MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPARTMENT OF ELECTRONIC ENGINEERING

ELECTRONIC WORKSHOP # 04

Capacitors

Roll. No:	**Date:**
Checked by:	**Grade:**

Object: To become familiar with Capacitors, their types and reading their values

Apparatus:

1). A Digital Multimeter (DMM)
2). Few Electrolytic and Non Electrolytic Capacitors

Theory:

A capacitor is an electronic component used to store electric charges. Together with resistors and inductors, it is the most frequently used component in electronics. Capacitors are made up of two metallic plates having an insulator (also called a Dielectric) in between them, which enables it to store charges in the form of an electric field. The kind of dielectric used along with several other factors, determines how much charge the capacitor can store. Whenever the terminals of a capacitor are connected across a battery, there is a deficiency of electrons on one plate and an excess of electrons on the other. This creates a potential difference between the two plates and gives rise to an electric field. The capacity of a Capacitor to store charges is known as its capacitance which has the unit Farad (F), however, Farad is typically a big unit and one usually talks about capacitance in much smaller units such as µF, nF and pF etc.

There are two types of capacitors, Electrolytic and Non Electrolytic. The symbols of both are shown in figure-1.

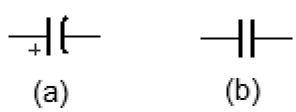

Figure-1: Symbol of Electrolytic (a) Non-Electrolytic (b) Capacitors

Electrolytic capacitors are polarized in that they need to be connected the correct way round (+ve supply to +ve terminal and –ve supply to –ve terminal) to charge them. They come in large as well as small values but are usually greater than 1µf. They come in two main types; one consists of metal foils with oxide insulators (electrolytic) and hence is simply called an Electrolytic Capacitor. The other type of polarized capacitors is Tantalum capacitors. The positive end is marked by a "+" and the negative lead is marked by a "-". Since these capacitors are usually physically large, their values are printed on them along with their voltage ratings and tolerances. Electrolytic capacitors are used for filtering out ripples in DC power supplies.

Non-Electrolytic capacitors on the other hand can be charged with any polarity and are thus non-polarized. They use Mica, Glass, Paper, Ceramic, Porcelain, Polycarbonate and Wax as the dielectric and are usually less than 1µf. They are usually used in AC circuits along with resistors and inductors to perform mathematical operations and filtering.

Ideal capacitors have infinite resistance. Real capacitors show a very high resistance in the order of 100's of Kilo Ohms, in fact this is one way to check whether a capacitor is faulty or not. When connected across a multimeter, with the range set to measure up to 1MΩ, a working capacitor would show zero first and gradually rise to a very high value (this is because the capacitor is being charged by the battery of the multimeter), if it is faulty, than it will stay at zero and the capacitor is said to have become shorted, if it the capacitor has become opened, there will be no reading on the multimeter.

Electrolytic capacitors, as mentioned before have values printed on them, on the other hand, the values of non-electrolytic capacitors have to be decoded. This takes into consideration a general rule plus some common sense with regard to the value non electrolytic capacitors can have i-e <1µF. The general rule is

$$(1^{st}\text{ Digit})\ (2^{nd}\text{ Digit}) \times 10^{\text{Multiplier}}\ \mu\text{F/pF}$$

Determining the unit is where the consideration kicks in, say if a capacitor has the number 102 written on it, and this is how one would decode its value,

$$10\text{x}10^2\ \text{pF} = 1000\text{pF} = 1\text{nF}$$

We took the unit to be pF because if we considered it to be µF, the capacitance would come out to be 1mF which would be too large a value for non-electrolytic capacitors. As another example, let's say that the number written on the capacitor is .02, now the value of this capacitor would be decoded as .02µF since .02pF is too small a capacitance value.

Some capacitors also have several suffixes following the coded values, the symbols for the tolerances and their corresponding values are shown in the table-1.

The capacitors discussed so far were fixed value capacitors; there are also variable capacitors that allow us to vary the capacitance. This is achieved in two ways, in one method, there is a set of fixed (stator) plates and some movable (rotor) plates in between those stator plates, the movable plates can be brought into and taken out of the mesh by means of a shaft thus varying the capacitance, in the next method one has a mechanism for moving the dielectric thus changing the capacitance. The capacitance of variable capacitors ranges between 1pF and 500pF. Variable capacitors of very small value are known as Trimmer capacitors. These are used in radios for tuning purpose. Symbols are shown in figure-2.

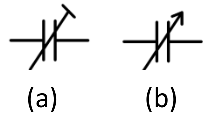

Figure-2: Symbol of Variable (a) Trimmer (b) Capacitors

Tolerance Code	**Tolerance Value**
Z (For Large capacitors)	+80%, -20%
M	±20%
K	±10%
J	±5%
G	±2%
F	±1%
D	±0.5%
C	±0.25%
B	±0.1%
A	±0.05%
Z (For Small Precision Capacitors)	±0.025%
N	±0.02%

Table-1: Capacitor tolerance codes and values

Every capacitor has a voltage rating for which it can be used, if the capacitor is supplied with a voltage greater than the rating, it will result in it getting damaged. Some real capacitors are shown in figure-3.

