

13 Digital Instrument :-

Introduction :

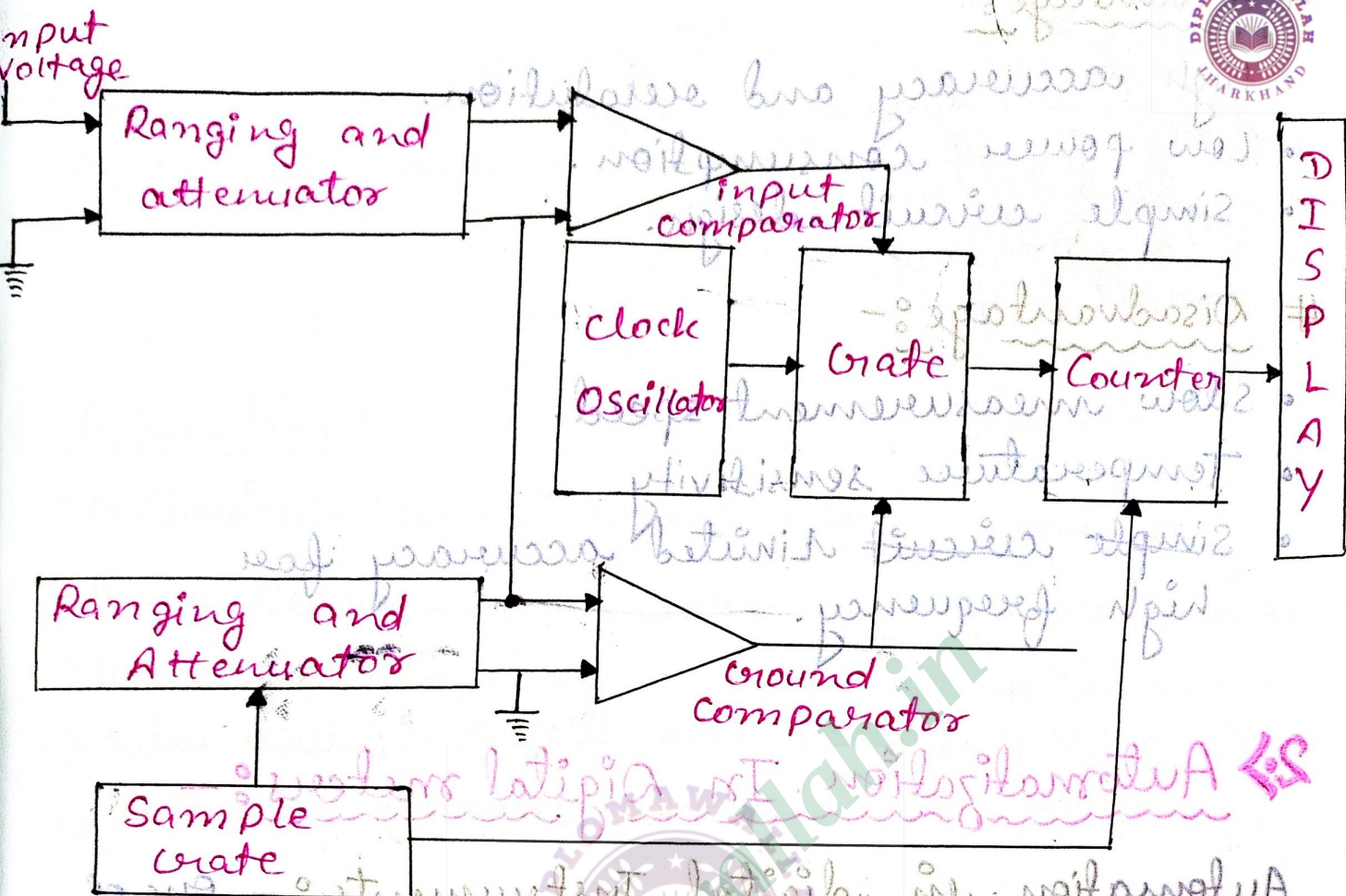
Digital instruments are essential for measuring electrical quantities like voltage, current and resistance with high accuracy and reliability.

This display reading in a digital format typically using LED or LCD display.

Advantages include more resistance better precision and data storage capabilities compared to analog instruments.

Ramp type DVM :- (Digital voltmeter)

- The operating principle of a ramp type digital voltmeter is to measure the time that a linear ramp voltage takes to change from level of input voltage to zero voltage.
- The conversion of a voltage value of a time interval is shown in the timing diagram given below.



Working :-

- At the start of measurement a ramp voltage is initiated.
- A negative going ramp is shown in figure but a positive going ramp may also be used.
- At the instant the value of ramp voltage is equal to that of unknown voltage.
- The ramp voltage continues to decrease till it reaches ground level (zero voltage).
- At the same time it sends a pulse to the converts which set all of them to 0.

Advantage:-

- High accuracy and resolution.
- Low power consumption.
- Simple circuit design.

Disadvantage:-

- Slow measurement speed.
- Temperature sensitivity.
- Simple circuit limited accuracy for high frequency.

2. ➤ Automatization In Digital meters:-

Automation in digital Instruments:- One of the advantages of digital multimeters is their ease of operation. The reading is easy to take and does not lend itself to errors of interpretation. Moreover, the number of ranges is limited because the ranges move in steps of 10 (instead of the $\sqrt{10}$ steps used for analog instruments).

