



KLE Technological
University

Creating Value
Leveraging Knowledge

Chapter 7

LPS, UPS and CRO

Basic Electronics, 2021-2022, Even Semester

Agenda

1. Linear power supply
 1. Working, advantages and disadvantages
2. Uninterrupted Power Supply
 1. Types and their working
3. Cathode Ray Oscilloscope
 1. Working and applications

Topic Learning Outcomes

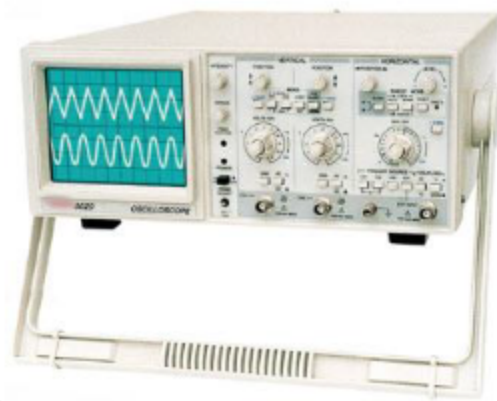
At the end of the module student will be able to:

- 1.Explain working principle of linear power supply
- 2.Discuss block diagram of UPS
- 3.Measure parameters of a given signal in CRO

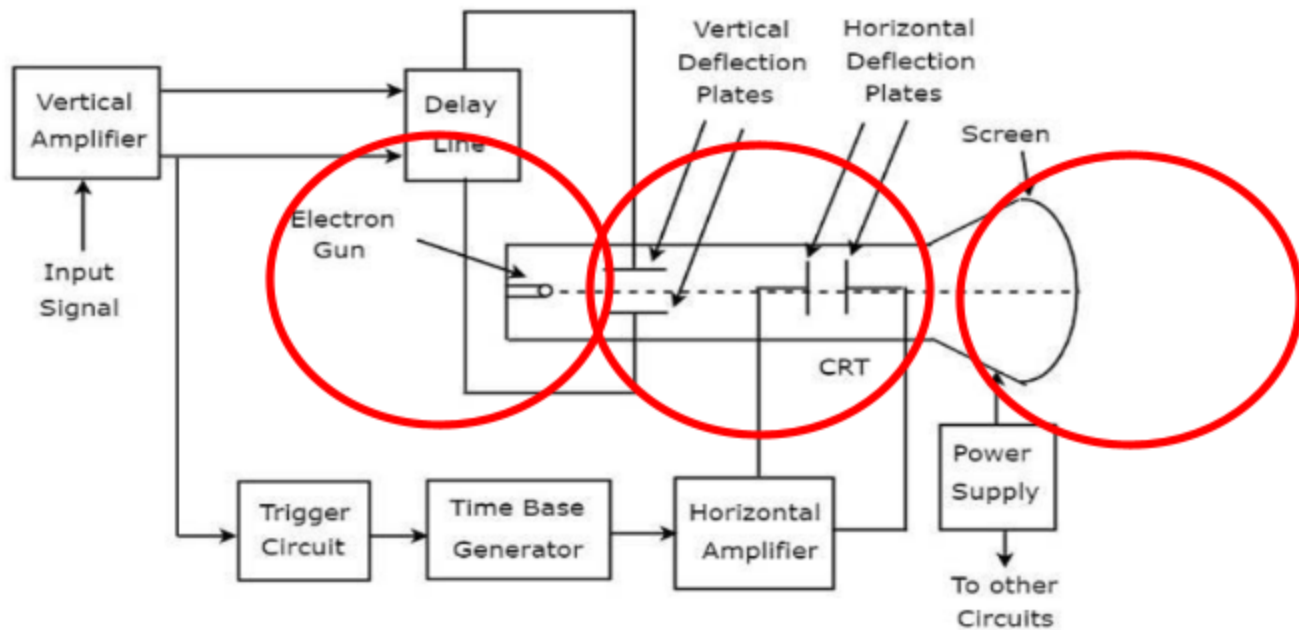
CO6: Discuss the concepts of linear power supply, UPS and measurement of electrical signal/ parameters using CRO.

