Capacitors

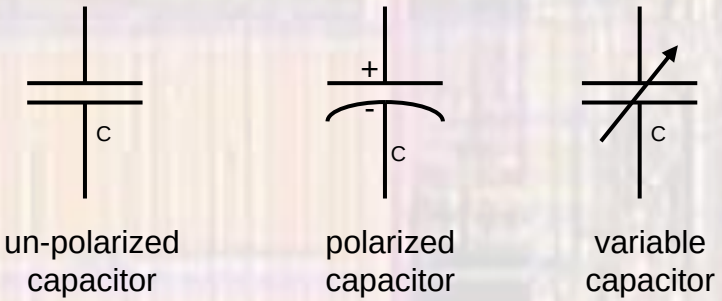
Last updated 1/10/24

Capacitors

- Basics
  - C

$$Q = C\,V \qquad i = C\,dv/dt$$

  - Circuit Symbols



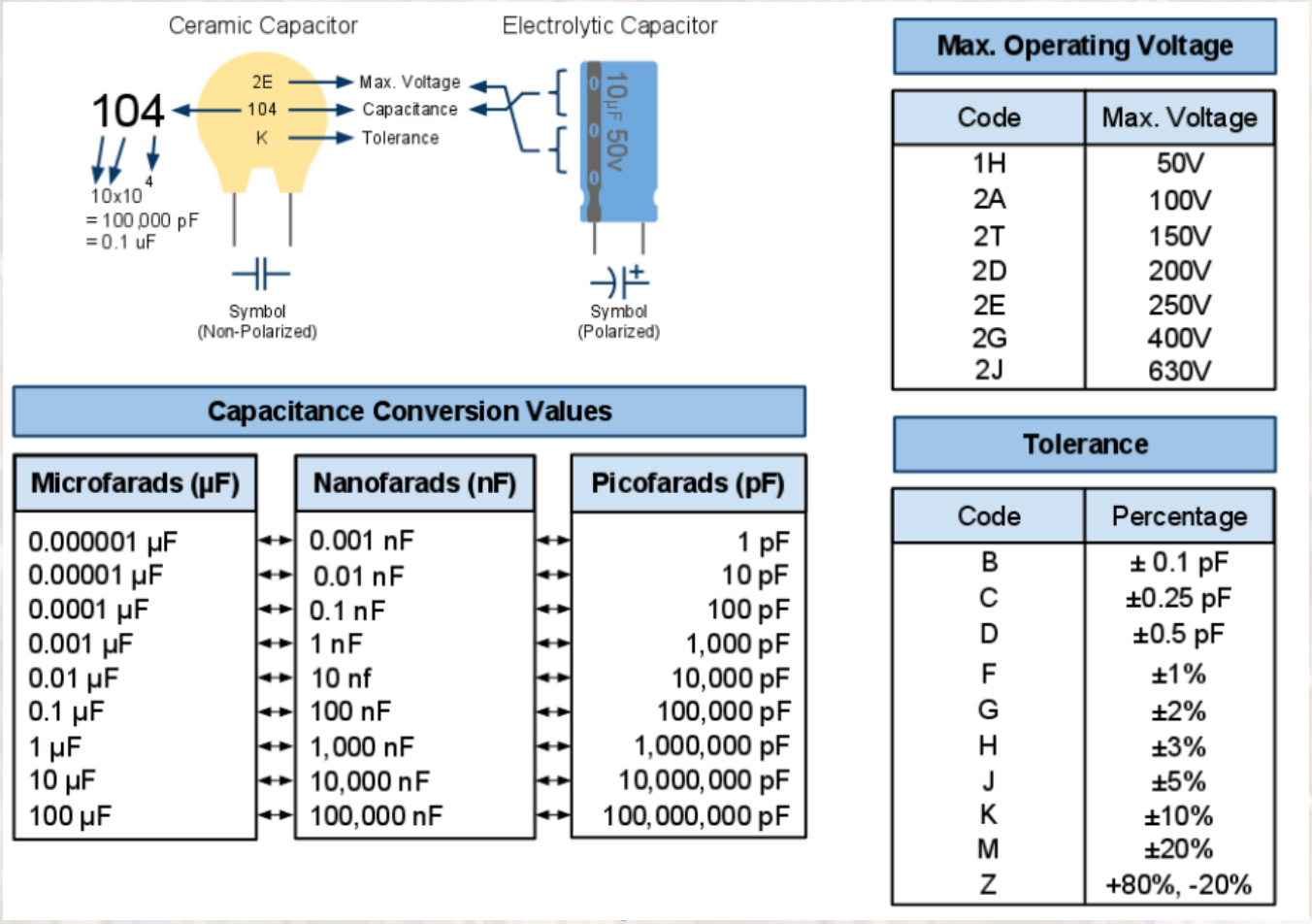
Common Capacitors

value	range
1.0	
1.5	value x 1pF
2.2	to
3.3	value x 10^3uF
4.7	
6.8	

  - Tolerance
    - 1% → 20%
    - Most common: 10%
    - Lower tolerance → more expensive

Capacitors

- Leaded Capacitor
  - Ceramic, electrolytic



