

Chapter 8

Digital and Analog Interfacing Methods

Lesson 12 Part c

MCU Based Scale, Shaft Linear Position and precision Motion Encoders for Industrial Control

Incremental linear encoder

1. Counts the forward and backward displacement steps

2. When the scale displaces forward or backward, the numbers of occurrences of either '1's (or '0's) are counted. Counting is upwards for forward motion and downward for backward motion

Incremental linear encoder

3. Resolution is $(1/n)$ cm when there are n pulses from l - scale 1 cm move

4. For a resolution of $(1/n)$ cm, l -scale has n *markings per cm*

5. Counting can be by internal timer-counter in MCU

Dual Incremental linear scale for Encoding

- Vernier scale gives precision results
- Use two- one linear (l) and other Vernier (v) scales as encoders l and v . Linear encoder scale l if having $(n - 1)$ markings, the encoder v has (n) markings in $(1 - 1/n)$ cm.
- The encoder scale v can also be moved with the shaft 3

Incremental linear Encoder

- System, which notes the *increments* or *decrements* at each step change in the distance when a shaft displaces by one step-linearly, *forward* or *backward*, respectively .

Parts of Incremental linear Encoder

- Two scales
- A linear scale l
- A Vernier scale v
- Scale index mark defines the 0.00 cm with respect to an assumed axis around which the scale displaces

