EIPC
NEE-403
Unit-2
motion measurement

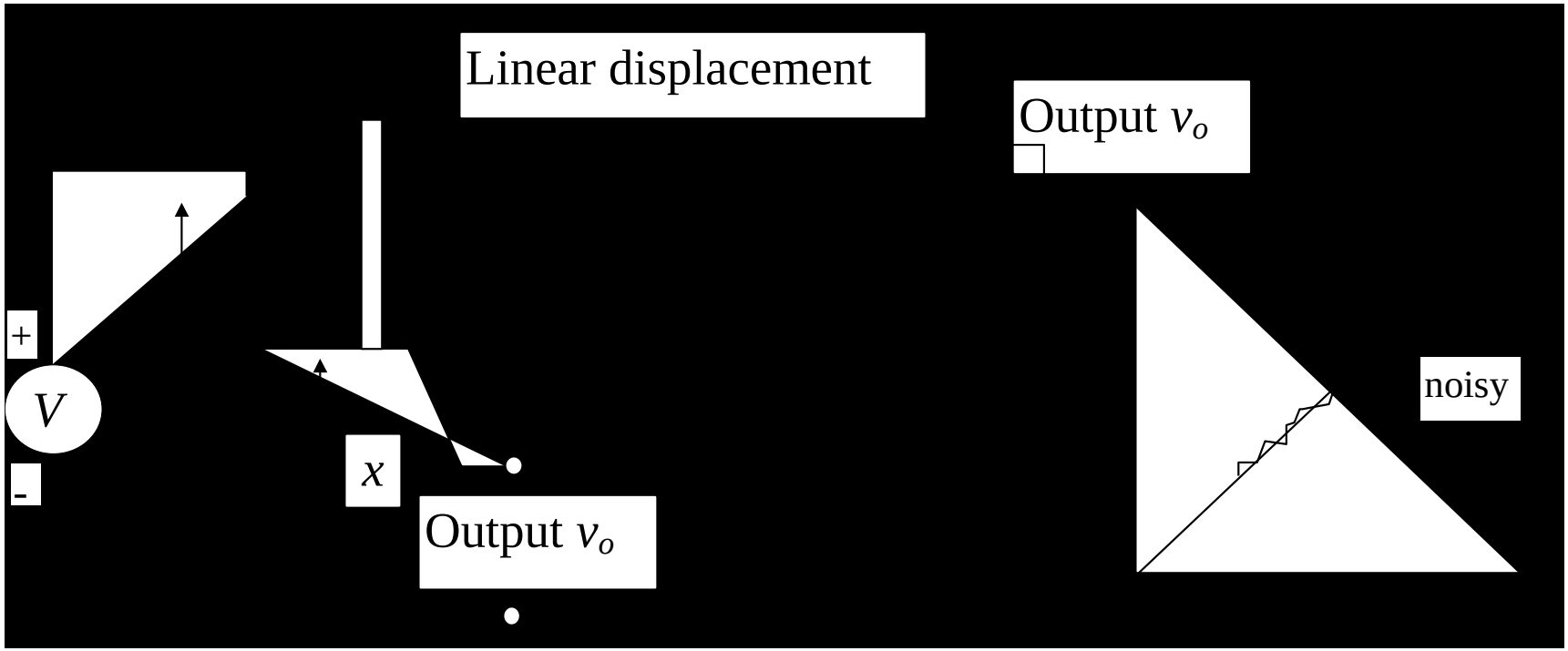
Transducer of linear displacement

Force and displacement are closely linked. A true/ideal displacement transducer is one which requires a negligible force to make a large displacement.

Analog Methods

Resistive type

The simplest linear displacement transducer is a linear potentiometer.



Use a linear potentiometer as a linear displacement transducer

Features :

1. Simple and cheap
2. Accuracy depends on quality and dimension of the resistive wire used or the quality of the resistive film.
3. The force required to operate, although small, depends on the size of the potentiometer, but that required to start movement of the slider is generally about twice that to keep it in motion.
4. The frequency response is limited by the mass of the system but small transducer can have a flat response up to 50 or 60 Hz.

