

A capacitor works on the principal of having two conductive plates which are very close and are parallel to each other. When a charge is applied to one plate of the capacitor, the electrons will generate an approximately equal, but opposite charge on the other plate of the capacitor. Capacitors will pass AC current, but will block DC current. A capacitor can also be used to smooth out voltage ripple, as in DC power supplies. Capacitance is measured in Farads (F).

Capacitor Parameters

Capacitors have five parameters. Capacitance (Farads), Tolerance (%), Maximum Working Voltage (Volts), Surge Voltage (Volts) and leakage. Because a Farad is a very large unit, most capacitors are normally measured in the ranges of pico, nano and micro farads.

Working Voltage

This refers to the maximum voltage that should be placed across the capacitor under normal operating conditions.

Surge Voltages

The maximum **instantaneous** voltage a capacitor can withstand. If the surge voltage is exceeded over too long a period there is a very good chance that the capacitor will be destroyed by the voltage 'punching' through the insulating material inside the casing of the capacitor. If a circuit has a surging characteristic, choose a capacitor with a high rated surge voltage.

Leakage

Refers to the amount of charge that is lost when the capacitor has a voltage across its terminals. If a capacitor has a low leakage it means that very little power is lost. Generally leakage is very small and is not normally a consideration for general purpose circuits.

Tolerance

As with resistors, tolerance indicates how close the capacitor is to its noted value. These are normally written on the larger capacitors and encoded on the small ones.

Code	Tolerance	Code	Tolerance
C	±0.25pF	D	±0.5pF
E	±1pF	G	±2%
J	±5%	K	±10%
L	±15%	M	±20%
N	±30%		

Capacitor Markings

There are a two methods for marking capacitor values. One is to write the information numerically directly onto the capacitor itself. The second is to use the EIA coding system.

EIA Coding

The EIA code works on a very similar principle to the resistor colour code. The first two digits refer to the value with the third being the multiplier. The fourth character represents the tolerance.

When the EIA code is used, the value will always be in Pico-Farads (see Decimal Multipliers).

Example 1: 103K

This expands to:

1 = 1

0 = 0

3 = x 1,000

K = 10% (see Capacitor Tolerance for listings)

Then we combine these numbers together:

1 0 x1,000 = 10,000pF = 0.01µF,

at ±10% tolerance.

Example 2 : 335K

This expands to:

3 = 3; 3 = 3; 5 = x 100,000; K = ±10%

Then we combine these numbers together:

3 3 x100,000 = 3,300,000pF = 3,300nF = 3.3µF, at 10% tolerance.

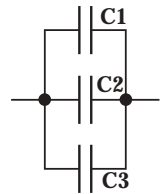
Capacitors in Series

Capacitors in series can be calculated by: Note:- The new value will always be lower.

$$C_{Total} = \frac{1}{\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{etc} \dots\right)}$$

Capacitors in Parallel

When capacitors are placed in parallel they can be simply added together.



$$C_{Total} = C_1 + C_2 + C_3 + \text{etc} \dots$$

Note :- The new capacitance value will be higher.

READING & CONVERTING CAPACITOR VALUES

1,000,000pF	=	1µF	=	1,000nF
100,000pF	=	0.1µF	=	100nF
10,000pF	=	0.01µF	=	10nF
1,000pF	=	0.001µF	=	1nF
100pF	=	0.0001µF	=	0.1nF
10pF	=	0.00001µF	=	0.01nF
1pF	=	0.000001µF	=	0.001nF

OR ...

µF	nF	pF	EIA Code
0.001µF	1.0nF	1000pF	102
0.0012µF	1.2nF	1200pF	122
0.0015µF	1.5nF	1500pF	152
0.0018µF	1.8nF	1800pF	182
0.0022µF	2.2nF	2200pF	222
0.0027µF	2.7nF	2700pF	272
0.0033µF	3.3nF	3300pF	332
0.0039µF	3.9nF	3900pF	392
0.0047µF	4.7nF	4700pF	472
0.0056µF	5.6nF	5600pF	562
0.0068µF	6.8nF	6800pF	682
0.0082µF	8.2nF	8200pF	822
0.01µF	10nF	1.00 x10 ⁴ pF	103
0.012µF	12nF	1.20 x10 ⁴ pF	123
0.015µF	15nF	1.50 x10 ⁴ pF	153
0.018µF	18nF	1.80 x10 ⁴ pF	183
0.022µF	22nF	2.20 x10 ⁴ pF	223
0.027µF	27nF	2.70 x10 ⁴ pF	273
0.033µF	33nF	3.30 x10 ⁴ pF	333
0.039µF	39nF	3.90 x10 ⁴ pF	393
0.047µF	47nF	4.70 x10 ⁴ pF	473
0.056µF	56nF	5.60 x10 ⁴ pF	563
0.068µF	68nF	6.80 x10 ⁴ pF	683
0.082µF	82nF	8.20 x10 ⁴ pF	823
0.1µF	100nF	1.00 x10 ⁵ pF	104
0.12µF	120nF	1.20 x10 ⁵ pF	124
0.15µF	150nF	1.50 x10 ⁵ pF	154
0.18µF	180nF	1.80 x10 ⁵ pF	184
0.22µF	220nF	2.20 x10 ⁵ pF	224
0.27µF	270nF	2.70 x10 ⁵ pF	274
0.33µF	330nF	3.30 x10 ⁵ pF	334
0.39µF	390nF	3.90 x10 ⁵ pF	394
0.47µF	470nF	4.70 x10 ⁵ pF	474
0.56µF	560nF	5.60 x10 ⁵ pF	564
0.68µF	680nF	6.80 x10 ⁵ pF	684
0.82µF	820nF	8.20 x10 ⁵ pF	824
1µF	1000nF	1.00 x10 ⁶ pF	105
1.2µF	1200nF	1.20 x10 ⁶ pF	125
1.5µF	1500nF	1.50 x10 ⁶ pF	155
1.8µF	1800nF	1.80 x10 ⁶ pF	185
2.2µF	2200nF	2.20 x10 ⁶ pF	225
2.7µF	2700nF	2.70 x10 ⁶ pF	275
3.3µF	3300nF	3.30 x10 ⁶ pF	335
3.9µF	3900nF	3.90 x10 ⁶ pF	395
4.7µF	4700nF	4.70 x10 ⁶ pF	475
5.6µF	5600nF	5.60 x10 ⁶ pF	565
6.8µF	6800nF	6.80 x10 ⁶ pF	685
8.2µF	8200nF	8.20 x10 ⁶ pF	825
10µF	10000nF	1.00 x10 ⁷ pF	106