Cathode Ray Oscilloscope (CRO)

- It is an electronic display device that converts electrical signal into a visual signals.
- Displays a voltage waveform.



Block Diagram of CRO



Block Diagram description

- **Vertical Amplifier** – It amplifies the input signal, which is to be displayed on the screen of CRT.
- **Delay Line** – It provides some amount of delay to the signal, which is obtained at the output of vertical amplifier. This delayed signal is then applied to vertical deflection plates of CRT.
- **Trigger Circuit** – It produces a triggering signal in order to synchronize both horizontal and vertical deflections of electron beam.
- **Time base Generator** – It produces a sawtooth signal, which is useful for horizontal deflection of electron beam.
- **Horizontal Amplifier** – It amplifies the sawtooth signal and then connects it to the horizontal deflection plates of CRT.
- **Power supply** – It produces both high and low voltages. The negative high voltage and positive low voltage are applied to CRT and other circuits respectively.

Measurements by using CRO

- We can do the following measurements by using CRO
 - Measurement of Amplitude
 - Measurement of Time Period
 - Measurement of Frequency

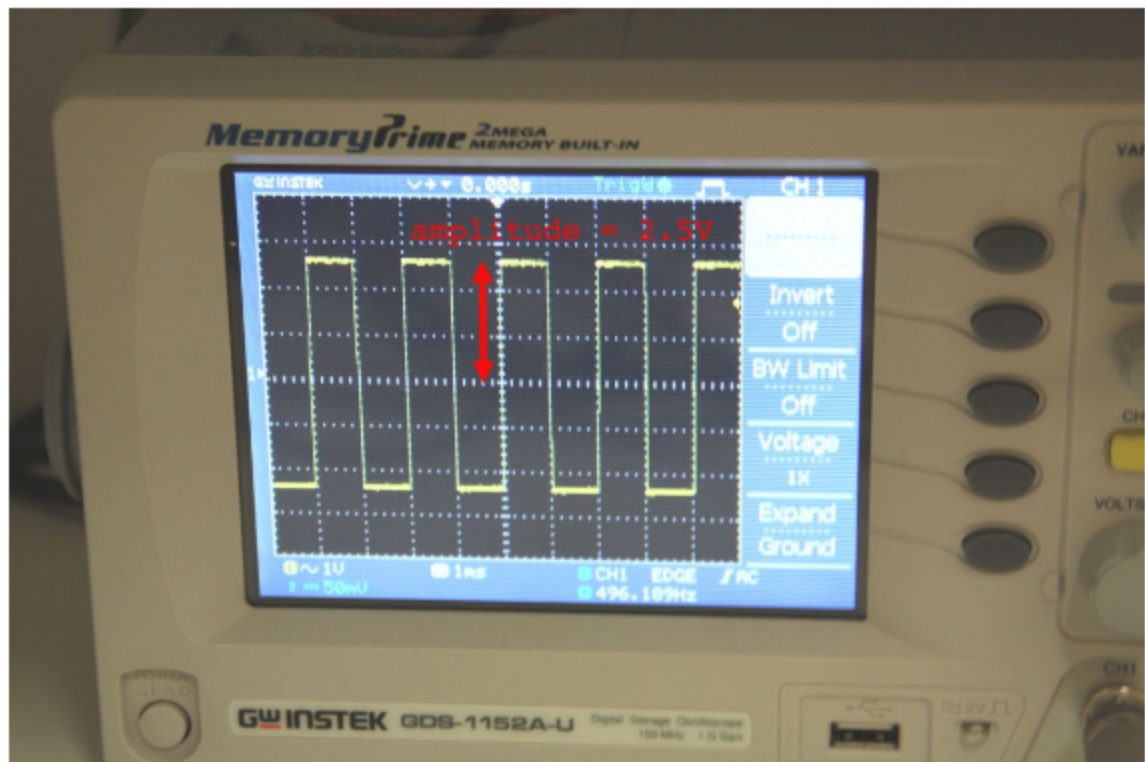
Measurement of Amplitude

- CRO displays the voltage signal as a function of time on its screen.
- The amplitude of that voltage signal is constant, but we can vary the number of divisions that cover the voltage signal in vertical direction by varying volt/division knob on the CRO panel.
- Therefore, we will get the amplitude of the signal, which is present on the screen of CRO by using following formula.

