


Presentation



- Basic Electronics
Hamtronics Part 1
- WA7PLC
Pearley "DOC"
Cunningham
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@Sunlife ARC

Basic Electronics- Hamtronics Part 1



- At the suggestion of President Sue Rogers I will be presenting a series of slides on the basics of electronics of importance to radio.
- The topics will eventually consist of passive devices, as today, and active devices, receivers and transmitters.

Hamtronics Part 1



- This presentation as well as any supporting material will be available at www.drcunningham.us/hamtronics

Hamtronics is a work in progress started last spring on Monday afternoons at the VO Ham Shack.

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- Only four basic physical quantities that we can measure ...
- Length - meter
- Mass- kilogram
- Time - second
- Charge - Coulomb

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□ Derived quantities ...

Units Review

Physical Quantity	Unit	Alternate Units	Equation
Charge	Coulomb (C)		$Q = I \times t$
Current	Ampere (A)		$I = Q/t$
Energy	Joule (J)	W Hr or KW Hr	$W = P \times t$
Work	Joule (J)	Electron volt Newton meter N m	$E = qV$ $W = F \times D$
Power	Watt (W)	HP, BTU/Hr J/s	$P = W/t$
Electrical Potential	Volt (V)	V	Joule/Coulomb $V = E/q$
Force	Newton (N)	pound	$F = \text{mass} \times \text{acceleration}$ $F = ma$
Time	Second (s)	Hour (hr) or Minute (min)	Fundamental unit of measure

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- For example ...
- Force is defined as
mass X acceleration or
mass x meter/(second X second)
all fundamental units!

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- Main Interest is the charge
- 1 Coulomb = 6.24×10^{18} electrical charges or 6.24 quintillion (way to big a number to mess with)
- A shopper buys one apple at a time, but the farmer sells it by the bushel Or maybe even the orchard. Same thing.

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- Current measured in
Coulombs/Second = Amperes, not
electrons/second!
- Voltage is Joules/Coulomb
- All derived units not fundamental.

Hamtronics - Part 1

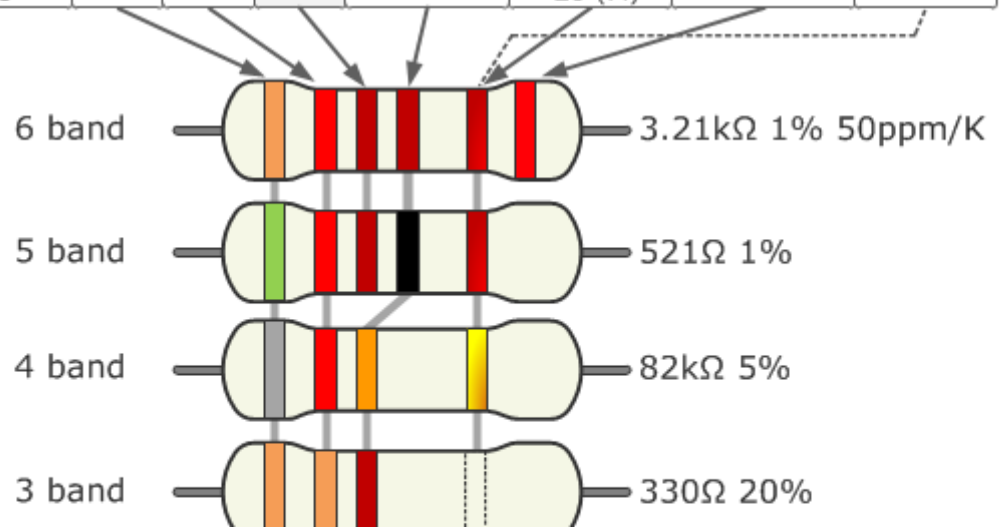


- Ohm's Law
- Resistors are designed to oppose the flow of charge. Consider them controlled conductors.
- They are made with carbon, various wire, and thin films.
- Usually marked values in "color code".