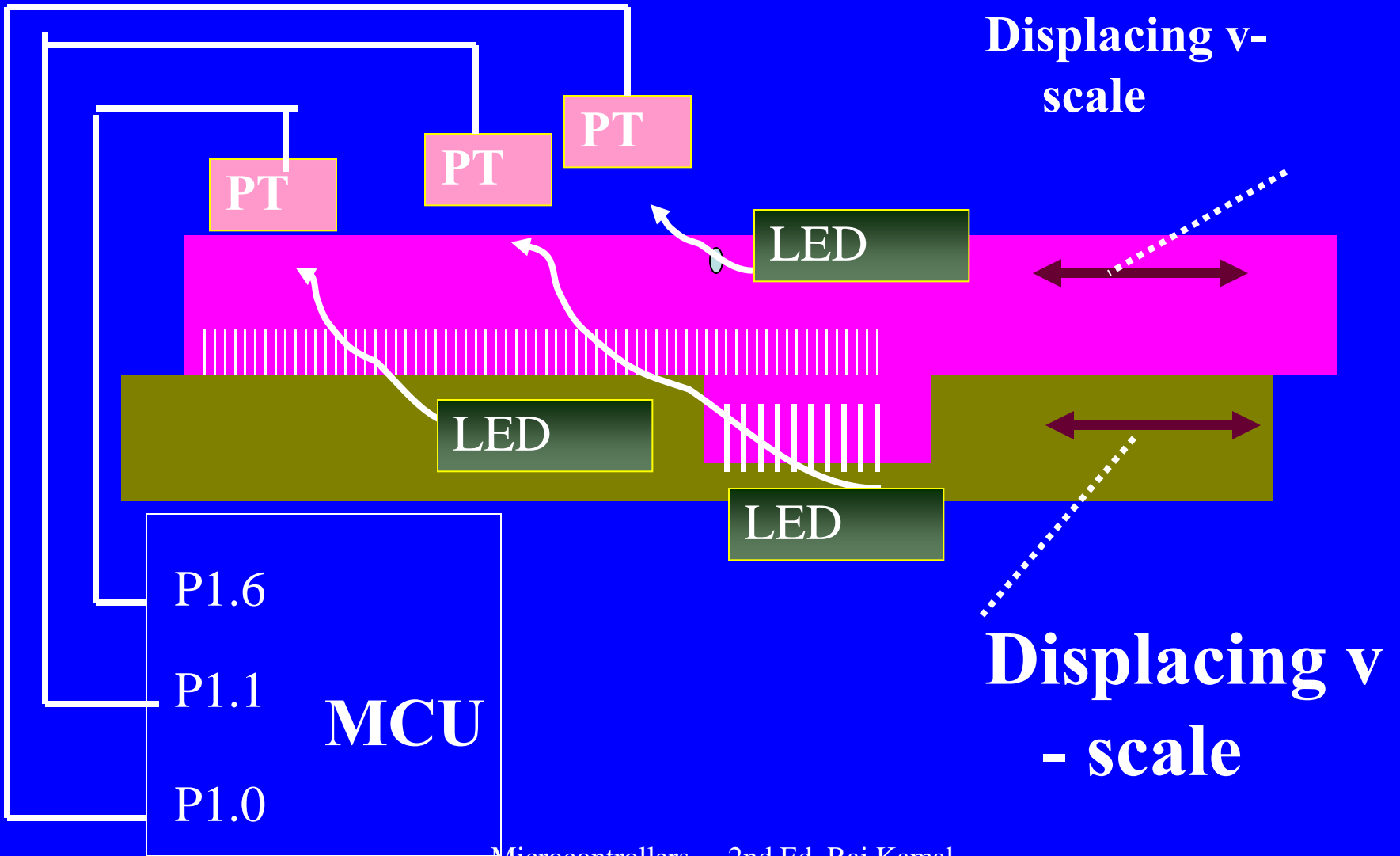
Parts of an Incremental linear Encoder

- Three LED-phototransistor pairs, one pair is for the origin and two are for the two scales l and v markings
- Scales l and v markings have slight offset (Vernier displacement) to enable noting the increments by one and also find the direction of motion by phase detection

Parts of a dual Incremental linear Encoder

- Each scale has the markings at successive distances
- A scale, l or v counter notes the movements stepwise. Counter l or v counts the displacements stepwise.

Scales and index hole on the plates



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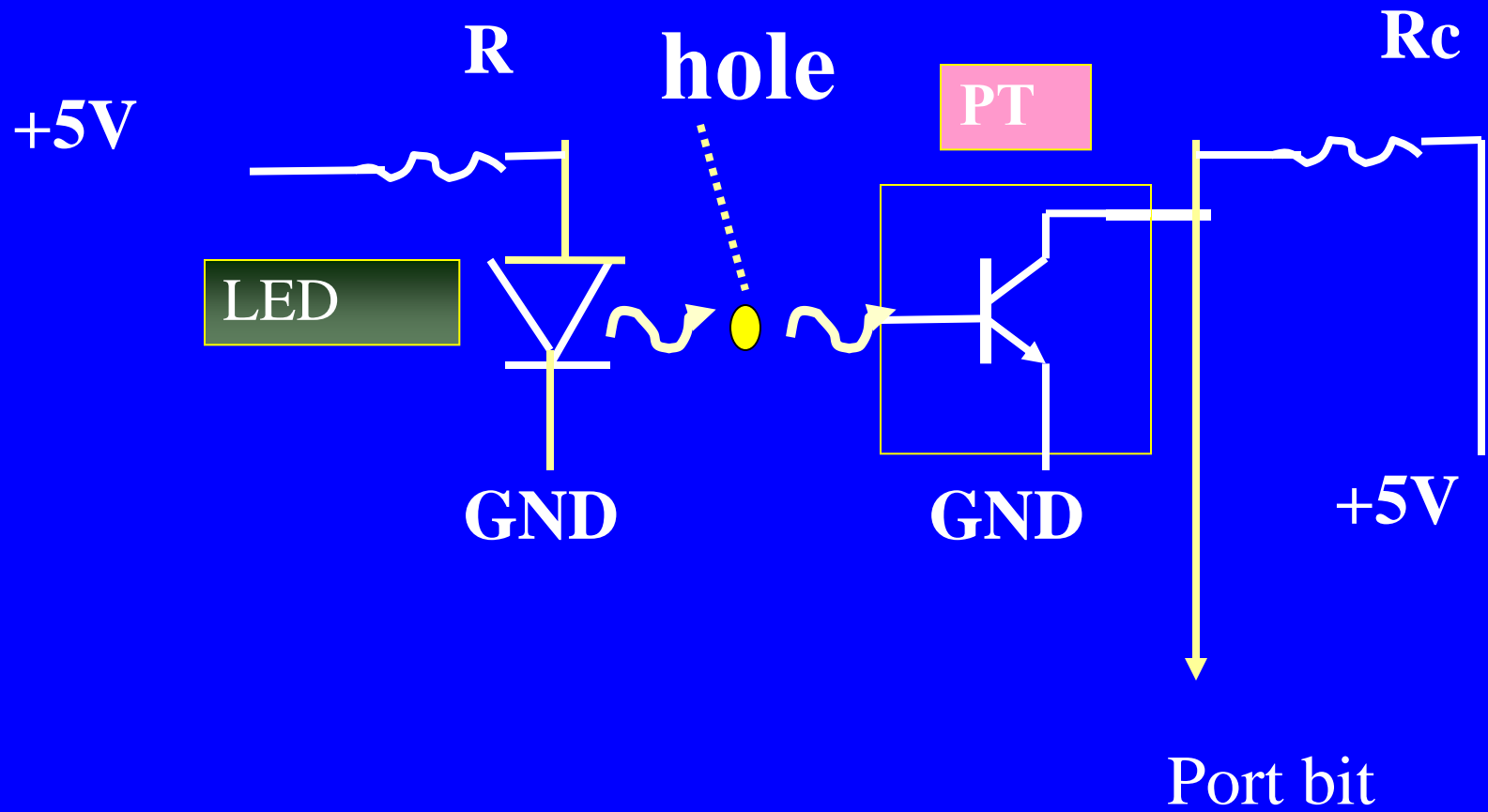
5. Counting can be by internal timer-counter in MCU

