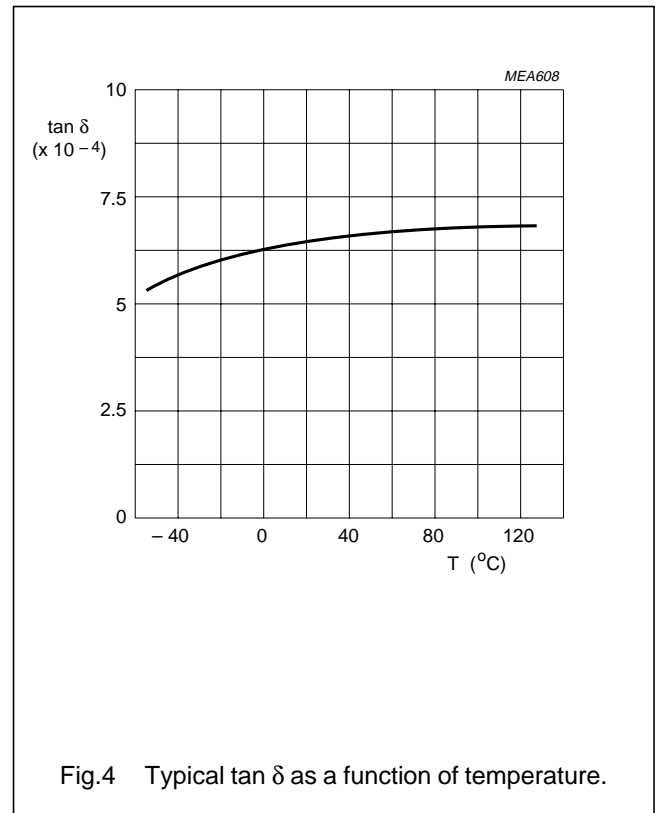
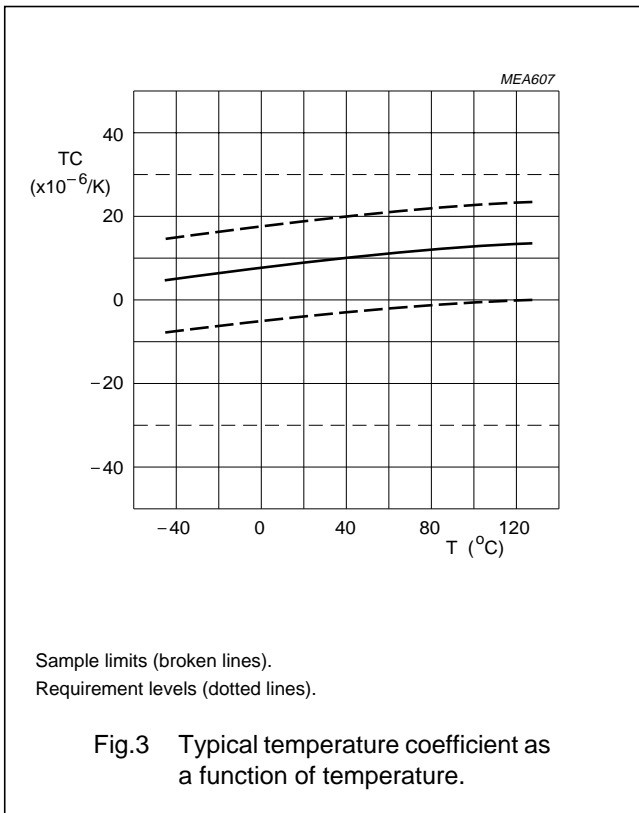
| DESCRIPTION | VALUE |
|---|--|
| Capacitance range (E12 series); note 1: 50 V 100 V 200 V 500 V | 0.47 pF to 47000 pF 10 pF to 22 nF 10 pF to 5600 pF 10 pF to 3300 pF |
| Tolerance on capacitance after 1000 hours: $C \geq 10$ pF $5 \text{ pF} \leq C < 10$ pF $C < 5$ pF | $\pm 5\%$; $\pm 2\%$ ± 0.5 pF, ± 0.25 pF ± 0.25 pF |
| Tan δ ; note 1: $C < 10$ pF $C \geq 10$ pF | $\leq 10 \left(\frac{3}{C} + 0.7 \right) \times 10^{-4}$ or 30×10^{-4} , whichever is smallest $\leq 10 \times 10^{-4}$ |
| Insulation resistance after 1 minute at U_R (DC) | $R_{ins} > 100 \text{ G}\Omega$ |
| Temperature coefficient: $C < 10$ pF $C \geq 10$ pF | $(0 \pm 150) \times 10^{-6}/\text{K}$; note 2 $(0 \pm 30) \times 10^{-6}/\text{K}$; note 2 |
| Ageing | not applicable |