$$A = j \times nv$$

Where,

- A is the amplitude
- j is the value of volt/division
- nv is the number of divisions that cover the signal in vertical direction



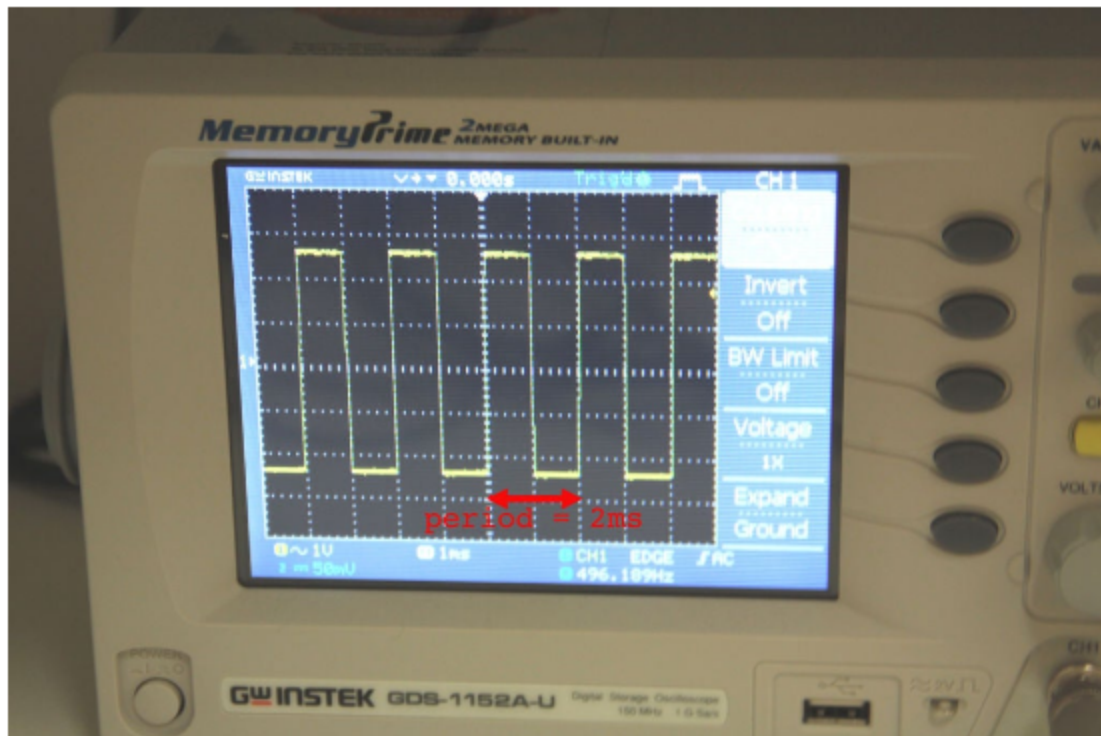
Measurement of Time Period

- The Time period of that periodic voltage signal is constant, but we can vary the number of divisions that cover one complete cycle of voltage signal in horizontal direction by varying time/division knob on the CRO panel.
- Therefore, we will get the Time period of the signal, which is present on the screen of CRO by using following formula

$$T = j \times nh$$

Where,

- T is the Time period
- j is the value of time/division
- n_h is the number of divisions that cover one complete cycle of the periodic signal in horizontal direction.