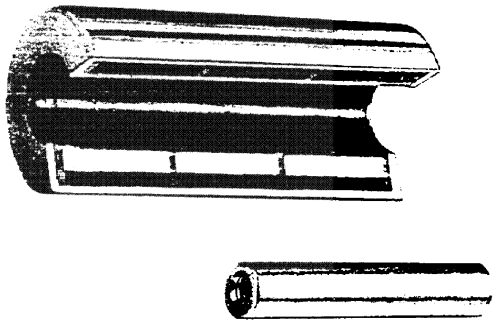
Main demerit :

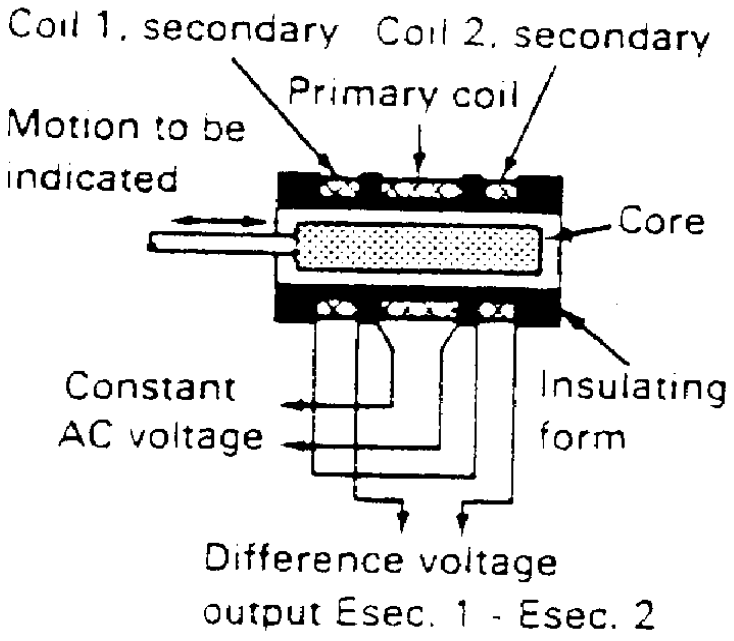
The output is very noisy when the slider moves.

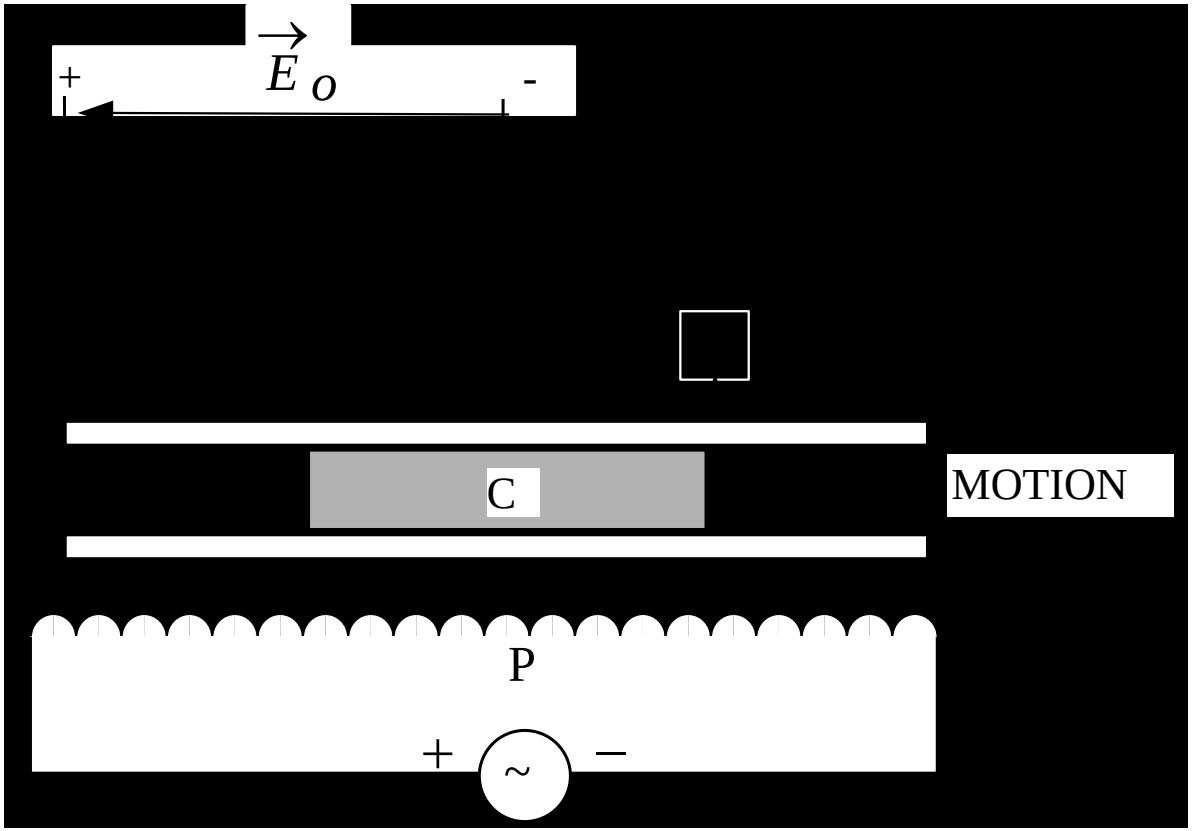
Cause of the noise are many: dirt and corrosion on the wire; chatting and vibration of the slider contact; variation of contact area as the slider moves; resolution noise when the slider makes and breaks contact with a turn of wire; etc.