Incremental linear encoders

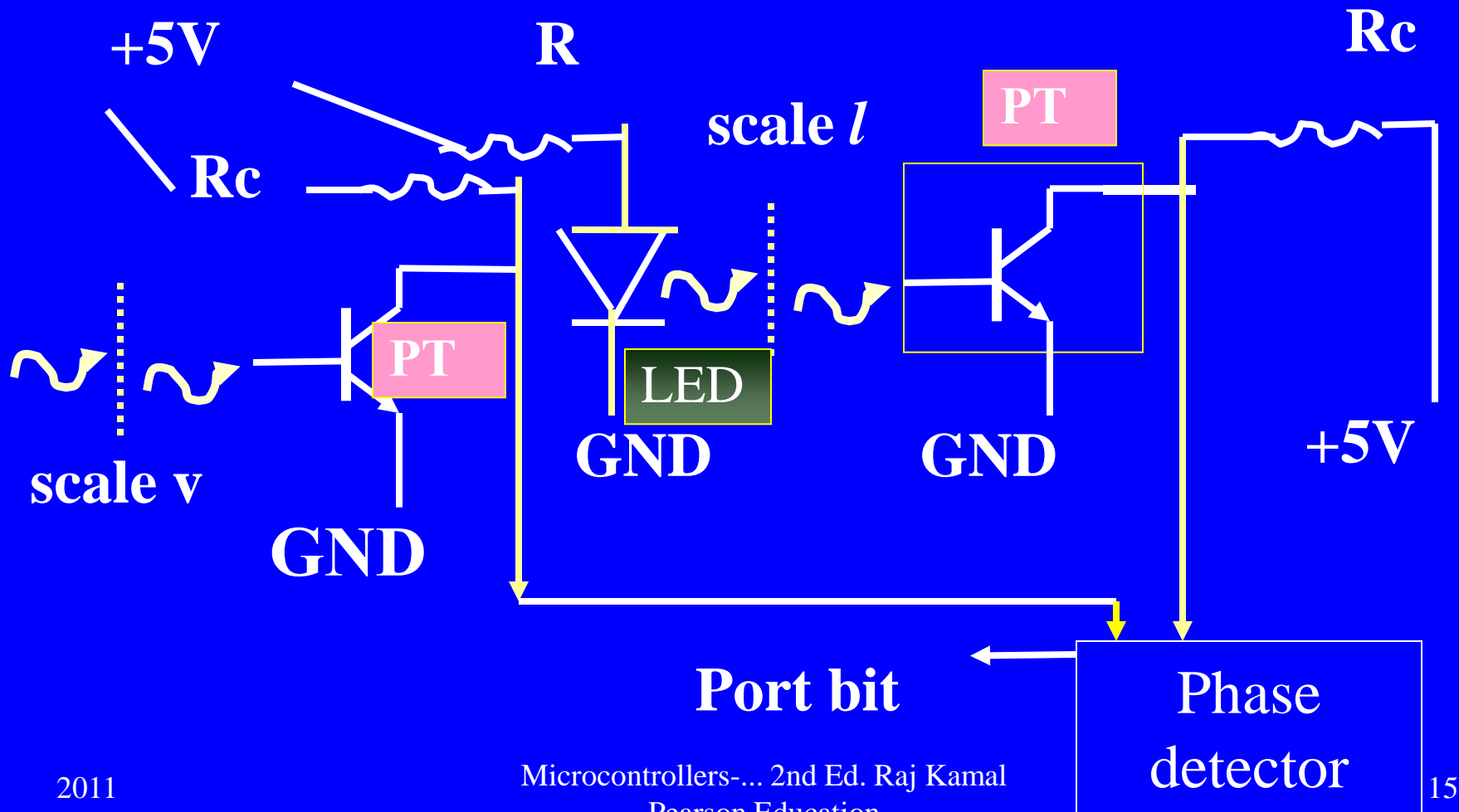
6. Resolution of $(1/n)^2$ cm, if l -scale movement after $n-1$ markings matches the v scale movement after n markings on it