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Resistor Color Code Chart

	Color	Significant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
Bad	black	0	0	0	x 1		250 (U)	
Beer	brown	1	1	1	x 10	1 (F)	100 (S)	1
Rots	red	2	2	2	x 100	2 (G)	50 (R)	0.1
Our	orange	3	3	3	x 1K		15 (P)	0.01
Young	yellow	4	4	4	x 10K		25 (Q)	0.001
Guts	green	5	5	5	x 100K	0.5 (D)	20 (Z)	
But	blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
Vodka	violet	7	7	7	x 10M	0.1 (B)	5 (M)	
Goes	grey	8	8	8	x 100M	0.05 (A)	1(K)	
Well	white	9	9	9	x 1G			
Get	gold				x 0.1	5 (J)		
Some	silver				x 0.01	10 (K)		
Now!	none					20 (M)		



Source:
www.resistorguide.com

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- Suppose we have a resistor with 3 bands of red-black-orange
- What is it's value?
- Looking at the chart red = 2
black = 0 and orange = X1000
- So resistor is 20,000 ohm or 20kOhm.

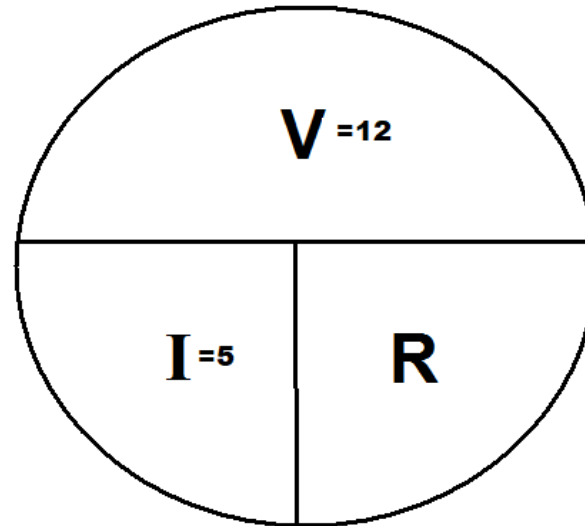
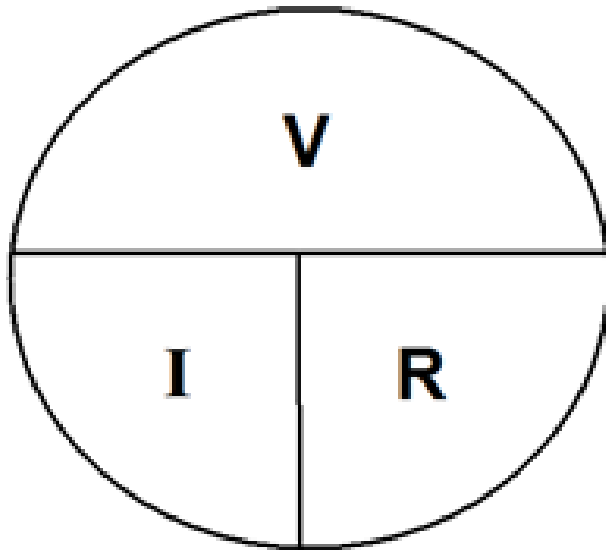
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- Voltage, E; Current, I: Ohmage, R
- Ohm's Law
- $V=I \times R$
- Say we have 12 volts across a resistor and 5 milliAmps passing through What is the resistance?
 $V=I \times R$ or $12 = 5 R$ so $R=12/5=2.4$ kOhms

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- Math Help
- The “Magic Circle”



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□ Better way. . .

□ There is a reference to a program called Smath Suites (go to Bing.com or google.com and search for Smath Suite.) It is free and will install on windows. I have used it for years. Also I will include solved formulas using Smath for equations on the Hamtronics web site. It is used a great deal in Europe and Canada, and is supported free by many programmers in these countries as well as Russia. There is also a user manual by me on the web site.

Ohm's Law

E is the voltage, I is the current and

R is the resistance or the Impedance XI or XC

Find E

I is in Amperes R is in Ohms

E is in Volts

$$I := 2.5$$

$$R := 3.5 \cdot 10^3$$

$$E := I \cdot R$$

$$E = 8750$$

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□ More . . .