Notes

1. Measured at 1 V, 1 MHz for $C \leq 1000$ pF and 1 V, 1 kHz for $C > 1000$ pF, using a four-gauge method.
2. For sizes 0402 and 0603 all capacitance values from 0.47 pF to 150 pF have a temperature coefficient of $(0 \pm 30) \times 10^{-6}/\text{K}$.

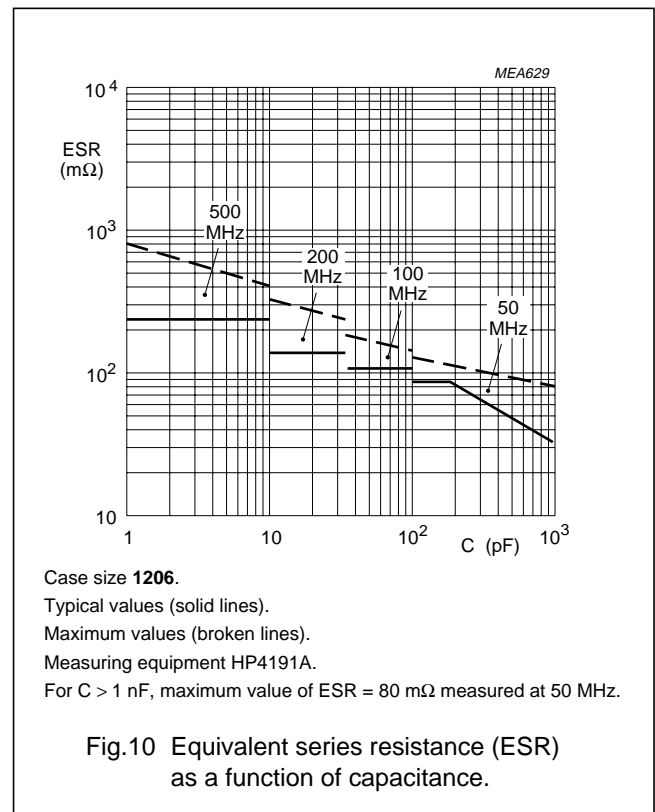
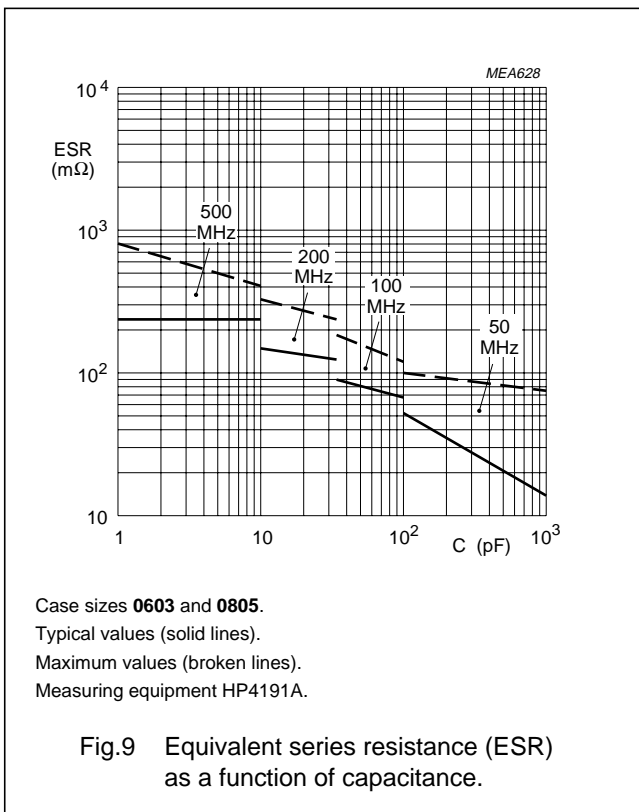
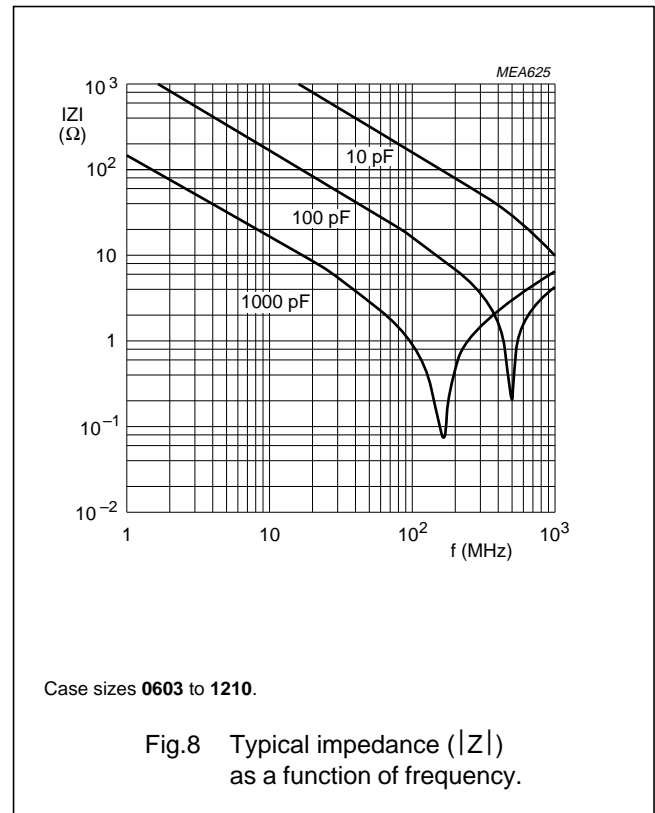
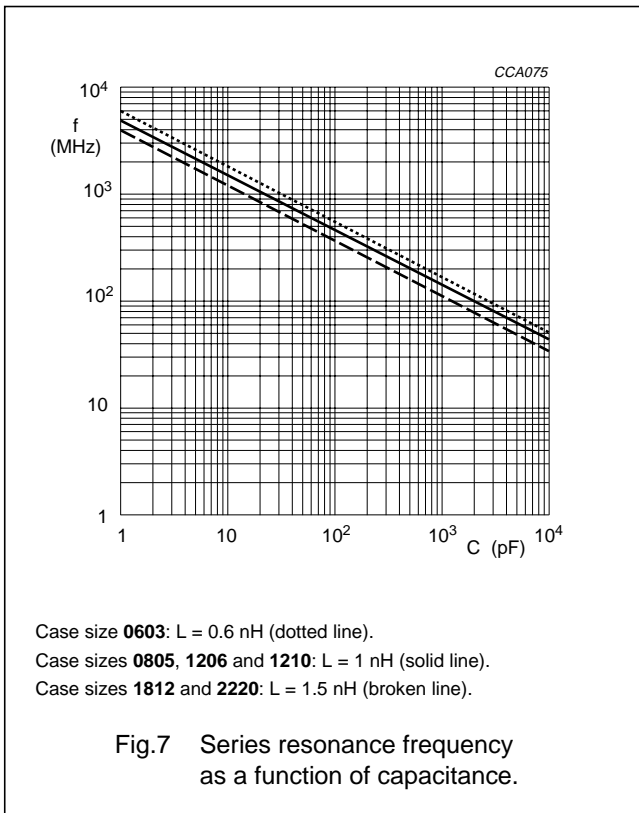
Surface mount ceramic
multilayer capacitors

