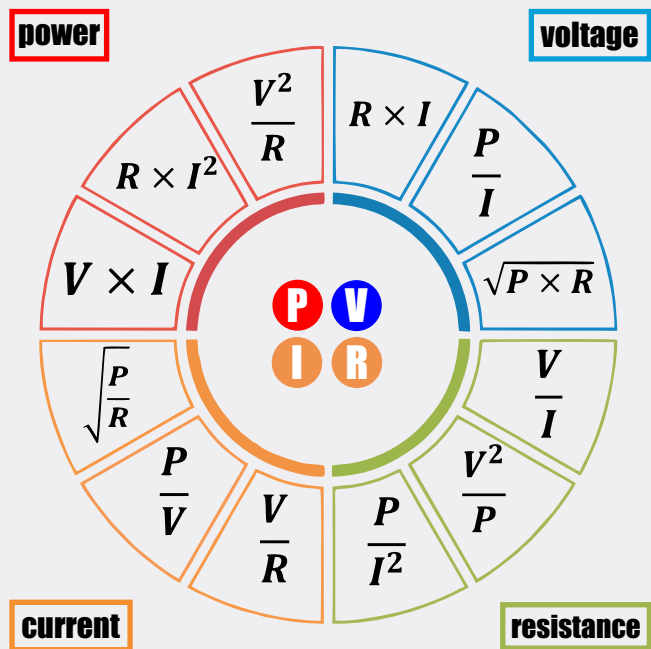


**BELIEVE IN YOURSELF**

**ELECTRONIC CHEAT SHEET**

**Ohm's law**



**American Wire Gauge**

Actual Cross Sect. Size

AWG No.	Diameter (in)	Diameter (mm)	CS Area. (mm <sup>2</sup> )	Resistance (Ω/Km)
4/0	.4600	11.68	107.2	.1608
3/0	.4096	10.40	85.03	.2028
2/0	.3648	9.266	67.43	.2557
1/0	.3249	8.252	53.48	.3224
1	.2893	7.348	42.41	.4066
2	.2576	6.544	33.63	.5127
3	.2294	5.827	26.67	.6465
4	.2043	5.189	21.15	.8152
5	.1819	4.621	16.77	1.028
6	.1620	4.115	13.30	1.296
7	.1443	3.665	10.55	1.634
8	.1285	3.264	8.366	2.061
9	.1144	2.906	6.634	2.599
10	.1019	2.588	5.261	3.277
11	.0907	2.305	4.172	4.132
12	.0808	2.053	3.309	5.211
13	.0720	1.828	2.624	6.571
14	.0641	1.628	2.081	8.286
15	.0571	1.450	1.650	10.45
16	.0508	1.291	1.309	13.17
18	.0403	1.024	.8231	20.95
20	.0320	.8118	.5176	33.31
22	.0253	.6438	.3255	52.96
24	.0201	.5106	.2047	84.22
26	.0159	.4049	.1288	133.9
28	.0126	.3211	.08098	212.9
30	.0100	.2546	.05093	338.6
32	.00795	.2019	.03203	538.3
34	.00630	.1601	.02014	856.0
36	.00500	.1270	.01267	1361
38	.00397	.1007	.00797	2164
40	.00314	.0799	.00501	3441

**Resistor color Coding**

4 Band: 4 4 3 ±5% = 473 = 47 × 10<sup>3</sup> = 47 000 Ω = 47 KΩ ±5%

5 Band: 4 7 0 3 = 4703 = 470 × 10<sup>3</sup> = 470 000 Ω = 470 KΩ ±5%

6 Band: 4 7 0 3 20 = 470 KΩ ±5% @Temp. Coeff 50 ppm/K

Black	0	0	×10 <sup>0</sup>	0	250
Brown	1	1	×10 <sup>1</sup>	±1%	100
Red	2	2	×10 <sup>2</sup>	±2%	50
Orange	3	3	×10 <sup>3</sup>		15
Yellow	4	4	×10 <sup>4</sup>		25
Green	5	5	×10 <sup>5</sup>	±.50%	20
Blue	6	6	×10 <sup>6</sup>	±.25%	10
Violet	7	7	×10 <sup>7</sup>	±.10%	5
Grey	8	8		±.05%	1
White	9	9			
Gold			×10 <sup>-1</sup>	±5%	
Silver			×10 <sup>-2</sup>	±10%	

**Capacitor coding**

**Common Capacitor**

Ceramic: 2D 103 J = 10 × 10<sup>3</sup> = 10 000 pF = 1 nF

Electrolytic: 10µF 25V

**Capacitance Conversion Table**

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

**Max. Operating Voltage Tolerance**

1H	50 V	2E	250 V	B	±.1 pF	H	±3 %
2A	100 V	2G	400 V	C	±.25 pF	J	±5 %
2T	150 V	2J	630 V	D	±.50 pF	K	±10 %
2B	200 V			F	±.1 %	M	±20 %
				G	±.2 %	Z	±.8% - 20%