7. Counts reset to 0 on active input when index-hole passes through the LED radiation

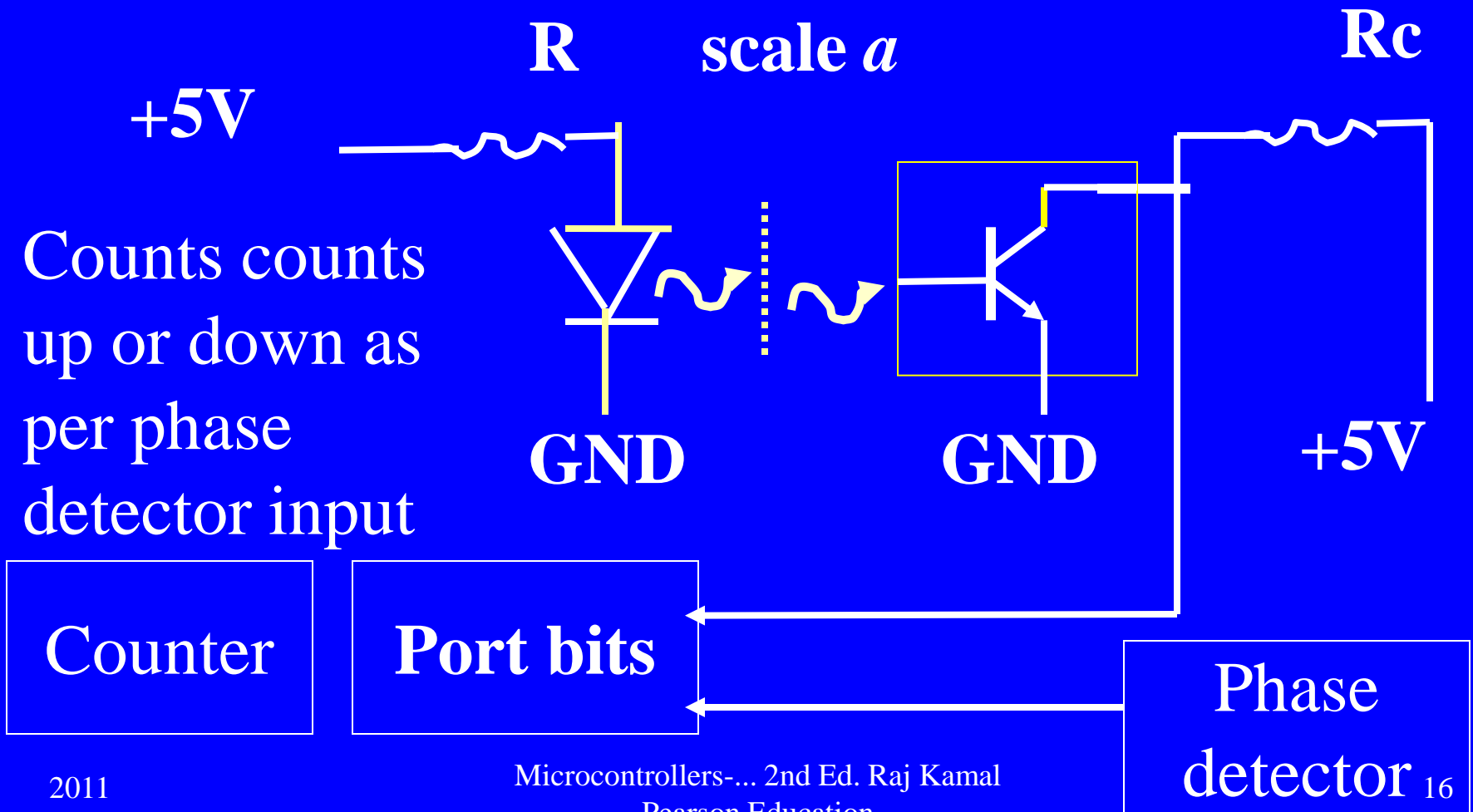
Interface circuit for Incremental linear Encoder LED-PT Pairs