Class 1, NP0 50/100/200/500 V
Noble Metal Electrode



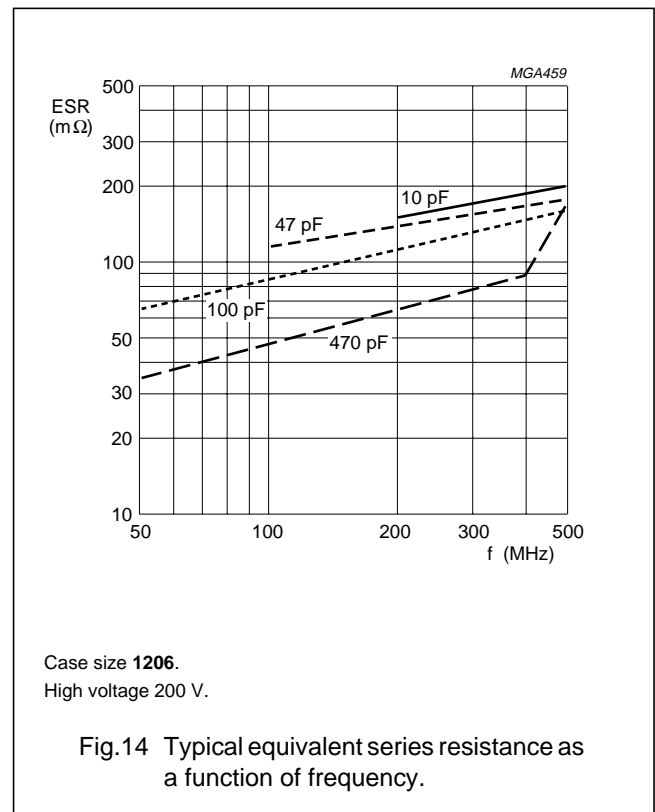
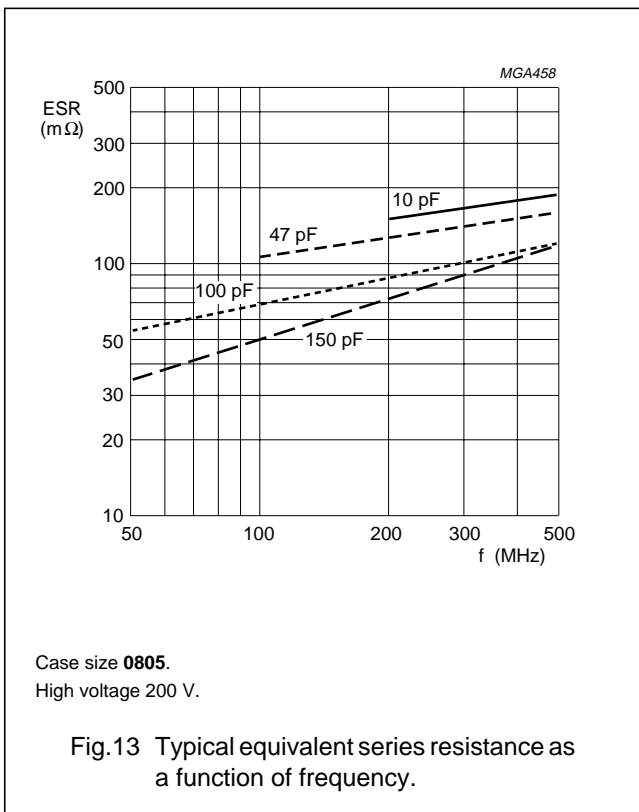