All instrument today have automatic polarity display and automatic decimal point positioning, while many have automatic ranging and zeroing too.

This Automation in digital instrument includes automatic polarity, indication automatic ranging and automatic zeroing.



1) Automatic Polarity Indication :-

Automatic polarity indication is a feature in electronic circuits that detects and display the polarity of a voltage or current without manual intervention. It is commonly used in multimeters, power supplies and circuit protection devices.

Application :-

- 1) Multimeter:- Displays correct polarity automatically.
- 2) Battery Devices:- Prevents damage from reverse connection.
- 3) Power Supplies:- Ensures correct voltage application.
- 4) Solar Panels:- Detects and corrects polarity.
- 5) Automotive Systems:- Identifies correct wiring.

Advantages :-

- Prevents damage to circuits.
- Saves time and reduce errors.
- Improves use convenience.
- Some systems auto-correct polarity.

Disadvantages :-

- Adds extra components and cost.
- May cause slight voltage loss (diodes).
- Consumes additional power.
- Can introduce complexity in sensitive systems.

2) Automatic decimal point positioning :-

Automatic decimal point positioning is a feature commonly found in digital calculators, financial systems and digital measurement devices. It ensures that numerical value are displayed with the correct decimal placement based on predefined rules or user settings.

Application :-

- Financial system (Banking, Billing)
- Digital measurement devices (voltmeters, scales)
- POS systems (retail, commerce)
- Microcontroller-based systems.
- Medical equipment (glucose meters, ECG).

Advantage :-

- Reduce errors
- Save time
- Improves readability
- Enhances precision
- User Convenience.

Disadvantage :-

- Limited flexibility
- Rounding errors
- Complex implementation
- Possible user confusion.

3> Automatic ranging and zeroing :-

Automatic ranging and zeroing are key features in electronic measuring instruments, especially in digital multimeters and some oscilloscope.

1> Automatic Ranging :-

- Found in digital multimeters and some oscilloscopes
- The instrument automatically selects the most appropriate range for measurement (e.g., voltage, resistance, current) without requiring manual adjustment.

• Benefits :-

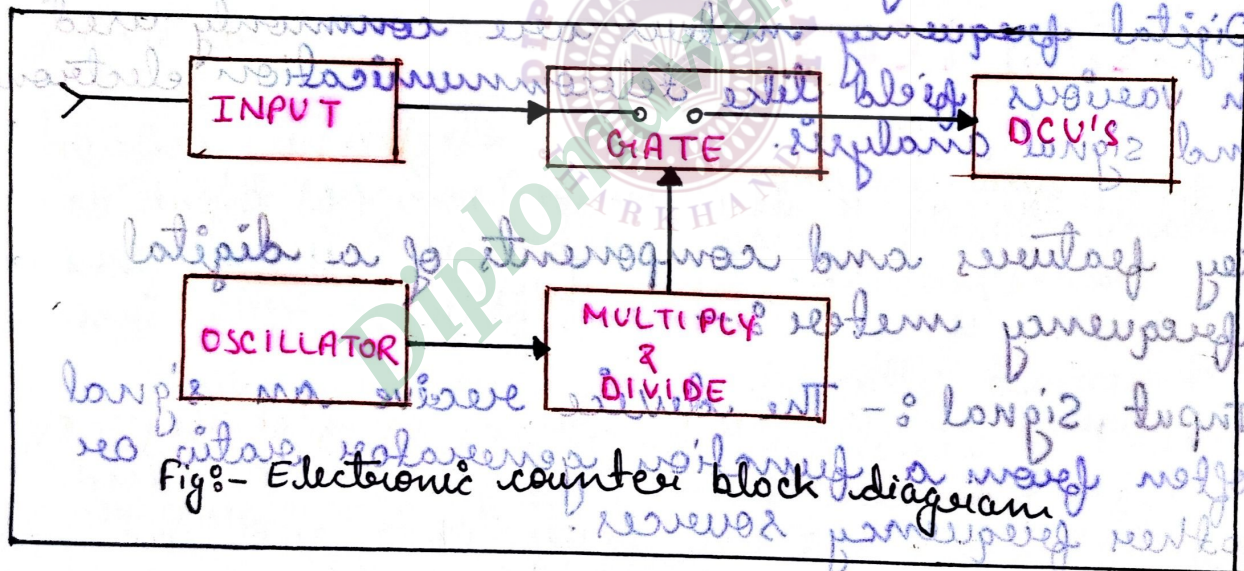
→ Eliminates guesswork

- Prevents overloading the instrument.
- Speeds up measurement task.

2> Automatic zeroing :-

- Used in precision measurement instruments (e.g., strain gauges, digital scales, and oscilloscope).
- It automatically adjusts the baseline (zero-point) to compensate for drift or offset errors.
- Benefits :-
 - Improves accuracy
 - Reduces manual calibration
 - Ensures consistency in repeated measurements.

3> Electronic Counters :-



- 1> Input Signal :- Receives the pulse signal from an external source (e.g., sensor or switch).
- 2> Gate circuit :- Controls when the pulses are allowed into the counter.
- 3> Oscillator :- Generates a precise clock signal for time-based counting.
- 4> DCU (Digital Control Unit) :- Processes signal manages counting modes, & controls other component.