Measurement of Frequency

- The frequency, **f** of a periodic signal is the reciprocal of time period, **T**.
- Mathematically, it can be represented as , **$F = 1/T$**
- So, we can find the frequency, **f** of a periodic signal by following these two steps.
 - **Step1** – Find the **Time period(T)** of periodic signal
 - **Step2** – Take reciprocal of Time period of periodic signal, which is obtained in Step1

Linear power supply

Definition: A power supply is an electrical device that supplies electric power to an electrical load

- The primary function of a power supply is to convert electric current from a source to the required voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as **electric power converters**

Linear Power supply (LPS)

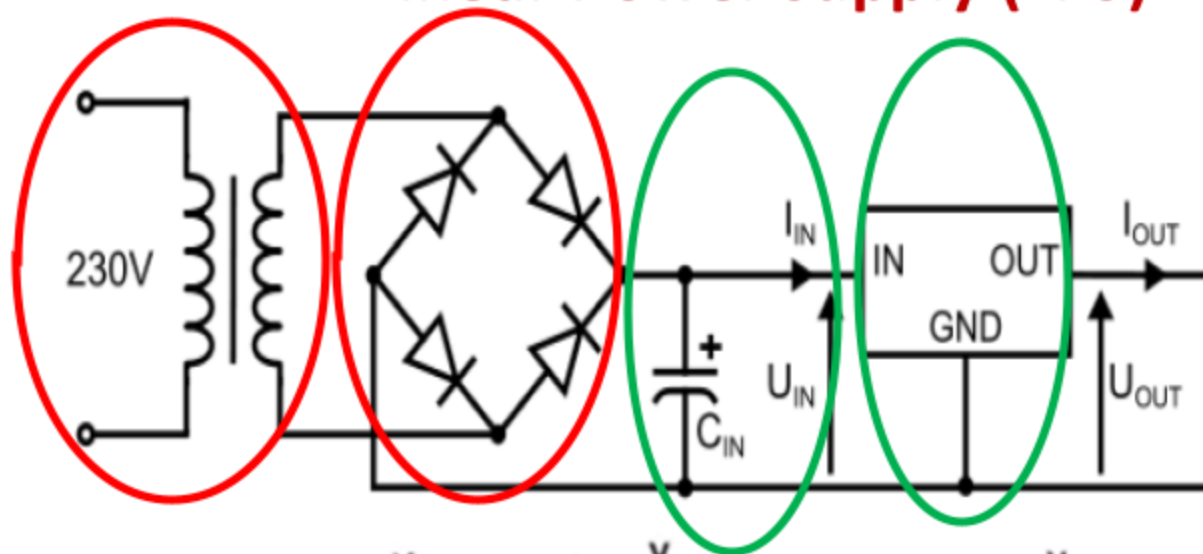
Definition: The term linear power supply implies that the power supply is regulated to provide the specified voltage at the output

- Linear regulated power supplies gain their name from the fact that they use linear, i.e. non-switching techniques to regulate the voltage output from the power supply

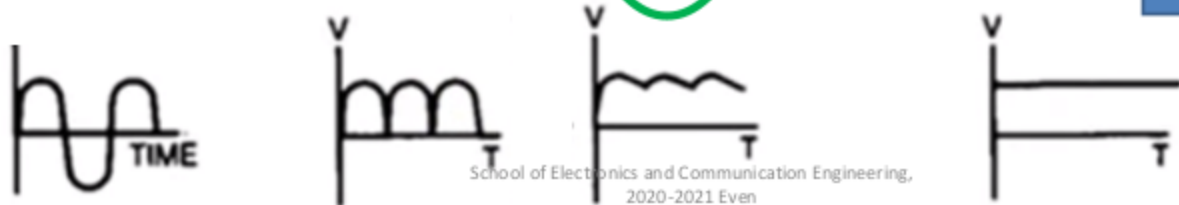
Typical variable linear
power supply for bench
laboratory use



Linear Power supply (LPS)



**78xx- Positive
voltage regulator**
**79xx- negative
voltage regulator**



Advantages and Disadvantages

- **Advantages**

- Simple application
- Low cost
- Low noise/ripple
- Established technology

- **Disadvantages**

- Limited flexibility
- Limited outputs
- Poor efficiency
- Large Size/Bulky
- Heat dissipation

Uninterrupted Power supply (UPS)

Definition: An Uninterruptible Power Supply (UPS) is defined as a piece of electrical equipment which can be used as an immediate power source to the connected load when there is any failure in the main input power source.