Find R

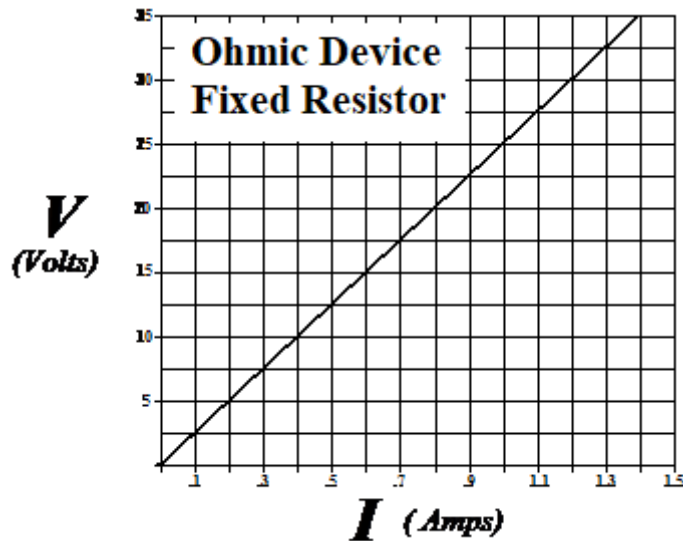
$$E := 9 \quad I := 4.5 \cdot 10^{-3}$$

$$R := \frac{E}{I}$$

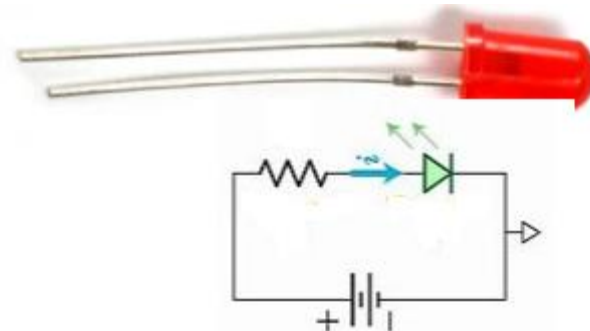
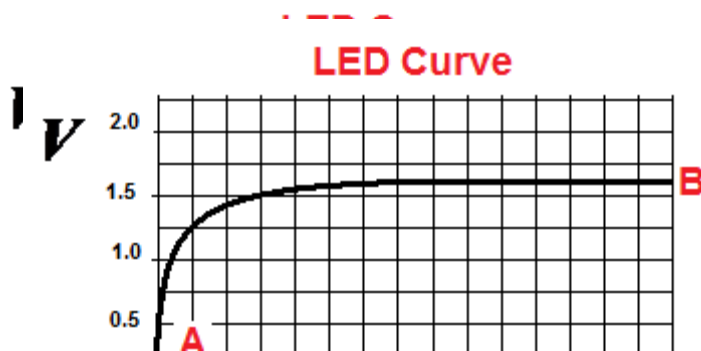
$$R = 2000$$

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□ Ohmic devices and non-Ohmic devices



Even in a non-Ohmic Device $V=I \times R$ at any point in the graph.



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- Let us take a look at an Smath screen.



This is your opening screen.

This next screen shows the result of setting the problem for a diode circuit into Smath. It is reusable!

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LED Resistor Circuit Direct from Smath...

From the graph and it being a red LED, the voltage on the led diode will always be $V_d = 1.6$ V.

$V_d := 1.6$ V Set the current to $I := 15 \cdot 10^{-3}$ Amperes

Battery voltage is $V_b := 12$ V

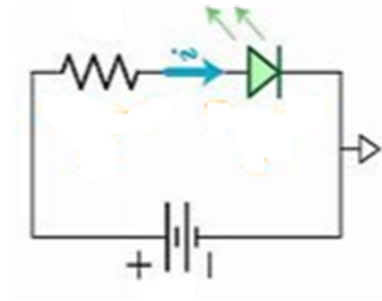
What resistor will allow this to happen?