Inductive type

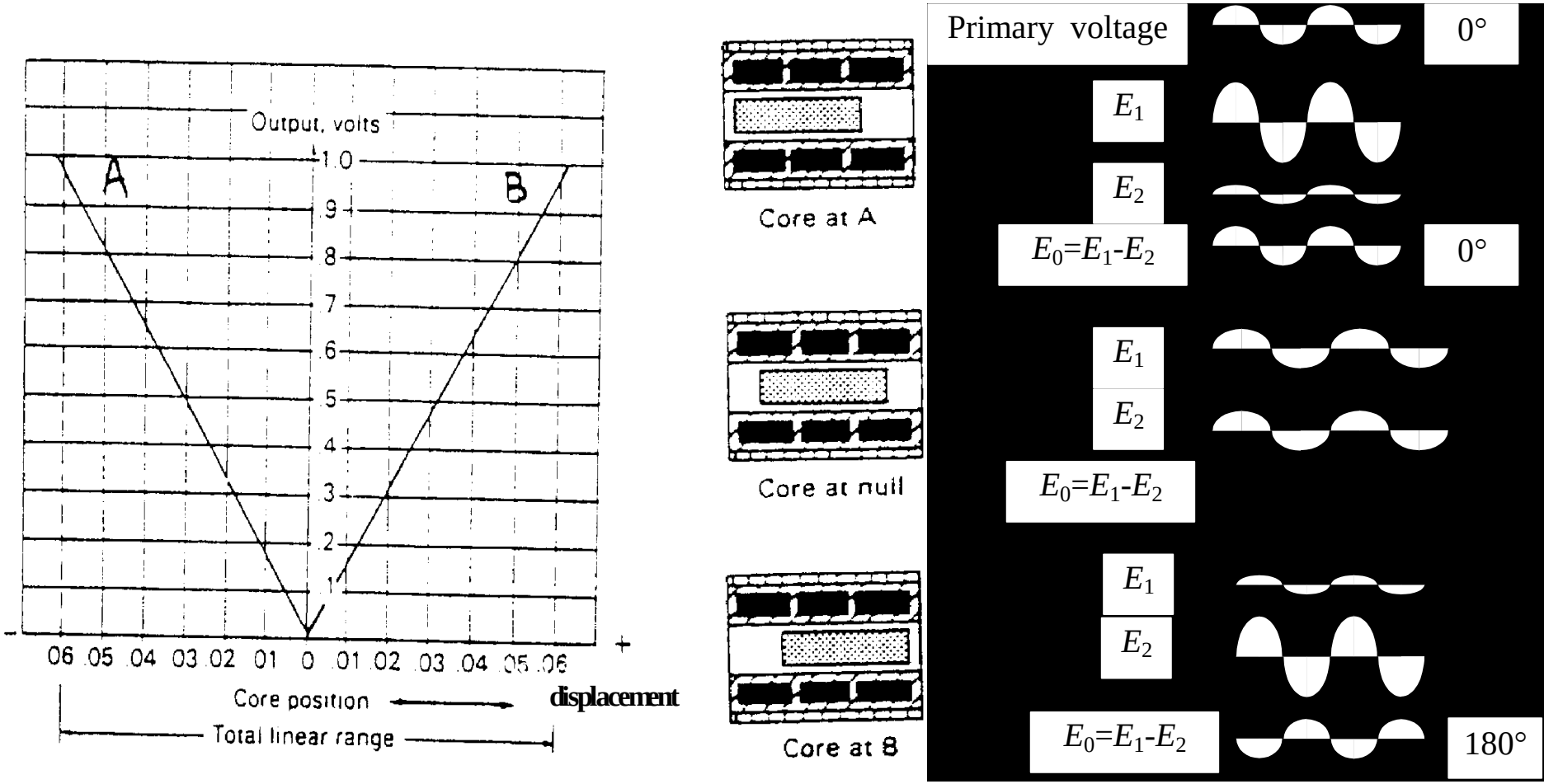
An important displacement transducer used in industrial and medical application is the **linear variable differential transformer** (LVDT).







