

# Chapter 8

## Digital and Analog Interfacing Methods

# Lesson 12 Part b

## Optical Rotatory Absolute Encoders

# Absolute Rotatory Encoder

- System, which notes the instantaneous value of *absolute angle with respect to an axis*

# Parts of an absolute Rotatory Encoder

- Circular disc— 0 to  $n-1$  tracks with equally spaced slots and dark arcs and index-hole
- Disc index-hole marks the  $0^\circ$  with respect to an axis around which the disc rotates

# Parts of an absolute Rotatory Encoder

- Each track on the disc has the slots at successive steps on the circumference over angle  $0^\circ$  to  $360^\circ$
- A track,  $0$  or  $n-1$  directly gives a region of the shaft angular axis

# Parts of an absolute Rotatory Encoder

- $(n+1)$  LED-phototransistor pairs, one pair is for the hole and one each for the  $n$ - tracks *0th* ... up to  $(n-1)th$

# Parts of an absolute Rotatory Encoder

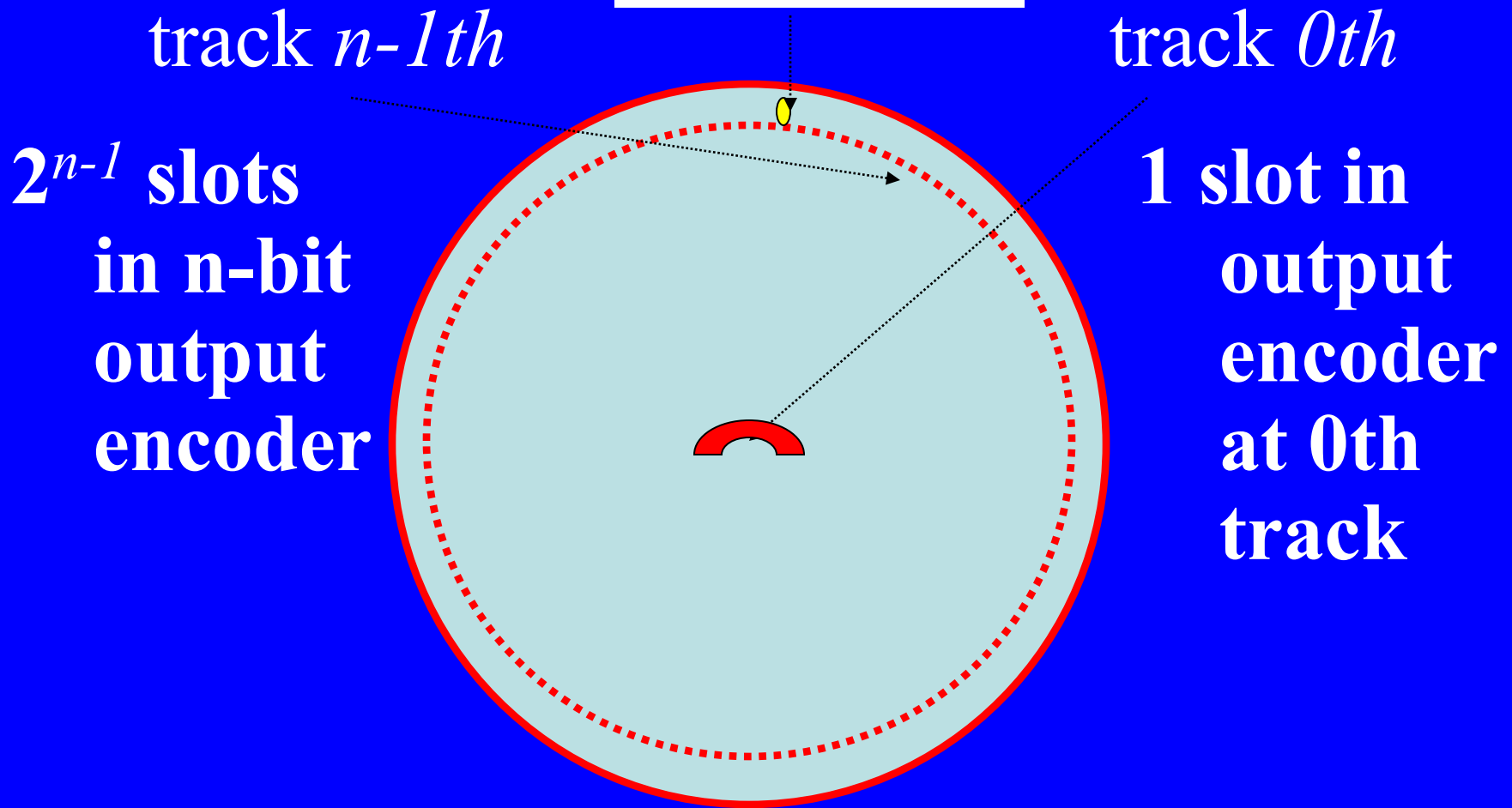
- $n = 1$  Track 0-th has 1 slot between  $0^\circ$  and  $180^\circ$  and dark area between  $180^\circ$  to  $360^\circ$
- $n = 2$  Track 1-th has 2 slots- (i) between  $90^\circ$  and  $180^\circ$  and (ii) between  $270^\circ$  to  $360^\circ$ . Offset between 2 and 1 is  $360^\circ/2^2$