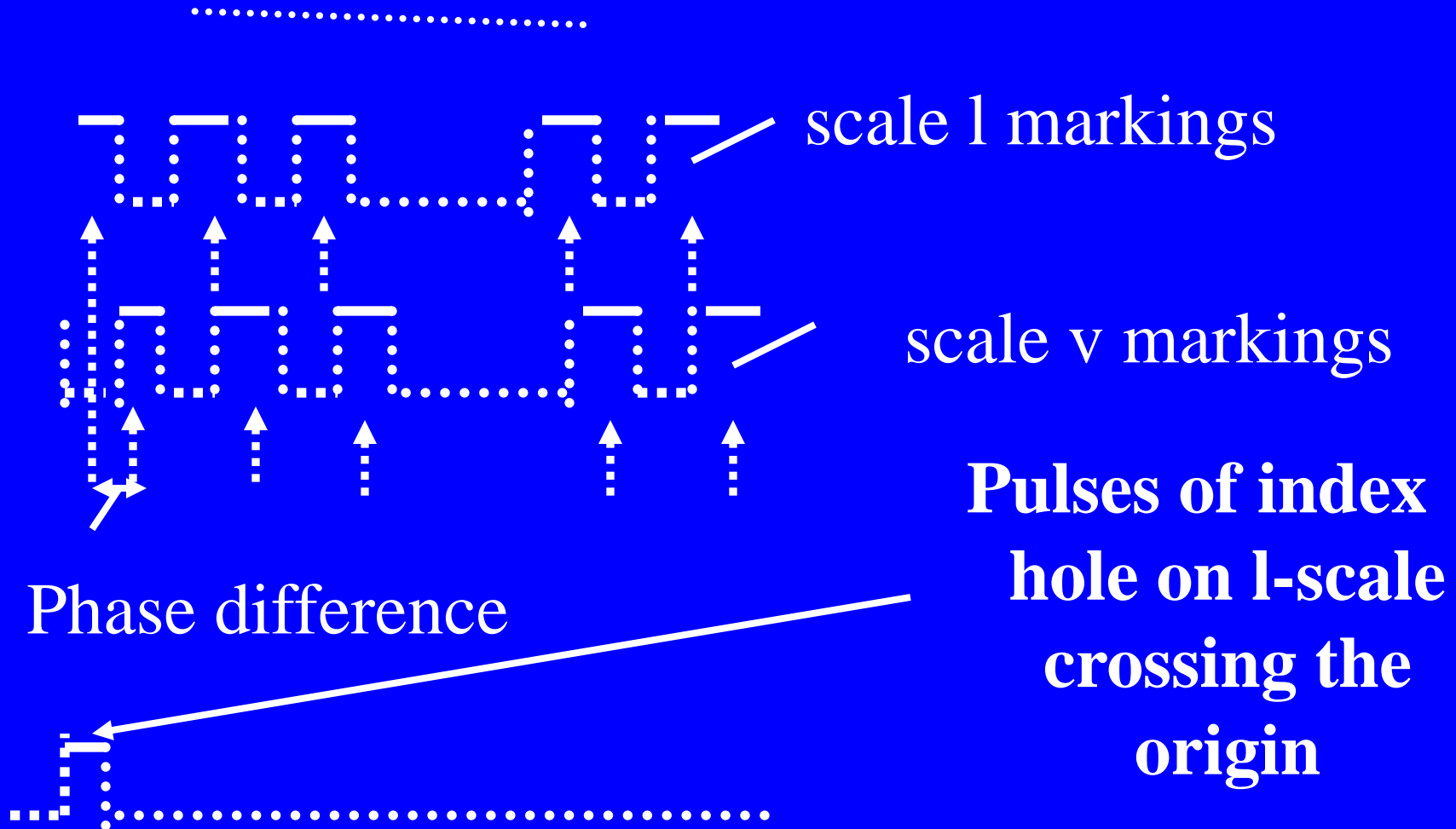
Incremental linear Encoder LED-PT Pairs



Incremental linear Encoder LED-PT Pairs



Pulses for Inputs from l and v and hole



Shaft Linear Position precision Motion Encoders for Industrial Control

Industrial Machine control

- Linear motion and angular motions are to be precisely controlled in precision machines and
- Linear and rotatory encoders provide MCU based control

Industrial Pressure control

- Pressure valves and engine-valve orifices are controlled by linear motion and angular motions
- Linear and rotatory encoders provide MCU based control

Summary

We learnt

Incremental linear encoder

- Enables the measurement of a shaft linear position at an instant with respect to an origin (at a fixed initial angular position).
- Enables measurement of the linear speeds also from number of input pulses per second.

End of Lesson 12 Part c

MCU Based Scale, Shaft Linear precision Position and Motion Encoders for Industrial Control