**Electrical Unit**

**Basic Electronic Unit**

	Abbrev. / Unit	Abbrev. / Unit
Capacitance	F Farad	H Henry
Charge	C Coulomb	Wb Weber
Current	A Ampere	V Volt
Energy	J Joule	W Watt
Force	N Newton	Ω Ohm
Frequency	Hz Hertz	

**M Metric Prefixes**

Prefix	Symbol	Factor	Value
Tera-	T	*10 <sup>12</sup>	1 000 000 000 000
Giga-	G	*10 <sup>9</sup>	1 000 000 000
Mega-	M	*10 <sup>6</sup>	1 000 000
Kilo-	K	*10 <sup>3</sup>	1 000
Hecto-	H	*10 <sup>2</sup>	100
Deka-	Da	*10 <sup>1</sup>	10
(base)	-	*10 <sup>0</sup>	1
Deci-	d	*10 <sup>-1</sup>	0.1
Centi-	c	*10 <sup>-2</sup>	0.01
Milli-	m	*10 <sup>-3</sup>	0.001
Micro-	µ	*10 <sup>-6</sup>	0.000 001
Nano-	n	*10 <sup>-9</sup>	0.000 000 001
Pico-	p	*10 <sup>-12</sup>	0.000 000 000 001

**Light Emitting Diode (LED)**

**Typical LED Characteristics**

Color	Wavelength (nm)	Typical Forward Voltage (V) @ 20 mA
Red	630 - 660	1.8
Orange	605 - 620	2.0
Yellow	585 - 595	2.2
Green	550 - 570	3.5
Blue	630 - 660	3.6
White	430 - 505	4.0
Ultraviolet	850 - 940	1.2

**Diodes and Transistors**

**Diode**

Schematic Symbol: Anode (A) Cathode (K)

Example: 1N4001

**Bipolar Junction Transistor (BJT)**

TO-92 package: NPN (2N3903, 2N2222), PNP (BC546, BC556)

BJT Schematic Symbol: NPN, PNP

**MOS Field Effect Transistor (MOSFET)**

SOT-23 package: N-channel (2N7000), P-channel (BS250)

MOSFET Schematic Symbol: Enhancement Mode MOSFET

Component pinout shown are the most common and may still vary per device manufacturer. Refer to the specific device datasheet to be sure.

**Surface Mount Devices (SMD)**

**SMD Resistor Marking**

3 Digit: 473 = 47 × 10<sup>3</sup> = 47 000 Ω = 47 KΩ

4 Digit: 4702 = 470 × 10<sup>2</sup> = 47 000 Ω = 47 KΩ

with Radix Point: 4R7 = 4.7 Ω, 0R47 = 0.47 Ω

**SMD Capacitor Markings**

Tantalum: 473 16V = 47 × 10<sup>3</sup> pF = 47 nF @ 16V

Electrolytic Capacitor: 473 16V = 47 × 10<sup>3</sup> pF = 47 nF @ 16V

**R Regulator**

**LM78XX Regulator**

TO-220 package

common Outputs: 7805, 5V Regulator; 7905, -5V Regulator; 7812, 12V Regulator; 7912, -12V Regulator

Basic Configuration: IN, GND, OUT

**Op-Amp**

**741 Op-Amp** (8 Pin Dip)

offset null 1, Inverting 2, Non-Inverting 3, Gnd 4, +VCC 5, vcc 6, Output 7, offset null 8

**Lm358 Dual Op-Amp** (8 Pin Dip)

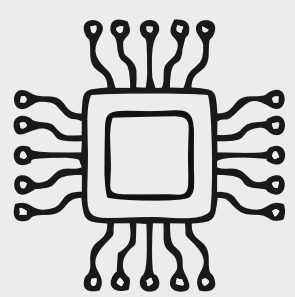
Output 1, Inverting 2, Non-Inverting 3, Gnd 4, vcc 5, Output 2 6, Inverting 2 7, Non-Inverting 2 8

**5 555 IC**

**555 IC Pinout** (8 Pin Dip)

End 1, Trigger 2, Output 3, Reset 4, 5 vcc, 6 Discharge, 7 Threshold, 8 CONTROL

**Custom information**



Redesigned by AmirHossein Amini

Gmail amir.electronic.1382@gmail.com

@Amirhosseinamini

**The Breadboard**

**Breadboard Anatomy and Parts**

Connecting Wires, DIP Support, Terminal strips, Power Rail

Horizontal holes in these rows are connected inside

Vertical holes in these rows are connected inside