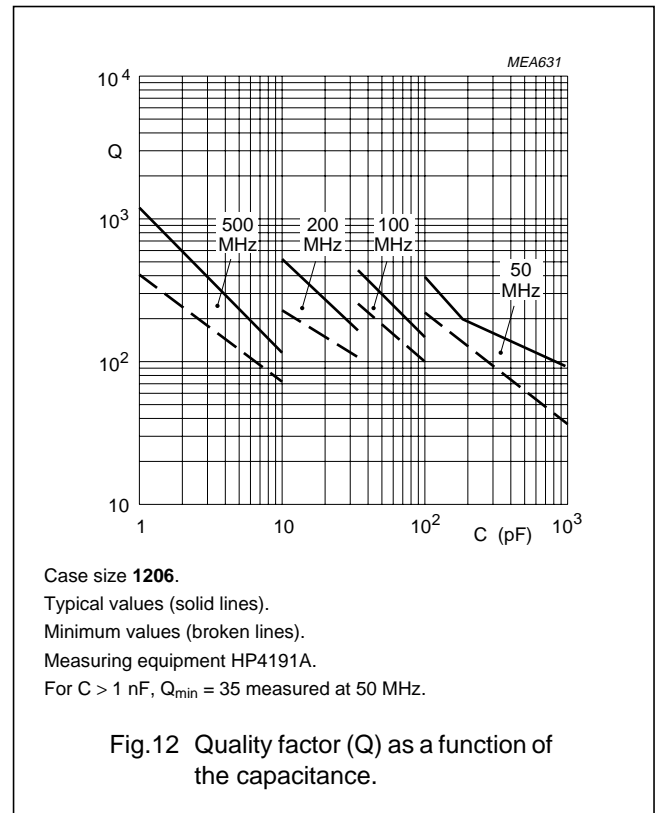
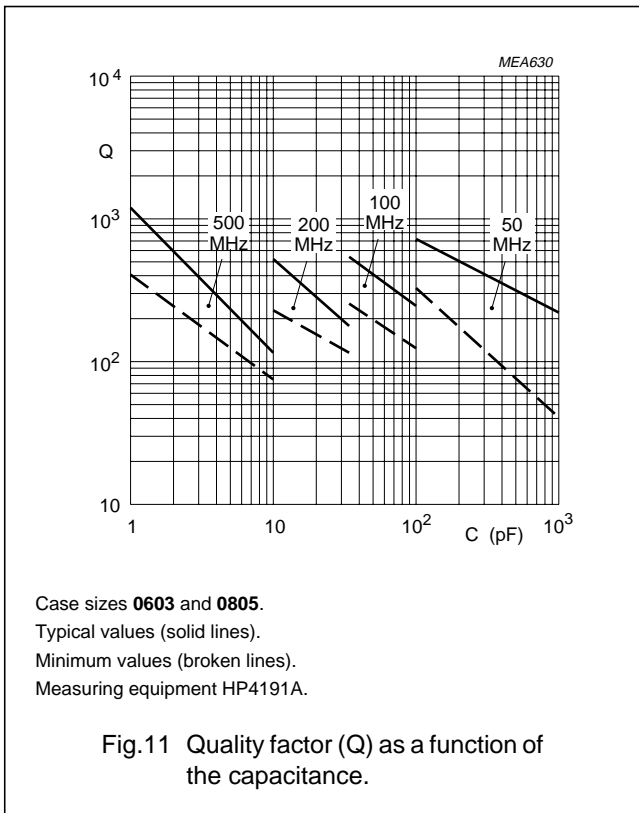
Surface mount ceramic multilayer capacitors