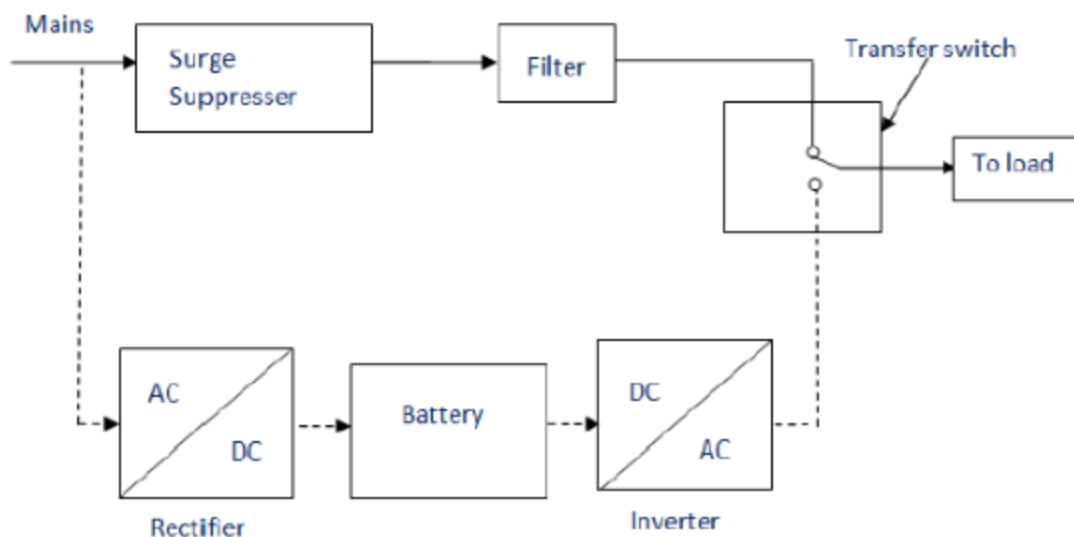
- The primary role of any UPS is to provide short-term power when the input power source fails. However, most UPS units are also capable in varying degrees of correcting common utility power problems:
- Voltage spike or sustained overvoltage
- Momentary or sustained reduction in input voltage
- Voltage sag
- Noise, defined as a high frequency transient or oscillation, usually injected into the line by nearby equipment
- Instability of the mains frequency
- Harmonic distortion, defined as a departure from the ideal sinusoidal waveform expected on the line

Types of UPS

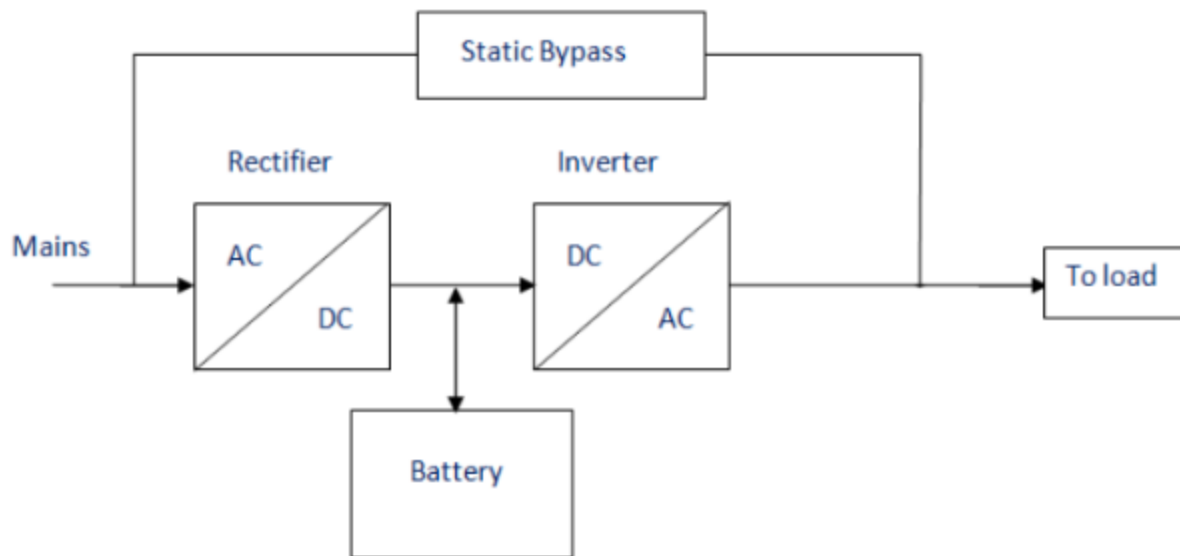
- UPS system is categorized into
 - Off-line UPS
 - On- line UPS
 - Line interactive UPS

