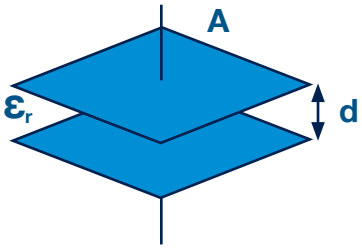
CAPACITOR EQUATIONS AND UNITS

$C = Q/V$

Where Q is Charge and V is Voltage

$C = \varepsilon_0 x \varepsilon_r (A/d)$

Where ε_0 is the permittivity of a vacuum
ε_r is the permittivity of the dielectric
A is the total area of the plates and
d is the distance between them



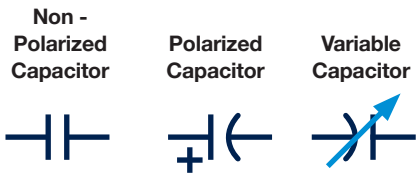
$Energy\ Stored = 1/2\ (CxV^2)$

The unit of capacitance is the Farad, symbol F.
Typical capacitor values range from 10 F down to 1 pF.

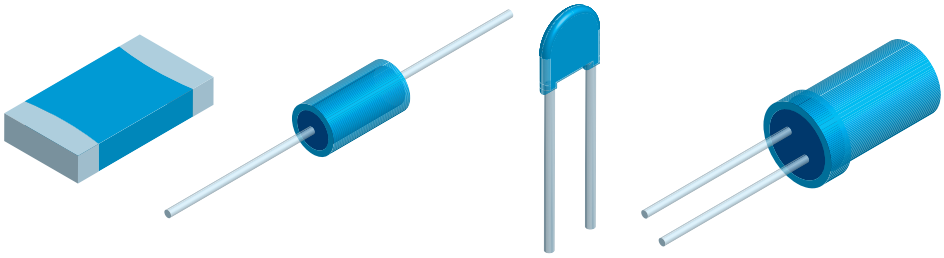
KEY CAPACITOR TECHNOLOGIES

- Ceramic
- Electrolytic
- Film
- Multi layer ceramic capacitor (MLCC)
- Polymer
- Tantalum

CAPACITOR TYPES & SYMBOLS



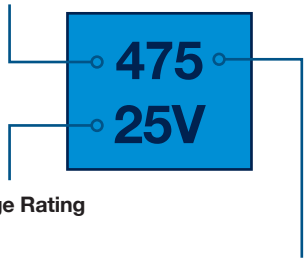
CAPACITOR SIZES & FORMATS



SMT Chip Capacitors | Axial Lead Capacitors | Disk Capacitors | Axial Capacitors

CAPACITOR MARKINGS

1st and 2nd digits indicate the capacitor value – in this example 47

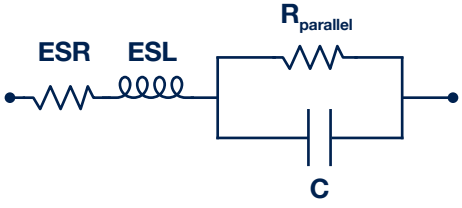


Voltage Rating

3rd digit gives the multiplier, with 0 indicating tens of pF. See opposite table. In this example, 475 is 4.7 µF.

CAPACITOR EQUIVALENT CIRCUIT

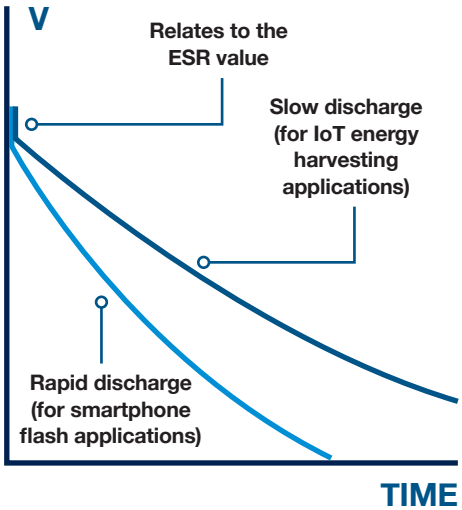
A capacitor's equivalent circuit takes into account the equivalent series resistance (ESR) and inductance (ESL), and the dielectric insulation resistance across the capacitance.



MULTIPLIER FACTORS

3RD DIGIT	ORDER OF MAGNITUDE	EXAMPLE	CAPACITOR VALUE
0	1	470	47 pF
1	10	101	100 pF
2	100	222	2.2 nF
3	1,000	473	47 nF
4	10,000	224	220 nF/0.22 µF
5	100,000	475	4.7 µF

SUPER CAPACITOR DISCHARGE PROFILES



GLOBALCAPACITOR MARKET

Current annual worth of $20 billion in total (according to figures compiled by Lucintel)

It is estimated that nearly 5 trillion units were shipped in 2019 (according to Research & Markets)

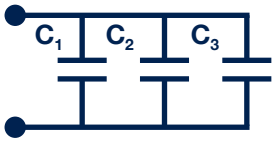
CAPACITOR CALCULATIONS

Series

$$\frac{1}{C_{equivalent}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

Parallel

$$C_{equivalent} = C_1 + C_2 + C_3$$



EIA CAPACITOR TOLERANCES

CODE	TOLERANCE FIGURE
B	±0.1 %
C	±0.25 %
D	±0 %
F	±1 %
G	±2 %
J	±5 %
K	±10 %
M	±20 %
Y	±30 %
Z	+80 % -20 %

EIA CAPACITOR VOLTAGE CODES

CODE	VOLTAGE
0L	5.5 V
1A	10 V
1E	25 V
1H	50 V
2A	100 V
2D	200 V
2E	250 V
2G	400 V

KEY CAPACITOR SELECTION PARAMETERS

- Capacitance
- Working Voltage
- Temperature Range Supported
- Leakage Current
- Equivalent Series Resistance (ESR)
- Tolerance Level
- Moisture Sensitivity

MOUSER ELECTRONICS

CAPACITOR REFERENCE SHEET