F. Coil former;
C. Movable core;
P. Primary winding;
S_1 and S_2. Secondary windings;
E_1. Induced voltage in S_1;
E_2. Induced voltage in S_2.
E_o. Output voltage E_1 - E_2



(a) Absolute magnitude output voltage; (b) phase-referenced output voltage as a function of LVDT core position

Characteristics:

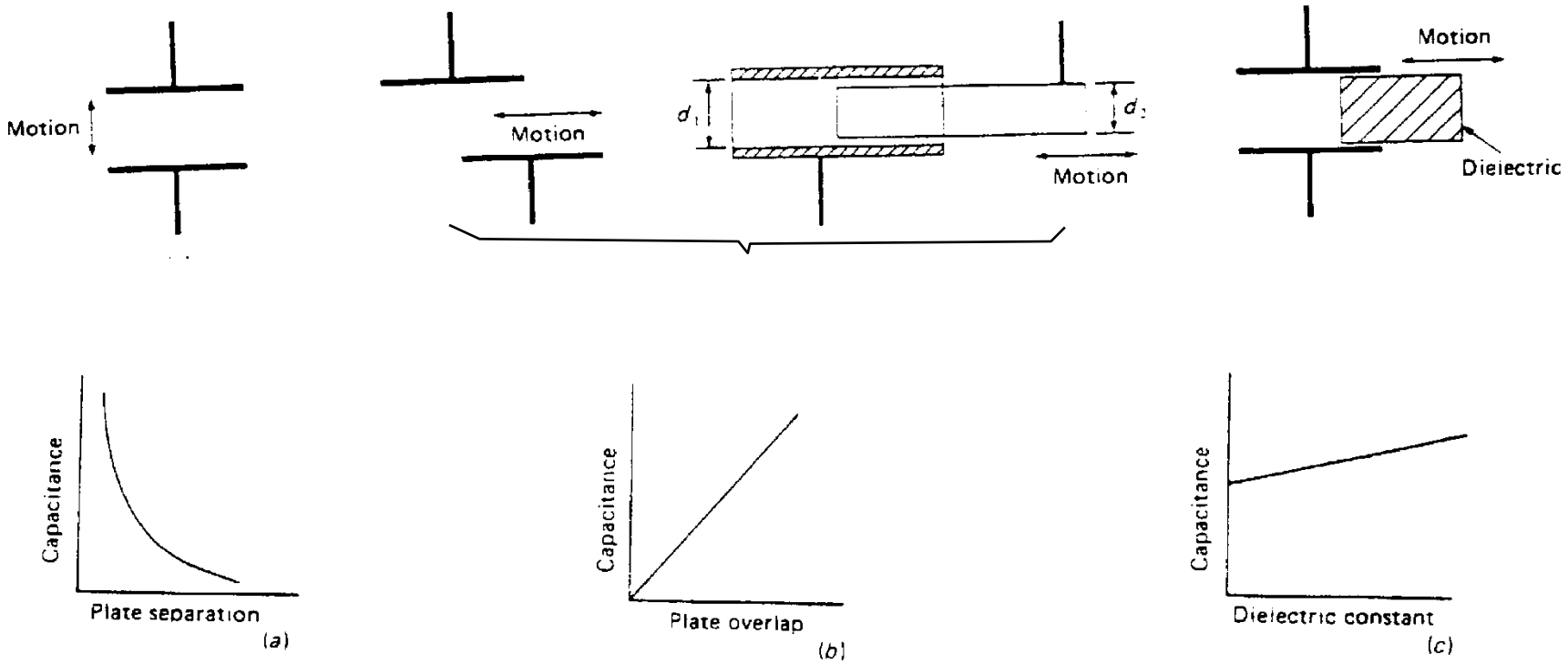
1. Due to no moving contact (non-contact) hence very low noise level. Resolution is excellent.
2. The frequency response is limited mechanically by the mass of the core and electrically by the frequency of the applied primary voltage (carrier), the frequency of this carrier should be at last ten times that of the highest frequency component to be measured.

