Aim ↬ To understand multimeter operations and verify the color coding for resistors and capacitor coding.

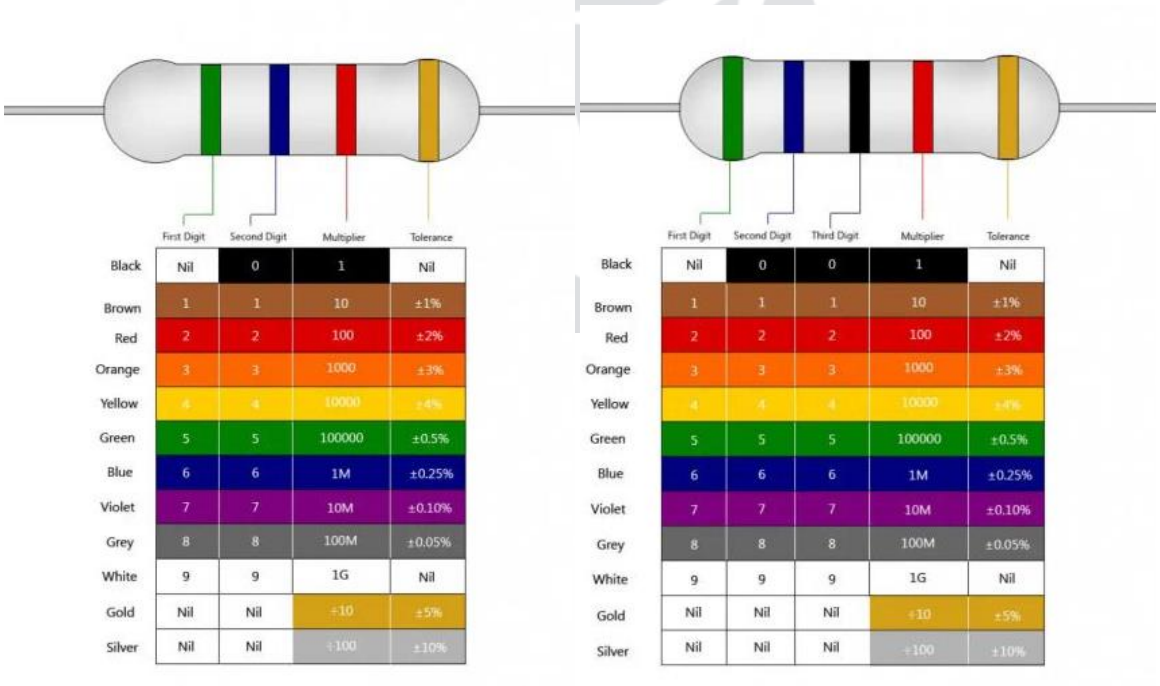
Equipment Required ↬

Multimeter, resistors, capacitors, breadboard, power supply, jumper wires.

Theory ↬

A multimeter is a versatile instrument used to measure voltage, current, and resistance in electrical circuits. It can operate in two modes: analog and digital. Digital multimeters (DMMs) provide numerical readings on a display, while analog multimeters use a needle to indicate measurements on a dial.

The color coding for resistors typically employs either a four-band or five-band system to identify resistance values and tolerance. In the four-band code, the first two bands represent significant digits, the third band indicates the multiplier, and the fourth band denotes tolerance. For example, a resistor with the bands red, yellow, brown, and gold would represent a resistance of 240 ohms with a tolerance of $\pm 5\%$.



	First Digit	Second Digit	Multiplier	Tolerance
Black	Nil	0	1	Nil
Brown	1	1	10	±1%
Red	2	2	100	±2%
Orange	3	3	1000	±3%
Yellow	4	4	10000	±4%
Green	5	5	100000	±0.5%
Blue	6	6	1M	±0.25%
Violet	7	7	10M	±0.10%
Grey	8	8	100M	±0.05%
White	9	9	1G	Nil
Gold	Nil	Nil	÷10	±5%
Silver	Nil	Nil	÷100	±10%