Capacitance Conversion Values

Microfarads (µF)	Nanofarads (nF)	Picofarads (pF)
0.000001 µF	0.001 nF	1 pF
0.00001 µF	0.01 nF	10 pF
0.0001 µF	0.1 nF	100 pF
0.001 µF	1 nF	1,000 pF
0.01 µF	10 nf	10,000 pF
0.1 µF	100 nF	100,000 pF
1 µF	1,000 nF	1,000,000 pF
10 µF	10,000 nF	10,000,000 pF
100 µF	100,000 nF	100,000,000 pF

Max. Operating Voltage

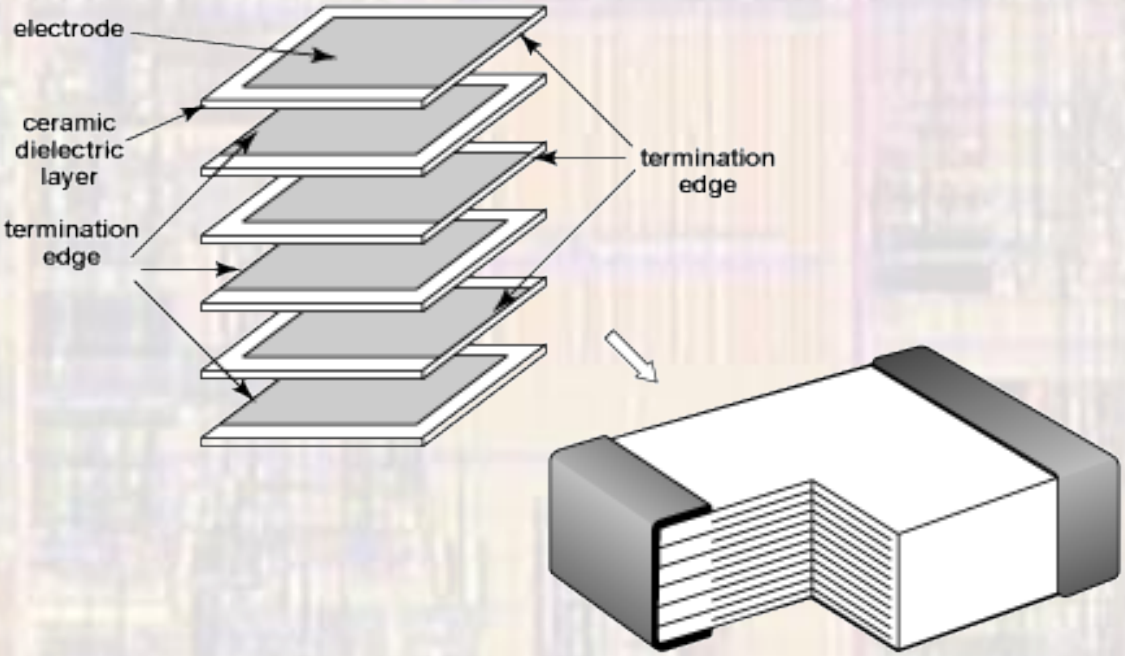
Code	Max. Voltage
1H	50V
2A	100V
2T	150V
2D	200V
2E	250V
2G	400V
2J	630V