# Parts of n-tracks absolute Rotatory Encoder

- (n-1)th track is outer most track and has  $2^{n-1}$  slots
- (n-1)th track has offset (angular displacement) of  $360^\circ / 2^{n-1}$  w.r.t (n-2) th



# Index hole



## absolute Rotatory Encoder Disc

# *n*-bit absolute Rotatory encoder

1. Records the angular region of present state of a rotating shaft
2. When the shaft rotates clockwise or anticlockwise, the '1's (or '0's) for each track is noted from the track's LED-PT pair.

# *n*-bit absolute Rotatory encoder

3. Angle Resolution is  $(360^\circ/2^k)$  when there are  $k$  slots at outermost track

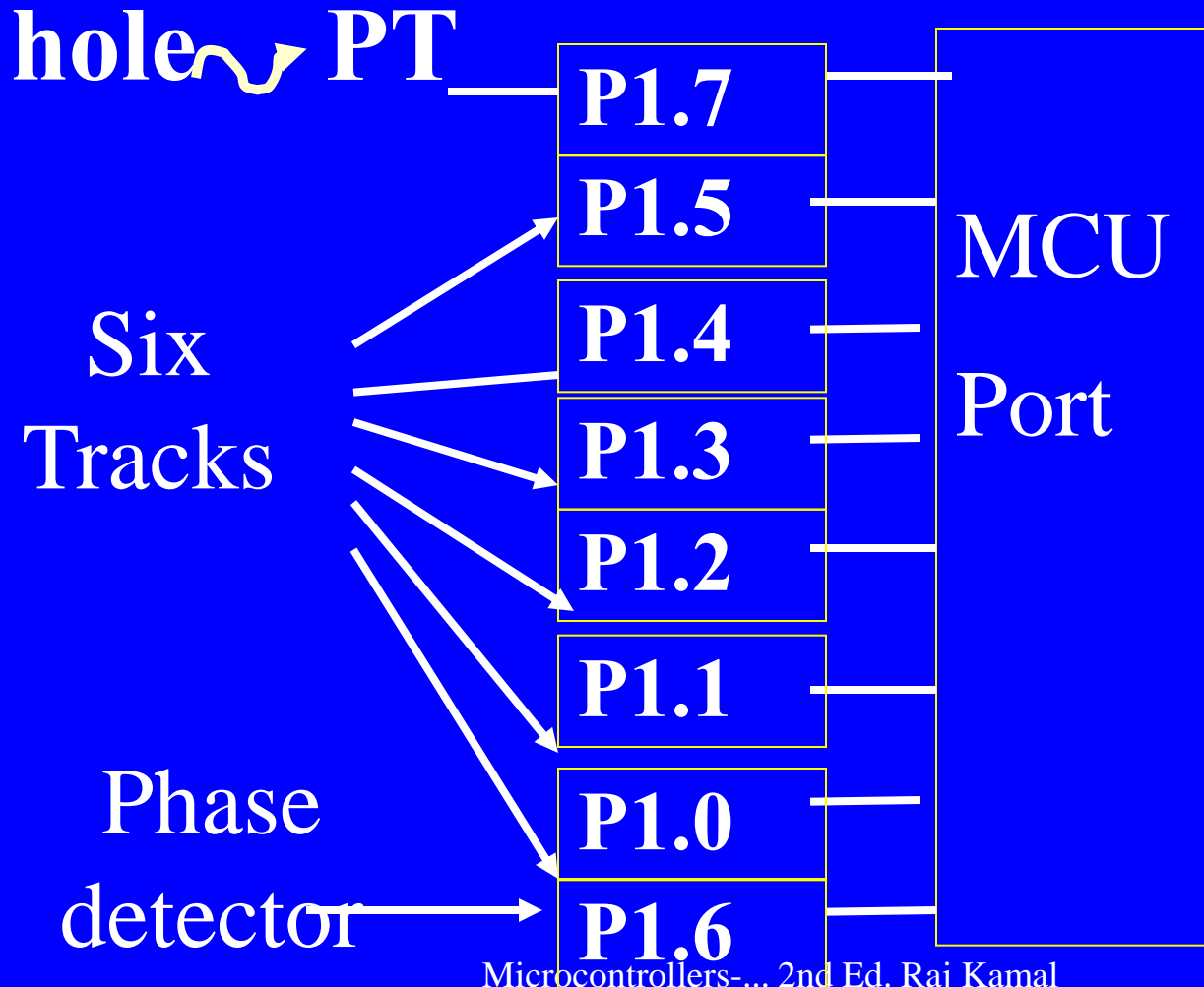
4. For a resolution of  $(360^\circ/128) = 2.8^\circ$ , outer  $(n-1)$ -th track has  $128 = 2^7$  slots and  $2^7$  dark areas.

