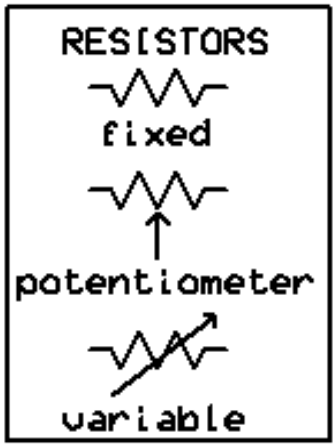
Resistor and capacitor information

Adapted from www.vintageradioworld. Written by Tony Thompson



Perhaps the most common components in any radio are resistors, in a variety of forms. Symbols encountered in valve radio technology are not the same as those used today. Physical appearance has changed, too, with the old large stick types becoming obsolete.

Despite their large size, they were capable only of modest power dissipation and modern, smaller resistors can often handle as much, or considerably more, power. Almost all variable resistors resistor are in reality potentiometers. A variable resistor is usually a potentiometer with the 'slider' (the centre tag connection) wired to one of the track ends. Typical uses in radio include volume and tone controls.

Resistors in series

When we connect resistors in series by wiring them end to end, their individual values simply add up, the total resistance being the sum of the individual values in the circuit.

EXAMPLE: 100 ohms in series with 200 ohms in series with 50 ohms = 350 ohms total resistance.

Resistors in parallel

When resistors are joined side-by-side, the combined value of resistance is always less than the value of the lowest value resistor in the network. An example: if we have two resistors wired in parallel, one being 200 ohms and the other being 100 ohms then the total value of resistance must be less than 100 ohms.

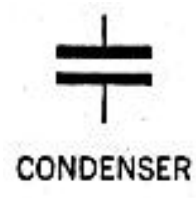
But, how much less? We can use this very simple formula to calculate the total value of the resistance from any network of 2 parallel resistors:

R*tot* = R1 X R2 over R1 + R2

Preferred values

In practice, it is easiest to choose a resistor nearest the value you require, bearing in mind that resistors come as so-called 'preferred values'. Usually, the nearest preferred value is close enough: few valve circuits need exact values, especially with the higher resistance ranges. So, if you decide you need 185 ohms you will choose the nearest available, in this case 180 ohms.

Capacitors



Or, to give them their old name, **condensers**. The second most common passive component in radio technology, these things come in a very wide range of sizes, forms and types for many purposes. In valve radio receivers, most of the physically larger capacitors were either of a tubular form, with a paper dielectric, or of a flat form with a mica dielectric. Paper types are common in AF (old LF) circuits for coupling and decoupling purposes at audio frequency - inter-valve coupling, tone

control etc. Mica types do similar functions but at much higher frequencies: RF (old HF) and also, in conjunction with inductors, tuning and alignment of tuned circuits.

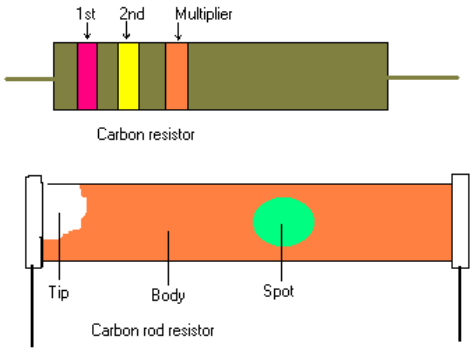
The colour coding of resistors and capacitors

RESISTORS

Resistors used in vintage valve equipment tend to fall into three categories, only two of which are colour coded. The third category is the wire-wound type of resistor, where values are normally printed on the vitreous paint finish of the component.

Resistors are measured in OHMS. The symbol for resistance is the Greek letter OMEGA, which looks like a small upturned horseshoe, i.e. Ω. The OHM is the unit of resistance but it is a very small unit for valve radio use and most resistors will be found to have high values i.e. thousands of ohms or even millions of ohms. Rather than print out lots of zeros, the symbol 'k' -kilo - is used to denote thousands and the symbol 'M' - mega - is used to denote millions. Examples: 56000 ohms is printed 56kohms. 1,200,000 ohms is printed 1.2MΩ. In some modern resistors, schematics and electronics texts, the 'k' or 'M' may be used in place of the decimal point, i.e. 1k2Ω = 1.2kΩ; 2M8Ω = 2.8MΩ.

Note that this code only refers to three or four banded resistors.