- An on-line UPS uses a "double conversion" method of accepting AC input, rectifying to DC for passing through the rechargeable battery (or battery strings), then inverting back to 120 V/230 V AC for powering the protected equipment.
- A line-interactive UPS maintains the inverter in line and redirects the battery's DC current path from the normal charging mode to supplying current when power is lost.
- In a standby ("off-line") system the load is powered directly by the input power and the backup power circuitry is only invoked when the utility power fails.
- Most UPS below one kilovolt-ampere (1 kVA) are of the line-interactive or standby variety which are usually less expensive.

Off-line UPS- Static UPS

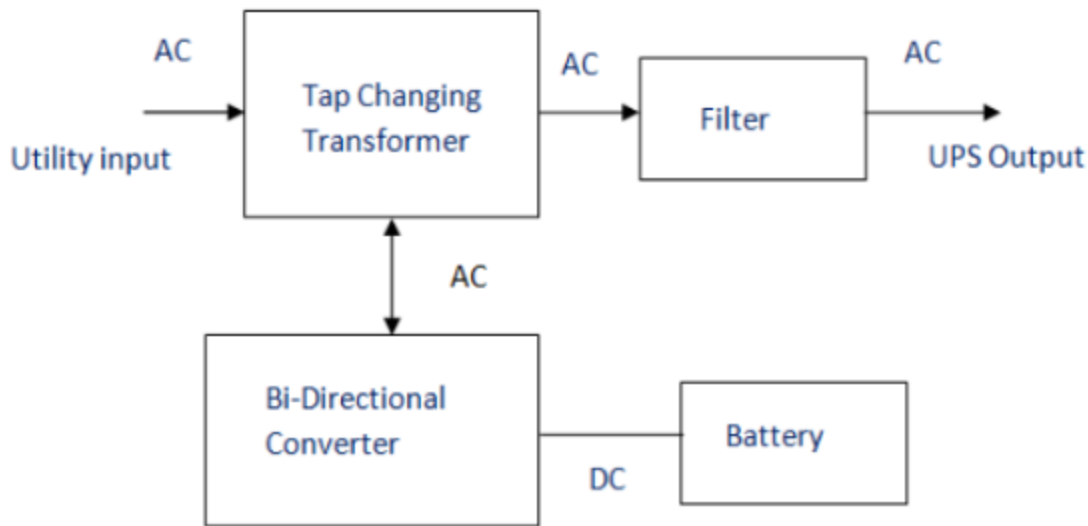


On-line UPS



- In an online UPS, the batteries are always connected to the inverter, so that no power transfer switches are necessary. When power loss occurs, the rectifier simply drops out of the circuit and the batteries keep the power steady and unchanged. When power is restored, the rectifier resumes carrying most of the load and begins charging the batteries,

Line interactive UPS



- The line-interactive UPS is similar in operation to a standby UPS, but with the addition of a multi-tap variable-voltage autotransformer. This is a special type of transformer that can add or subtract powered coils of wire, thereby increasing or decreasing the magnetic field and the output voltage of the transformer.

UPS Applications

- Data Centers
- Industries
- Telecommunications
- Hospitals
- Banks and insurance
- Some special projects (events)

References

- [1] <https://www.electrical4u.com/ups-uninterruptible-power-supply/>
- [2] https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_basics_of_oscilloscopes.htm
- [3] <https://www.youtube.com/watch?v=cwkuCgYI91w>
- [4] <https://www.youtube.com/watch?v=9scohkuTG88>

Thank You