Class 1, NP0 50/100/200/500 V Noble Metal Electrode



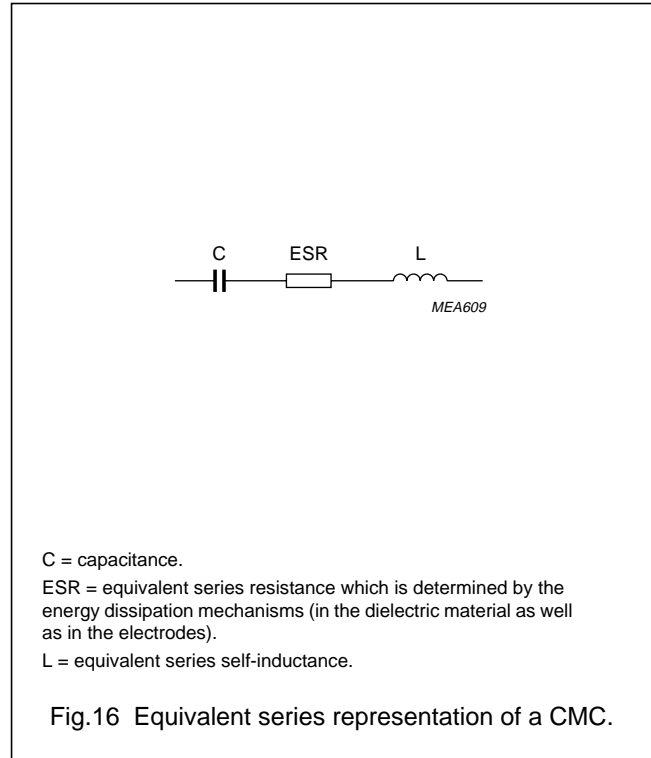
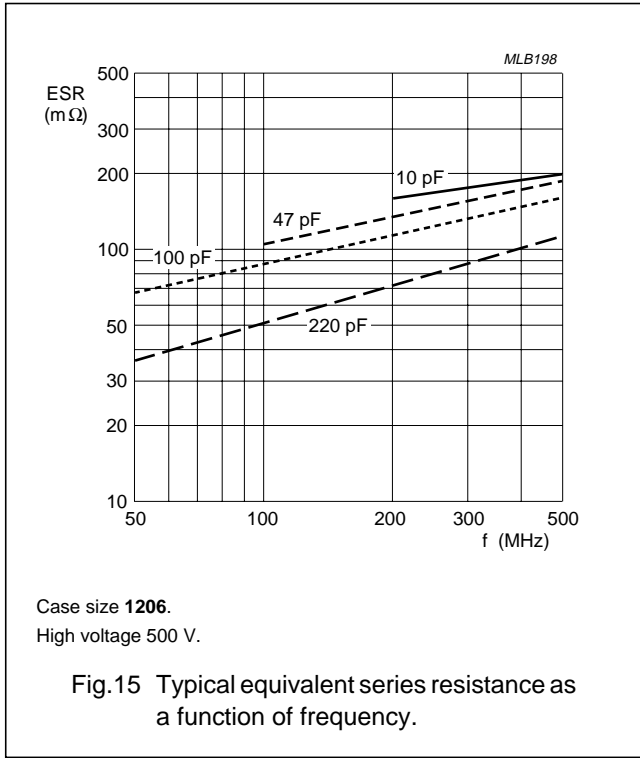
Surface mount ceramic multilayer capacitors

Class 1, NP0 50/100/200/500 V Noble Metal Electrode



Surface mount ceramic multilayer capacitors

Class 1, NP0 50/100/200/500 V Noble Metal Electrode



HIGH FREQUENCY BEHAVIOUR OF CERAMIC MULTILAYER CAPACITORS

Ceramic multilayer capacitors (CMC) are suitable for use at high frequencies. At frequencies below the series resonance frequency, the CMC can be represented by an equivalent circuit as shown in Fig.16.

In general, the quantities C, ESR and L are frequency dependent. For most applications, C and L can be regarded as frequency independent below 1 GHz.

The equivalent series self-inductance L is:

- Independent of the dielectric material.
- Dependent on the size of the capacitor, it increases with increasing length and decreases with increasing width or thickness of the product.
- The value of L is approximately:
 - 0.6 nH for case size 0603
 - 1 nH for case sizes 0805, 1206 and 1210
 - 1.5 nH for case sizes 1812 and 2220.

These figures are accurate to within 20%.

Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to the reactance of the capacitor.

This is known as the series resonance frequency (SRF) and is given by:

$$SRF = \frac{1}{2\pi\sqrt{LC}}$$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonance frequency will be low.

Using the values of C, L = 1 nH and the ESR at a specific frequency (f), two often used quantities can be derived.

The impedance (Z) is given by:

$$Z = \frac{1 - (2\pi f)^2 LC}{2j\pi f C} + ESR$$

The quality factor (Q) is given by:

$$Q = \frac{|1 - (2\pi f)^2 LC|}{2\pi f ESR C}$$