$V_R = V_b - V_d = 10.5$ V so ...

$V_R := 10.5$

$V_R = I \times R$ so... $R := \frac{V_R}{I}$

$R = 700$ Ohms



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Commercial Resistor Values – see web site Electronics1

Resistor	Tables							
Ohms	Ohms	Ohms	Ohms	Kilohms	Kilohms	Kilohms	Megohm	Megohm
0.10	1.0	10	100	1.0	10	100	1.0	10
0.11	1.1	11	110	1.1	11	110	1.1	11
0.12	1.2	12	120	1.2	12	120	1.2	12
0.13	1.3	13	130	1.3	13	130	1.3	13
0.15	1.5	15	150	1.5	15	150	1.5	15
0.16	1.6	16	160	1.6	16	160	1.6	16
0.18	1.8	18	180	1.8	18	180	1.8	18
0.20	2.0	20	200	2.0	20	200	2.0	20
0.22	2.2	22	220	2.2	22	220	2.2	22
0.24	2.4	24	240	2.4	24	240	2.4	
0.27	2.7	27	270	2.7	27	270	2.7	
0.30	3.0	30	300	3.0	30	300	3.0	
0.33	3.3	33	330	3.3	33	330	3.3	
0.36	3.6	36	360	3.6	36	360	3.6	
0.39	3.9	39	390	3.9	39	390	3.9	
0.43	4.3	43	430	4.3	43	430	4.3	
0.47	4.7	47	470	4.7	47	470	4.7	
0.51	5.1	51	510	5.1	51	510	5.1	
0.56	5.6	56	560	5.6	56	560	5.6	
0.62	6.2	62	620	6.2	62	620	6.2	
0.68	6.8	68	680	6.8	68	680	6.8	
0.75	7.5	75	750	7.5	75	750	7.5	
0.82	8.2	82	820	8.2	82	820	8.2	
0.91	9.1	91	910	9.1	91	910	9.1	

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There are two possible values 680 Ohms or 750 Ohms, neither is 700 so ...

here is where savvy comes into play.

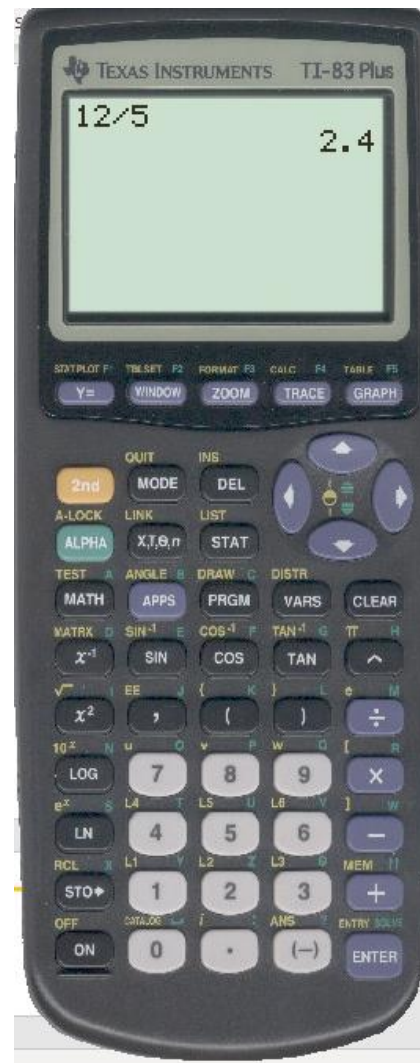
750 will reduce the current and 680 will increase it. The 680 Ohm is close to the 15 mA.

Electronics is a 10% Science.

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□ Another tool . . .

Look under Hamtronics at the website for the link to a free virtual TI-83 for your computer. I use this all the time!



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- I tried to demonstrate here the basics of Ohm's Law and resistance, voltage and current plus some useful tools. The goal is to present electronic topics in small bites rather than a fire hose of information. I hope it has been successful. Over the next year my goal is to expand the coverage of Hamtronics to include many radio related topics.

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- Questions? Comments?
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