Procedure:

1. Take a Multimeter that can measure capacitance, set it to measure resistance with the range set at 2MΩ.
2. Take a few capacitors (polarized and non-polarized). Taking each capacitor one at a time, use the method described in the theory to check whether the capacitor is faulty or not and write down your observation in the table-2.
3. Now set the multimeter to measure capacitance, decode/read the capacitance value and write it down in Column 3 of the observation table-3, measure the capacitance with the multimeter and write down in the observation table-3 as well.

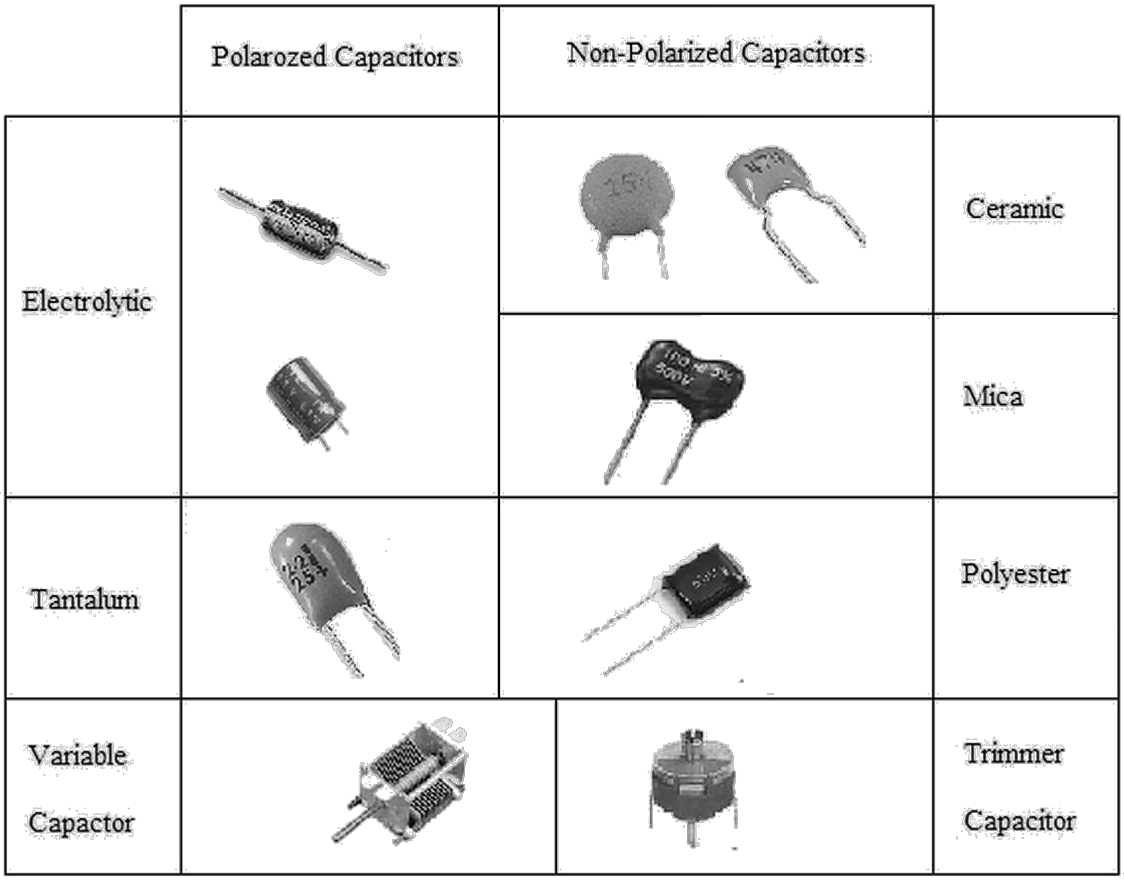

Figure-3: Some real Capacitors

Observations:

S N.o	**1**	**2**	**3**
	Polarized/Non-Polarized	**Value**	**Implication** **Faulty or not faulty**
1.			
2.			
3.			
4.			
5.			

Table-2: Checking a capacitor

S N.o	1	2	3	4	5	6
	Polarized/Non-Polarized	**Value**	**Decoded/Read Capacitance**	**Measured Value**	**Difference**	**Percent Error**
1.						
2.						
3.						
4.						
5.						

Table-3: Tolerance checking of a capacitor

Questions:

1. What happens to the overall capacitance if we connect two capacitors in series or in parallel?

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2. Decode the following capacitance values:

i. 104 ii. 560 iii.474

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3. Write down some of the applications of the fixed and variable capacitors.

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