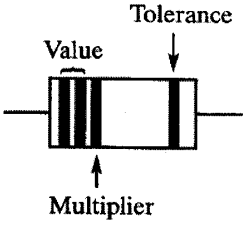


Electronics

Data Sheet

Resistors	Preferred values for resistors (E24) series: 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.3, 4.7, 5.1, 5.6, 6.2, 6.8, 7.5, 8.2, 9.1 ohms etc.	
Resistor Printed Code (BS 1852)	This code consists of letters and numbers: R means $\times 1$ K means $\times 1000$ (i.e. 10^3) M means $\times 1\,000\,000$ (i.e. 10^6) Position of the letter gives the decimal point Tolerances are given by the letter at the end of the code, F = $\pm 1\%$, G = $\pm 2\%$, J = $\pm 5\%$, K = $\pm 10\%$, M = $\pm 20\%$.	
Resistor Colour Code	Number	Colour
	0	Black
	1	Brown
	2	Red
	3	Orange
	4	Yellow
	5	Green
	6	Blue
	7	Violet
	8	Grey
	9	White
		Tolerance, gold = $\pm 5\%$, silver = $\pm 10\%$, no band = $\pm 20\%$
Silicon diode	$V_F = 0.7\text{ V}$	
Silicon transistor	$V_{be} \approx 0.7\text{ V}$ in the on state, $V_{ce} \approx 0.2\text{ V}$ when saturated	
Resistance	$R_T = R_1 + R_2 + R_3 + \dots$	series
	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$	parallel
Capacitance	$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$	series
	$C_T = C_1 + C_2 + C_3 + \dots$	parallel
Time constant	$T = CR, T_{\frac{1}{2}} = 0.69 CR$	
ac theory	$I_{\text{rms}} = \frac{I_0}{\sqrt{2}}$	
	$V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$	
	$X_C = \frac{1}{2\pi fC}$	reactance
	$X_L = 2\pi fL$	reactance
	$f = \frac{1}{T}$	frequency, period
	$f_0 = \frac{1}{2\pi\sqrt{LC}}$	resonant frequency



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Operational amplifier

$$G_V = \frac{V_{out}}{V_{in}}$$

voltage gain

$$G_V = -\frac{R_f}{R_1}$$

inverting

$$G_V = 1 + \frac{R_f}{R_1}$$

non-inverting

$$V_{out} = -R_f \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} \right)$$

summing

$$V_{out} = (V_+ - V_-) \frac{R_f}{R_1}$$

difference

555 Astable and Monstable

$$T = 1.1RC$$

monostable

$$t_H = 0.7 (R_A + R_B)C$$

$$t_L = 0.7 R_B C$$

astable

$$f = \frac{1.44}{(R_A + 2R_B)C}$$

astable frequency

Electromagnetic waves

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

speed in vacuo

Assembler language microcontroller instructions

Mnemonic	Operands	Description	Operation	Flags	Clock cycles
NOP	none	No operation	none	none	1
CALL	K	Call subroutine	stack <= PC PC <= K	none	2
RET	none	Return from subroutine	PC <= stack	none	2
INC	R	Increments the contents of R	(R) <= (R) + 1	Z	1
DEC	R	Decrements the contents of R	(R) <= (R) - 1	Z	1
ADDW	K	Add K to W	W <= W + K	Z, C	1
ANDW	K	AND K with W	W <= W • K	Z, C	1
SUBW	K	Subtract K from W	W <= W - K	Z, C	1
ORW	K	OR K and W	W <= W + K	Z, C	1
XORW	K	XOR K and W	W <= W ⊕ K	Z, C	1
JMP	K	Jump to K (GOTO)	PC <= K	none	2
JPZ	K	Jump to K on zero	PC <= K if Z=1	Z=1	2
JPC	K	Jump to K on carry	PC <= K if C=1	C=1	2
MOVWR	R	Move W to the contents of R	(R) <= W	Z	1
MOVW	K	Move K to W	W <= K	Z	1
MOVRW	R	Move the contents of R to W	W <= (R)	Z	1