Demerits:

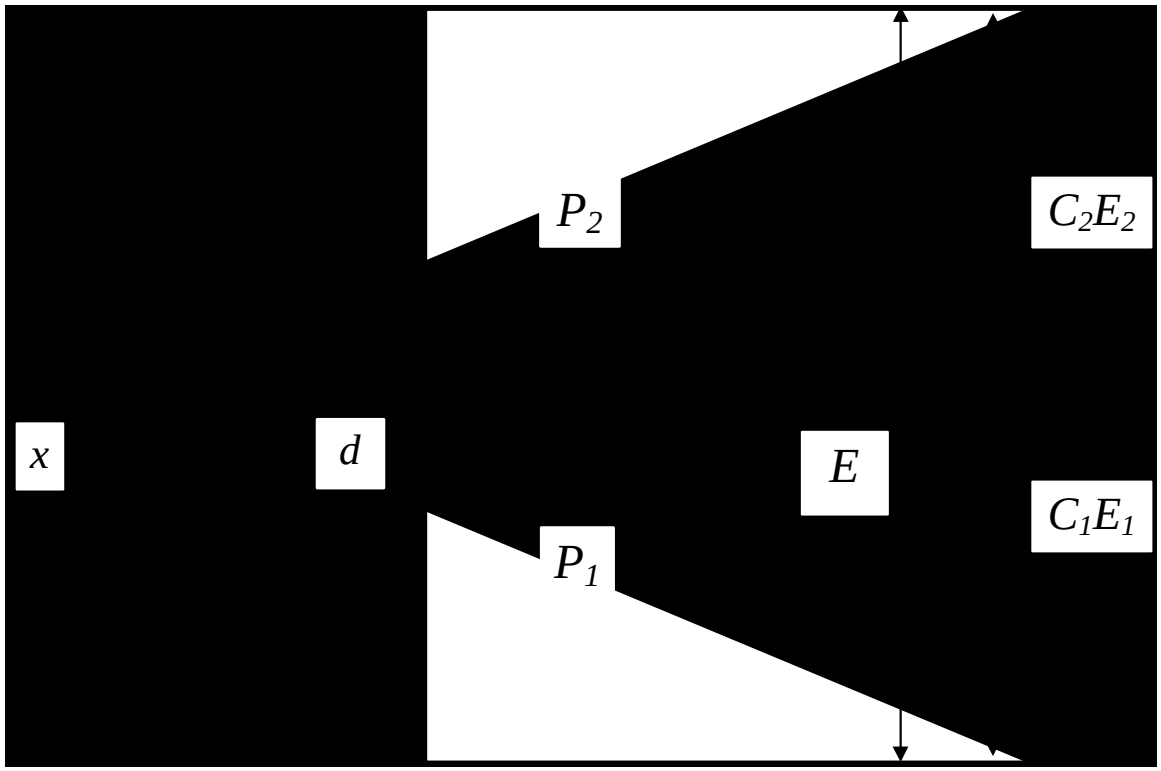
1. Quite expensive.
2. The operation can be severely affected by stray magnetic A.C. fields or by the presence of large mass of metal near by.

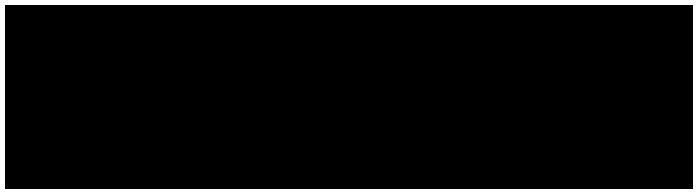
Capacitive methods

The capacitance of a capacitor can be changed by varying its area, gap length or dielectric constant.