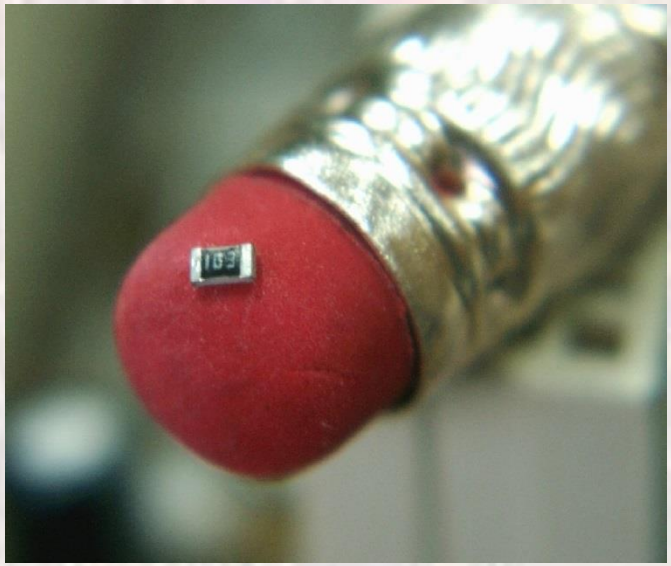
Tolerance

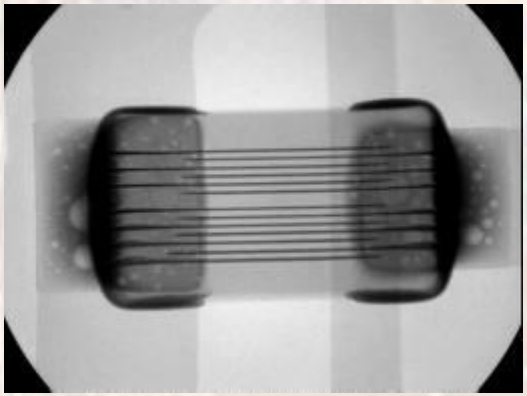
Code	Percentage
B	± 0.1 pF
C	±0.25 pF
D	±0.5 pF
F	±1%
G	±2%
H	±3%
J	±5%
K	±10%
M	±20%
Z	+80%, -20%

Capacitors

- Chip Capacitor







Capacitors

- Chip Capacitor
  - Also called Surface Mount Capacitor

  - Sizes – mm
    - L W
    - 0402, 0603, 0805, 1206, 1812, 2412

  - Markings – if they exist
    - 1 letter, 1 number
    - Letter indicates value
    - Number indicates exponential multiplier
    - All values are in pF
    - E.g E4 → 1.5×10^4pF =.015uF

Alpha:	A	B	C	D	E	F	G	H	J	K	a	L
Signif. Fig.	1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.5	2.7
Alpha:	M	N	b	P	Q	d	R	e	S	f	T	U
Signif. Fig.	3.0	3.3	3.5	3.6	3.9	4.0	4.3	4.5	4.7	5.0	5.1	5.6
Alpha:	m	V	W	n	X	t	Y	y	Z			
Signif. Fig.	6.0	6.2	6.8	7.0	7.5	8.0	8.2	9.0	9.1			

Numeric:	0	1	2	3	4	5	6	7	8	9
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^8	10^{-1}

Capacitors

- Frequency Response
  - Model