Carbon resistors are colour coded either (1) as body-tip-spot or (2) triple bands of colour. A fourth band may be used on either type for tolerance, which is a measure of how close the actual value is to the coded indication. No band equals 20% tolerance. Close tolerances only become important with valve radios when the resistor value is quite low. Otherwise, valves are usually able to operate within the range of 20% above or below the coded value. For replacement purposes, fit similar tolerance replacements. Conversely, fitting a close-tolerance component when unnecessary will do no harm.

On banded resistors, read from the end toward the centre. On body-tip-spot types, read in that order. The third band or the spot is a multiplier. If, on the latter type, a colour seems to be missing (either the spot or the tip) it is because the 'missing' value is the same as the body. **Example:** Red body, red tip, brown spot = 220Ω.

The resistor colour code chart

Colour	First figure Body or first band	Second figure Tip or second band	Third figure Spot or third band	Tolerance
Black	0	0	x0	
Brown	1	1	x1	

Red	2	2	x2	
Orange	3	3	x3	
Yellow	4	4	x4	
Green	5	5	x5	
Blue	6	6	x6	
Violet	7	7	x7	
Grey	8	8	x8	
White	9	9	x9	
Gold				5%
Silver				10%

MORE EXAMPLES

The standard resistor shown in the graphic is coded Red -Yellow - Orange. This gives a value of 24kΩ. The vintage rod resistor shown with an orange body, white tip and green spot indicates a value of 3900000 = 3.9MΩ.

Comparison chart for standard capacitor values

Use this chart to determine the value of vintage components when replacing with modern equivalents. Example: 0.0005µF vintage component can be replaced with either a 0.5nF or 500pF modern component.

EXAMPLES

The standard resistor shown in the graphic is coded Red -Yellow - Orange.

Red = 2. Yellow = 4. Orange = 3 (the number of zeros). Therefore the resistor is 24000 (24kΩ)

The carbon stick resistor shown in the graphic is coded Orange - White - Green.

Orange = 3. White = 9. Green = 5 (the number of zeros). Therefore the resistor has a value of 3900000 (3.9MΩ)

Body = red, tip = green, spot = orange. Value (in ohms): 25,000 (25KΩ). No silver or gold band means a 20% tolerance.

First band = green. Second band = blue. Third band = red. Fourth band = gold. Value (in ohms) 5600 (5.6kΩ). Tolerance of 5%.

CAPACITORS

In this writer's opinion it is far better to invest in a modestly priced capacitance meter than to rely on reading what can be a hard to see and complicated code. Such meters are usually in 'multimeter' combination with volt ohm and inductance meters.

There are a number of methods of coding, depending upon the amount of information given. The coding is the same as for resistors. Colours are read from left to right, the first colour being nearest to one end. Some capacitors have an arrow denoting the direction the code is to be read.

ONE COLOUR: Tolerance only

TWO COLOURS: Tolerance and voltage rating

THREE COLOURS: Capacitance (in picoFarads)

FIVE COLOURS: The first three colours denote capacitance in picoFarads, the remaining two denote tolerance and voltage rating.

AMERICAN CAPACITORS

Slight variations on the above. The RMA three-dot code is used for capacitors having a voltage rating of 500V and a tolerance of 20%. The dots simply give the value in picoFarads.

The RMA six-dot code offers - top row: First, second and third significant figures. Bottom row: voltage rating, tolerance and DECIMAL MULTIPLIER.

American fixed ceramic capacitors have a broad band followed by four narrow bands or dots giving temperature coefficient, first significant figure, second significant figure, DECIMAL MULTIPLIER and tolerance.

MicroFARAD (µF)	NanoFARAD (nF)	PicoFARAD (pF)
	0.01	10
	0.022	22
	0.047	47
0.0001	0.1	100
0.00022	0.22	220
0.00039	0.39	390
0.00047	0.47	470
0.00056	0.56	560
0.00068	0.68	680
0.00082	0.82	820
0.001	1	1000
0.0015	1.5	1500
0.0022	2.2	2200
0.0033	3.3	3300
0.0047	4.7	4700
0.0068	6.8	6800
0.01	10	
0.015	15	
0.022	22	
0.033	33	
0.047	47	

0.068	68		
0.1	100		
0.15	150		
0.22	220		
0.33	330		
0.47	470		
0.68	680		
1.0	1000		
1.5	1500		

End of section