Differential capacitance method





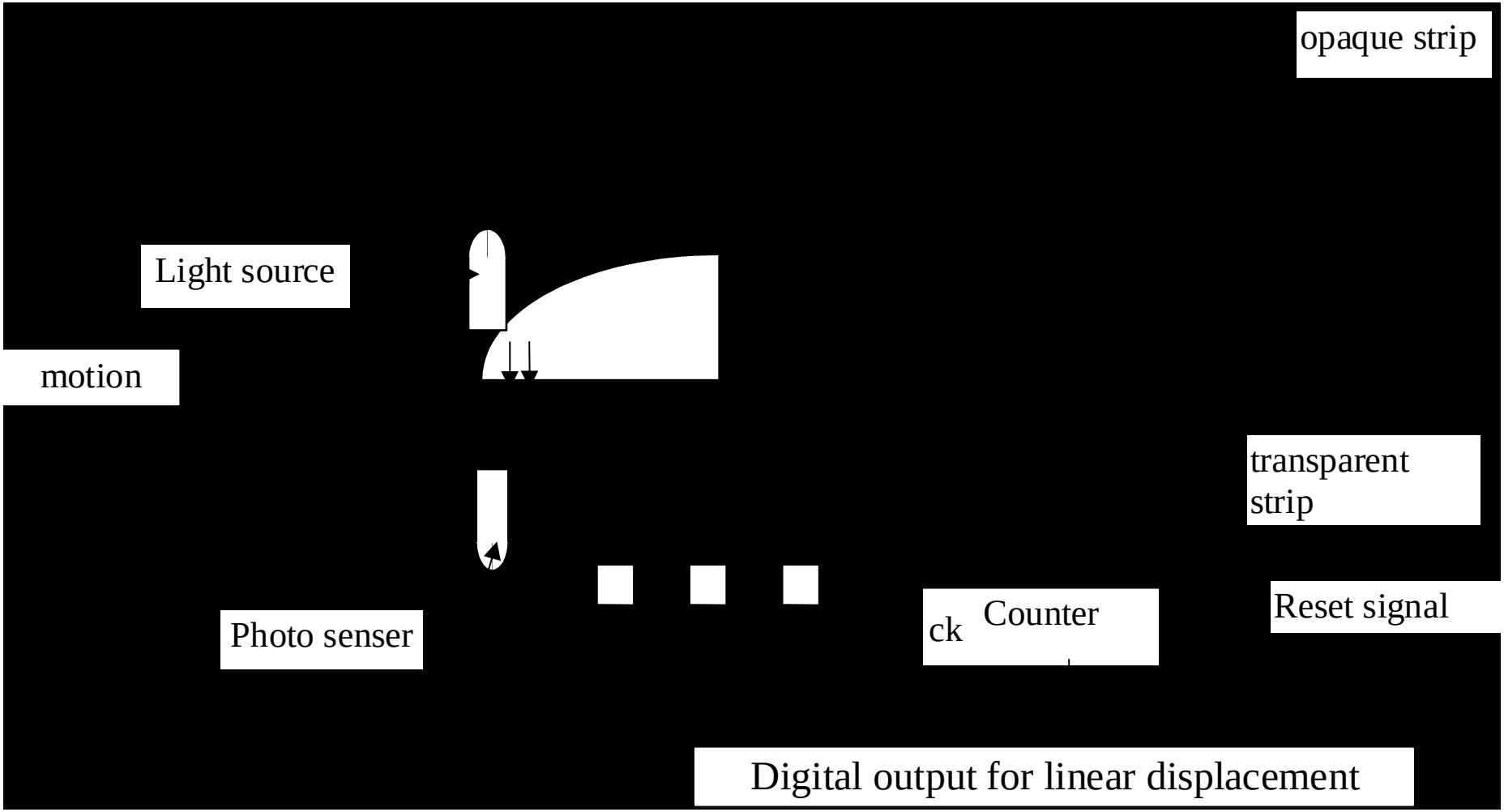
2.3 Digital methods

By means of coding (absolute linear encoder)

Identify the position of a movable test piece by a binary system of notation.

- The resolution depends upon the number of bits comprising the binary number.
- The accuracy obviously depends upon the accuracy with which the scale is drawn.