	First Digit	Second Digit	Third Digit	Multiplier	Tolerance
Black	Nil	0	0	1	Nil
Brown	1	1	1	10	±1%
Red	2	2	2	100	±2%
Orange	3	3	3	1000	±3%
Yellow	4	4	4	10000	±4%
Green	5	5	5	100000	±0.5%
Blue	6	6	6	1M	±0.25%
Violet	7	7	7	10M	±0.10%
Grey	8	8	8	100M	±0.05%
White	9	9	9	1G	Nil
Gold	Nil	Nil	Nil	÷10	±5%
Silver	Nil	Nil	Nil	÷100	±10%

Fig. i) 4-Band Resistor Coding Fig. ii) 5-Band Resistor Coding

The five-band color code is used for high-precision resistors, offering increased accuracy. Here, the first three bands indicate significant digits, the fourth band serves as the multiplier, and the fifth band denotes tolerance. For instance, a resistor with red, orange, yellow, black, and silver bands would indicate a

resistance of 234 ohms with a tolerance of ±10%. Both systems use specific colors for numerical values, enabling easy identification in electronic circuits.

Fig. iii) Multimeter measuring Resistance

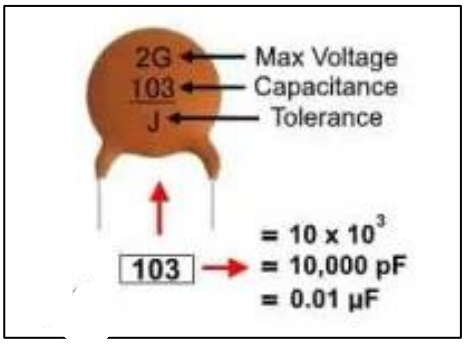


Fig. iv) Capacitance

Capacitor coding generally uses a numerical or alphanumeric system to indicate capacitance value, voltage rating, and tolerance. Unlike resistors, capacitors do not have a universal color code, but they often feature a printed label or a three-digit code.

In a three-digit code, the first two digits represent significant figures, and the third digit indicates how many zeros to add. For example, "104" means 10 followed by four zeros, or 100,000 picofarads (100 nanofa Multimeter tage ratings and tolerances are typically printed directly on the capacitor, ensuring proper selection for specific applications.

Code	Microfarad "µF"	Nanofarad "nF"	Picofarad "pF"	Code	Microfarad "µF"	Nanofarad "nF"	Picofarad "pF"
100	0.00001	0.01	10	225	2.2	2200	2200000
101	0.0001	0.1	100	254	0.2	200	200000
102	0.001	1.0	1000	330	0.000033	0.033	33
103	0.01	10	10000	331	0.00033	0.33	330
104	0.1	100	100000	332	0.0033	3.3	3300
105	1.0	1000	1000000	333	0.033	33	33000
121	0.00012	0.12	120	334	0.33	330	330000
131	0.00013	0.13	130	335	3.3	3300	3300000
150	0.000015	0.015	15	470	0.000047	0.047	47
151	0.00015	0.15	150	471	0.00047	0.47	470
152	0.0015	1.5	1500	472	0.0047	4.7	4700
153	0.015	15	15000	473	0.047	47	47000
154	0.15	150	150000	474	0.47	470	470000
155	1.5	1500	1500000	502	0.005	5.0	5000
181	0.00018	0.18	180	561	0.00056	0.56	560
202	0.002	2.0	2000	562	0.0056	5.6	5600
205	2.0	2000	2000000	681	0.00068	0.68	680
220	0.000022	0.022	22	682	0.0068	6.8	6800
221	0.00022	0.22	220	683	0.068	68	68000
222	0.0022	2.2	2200	684	0.68	680	680000
223	0.022	22	22000	751	0.00075	0.75	750
224	0.22	220	220000	821	0.00082	0.82	820

Fig. v) Capacitor Coding

Result ↬

The experiment effectively demonstrated multimeter operations and the ability to identify component values using color coding. The measured values from the multimeter correlated with the theoretical values, validating the functionality of the components and the circuit.

Conclusion ↬

This experiment provided foundational knowledge on the use of multimeters, the significance of color coding in resistors and capacitors, and the practical skills to measure electrical values in circuits. Understanding these concepts is crucial for further exploration and experimentation in electronics.

Precautions ↬

- Ensure accurate settings on the multimeter for the type of measurement being taken.
- Do not exceed the voltage and current ratings of components to prevent damage.
- Confirm the correctness of resistor and capacitor values based on their color codes before proceeding.
- Disconnect the power supply when making modifications to the circuit setup.