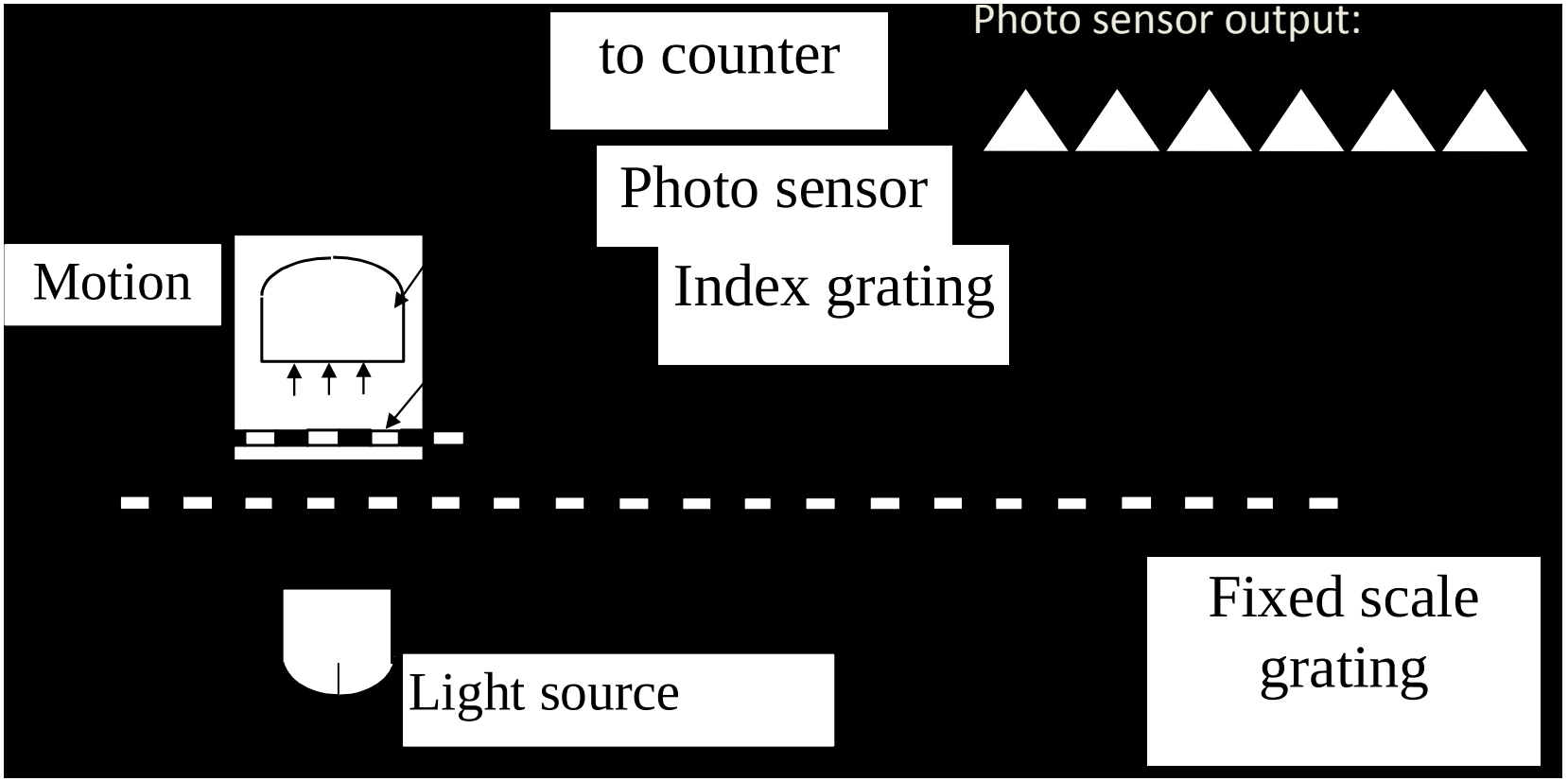
By pulse counting (incremental linear encoder)



All the above mentioned methods are impractical when measuring long displacement (say > 1m) with good accuracy (say, <0.01mm). Such measurement may be required in many application areas, e.g. large machine tools.

What should we do?

A grating measurement system can be though of as a development of a well-known mechanical-optical modulating transducer.



Gratings are available fairly cheaply in wide range of size. The resolution of measurement is essentially equal to the spacing between the lines. Gratings up to 1000 lines per mm are available.

Transducers of Angular displacement

All the methods used in linear measurement can be applied to angular measurement.

Analog Methods:
Resistive, Inductive, and Capacitive

Digital Methods:
Absolute angular encoder, Use of maximal length, and Incremental angular encoder

Thank You