5. Eight port bits interface the MCU for an 8-track encoder.

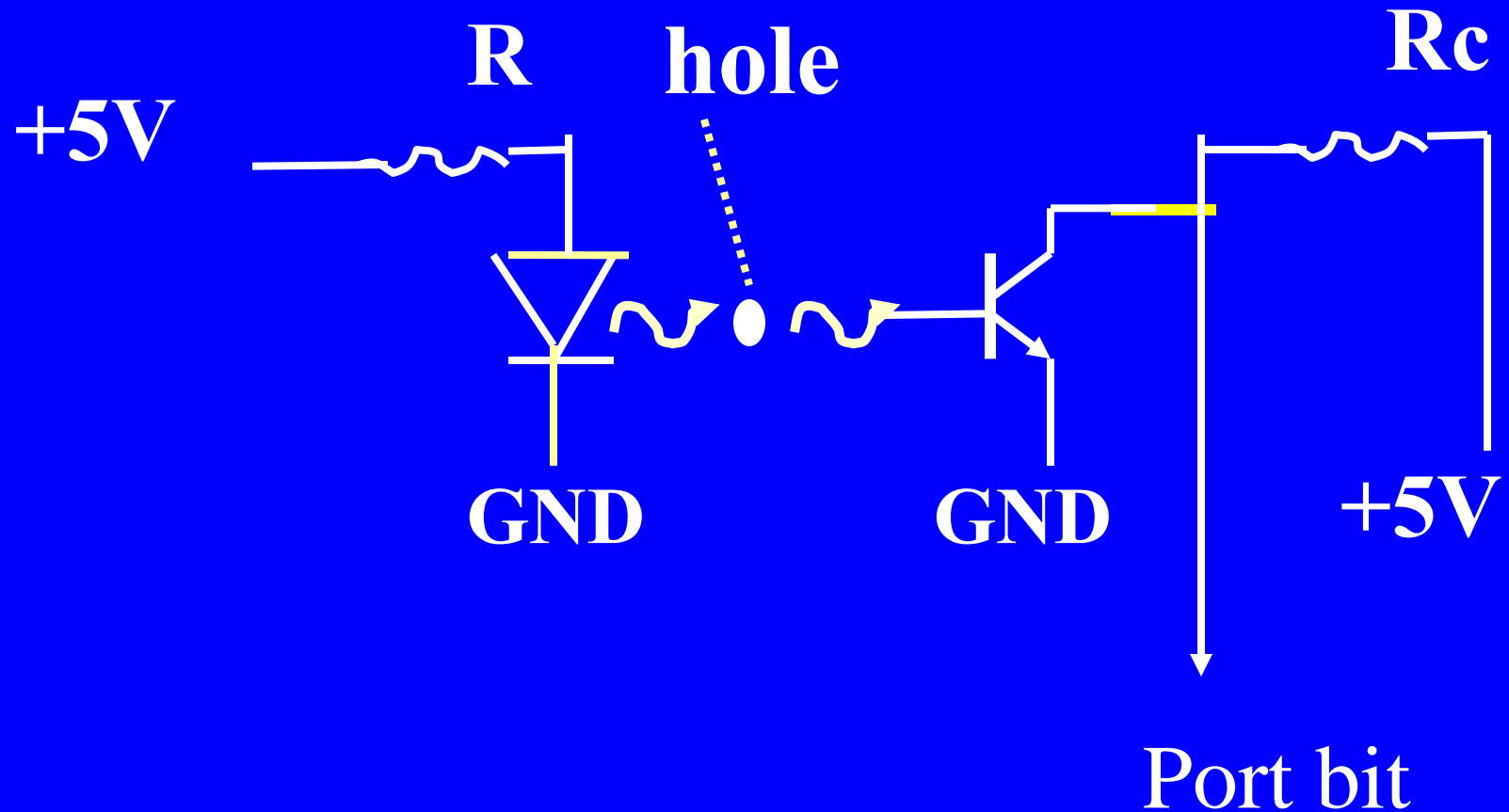
# *n*-bit absolute Rotatory encoder

5. All bits reset to 0 on active input when index-hole passes through the LED radiation

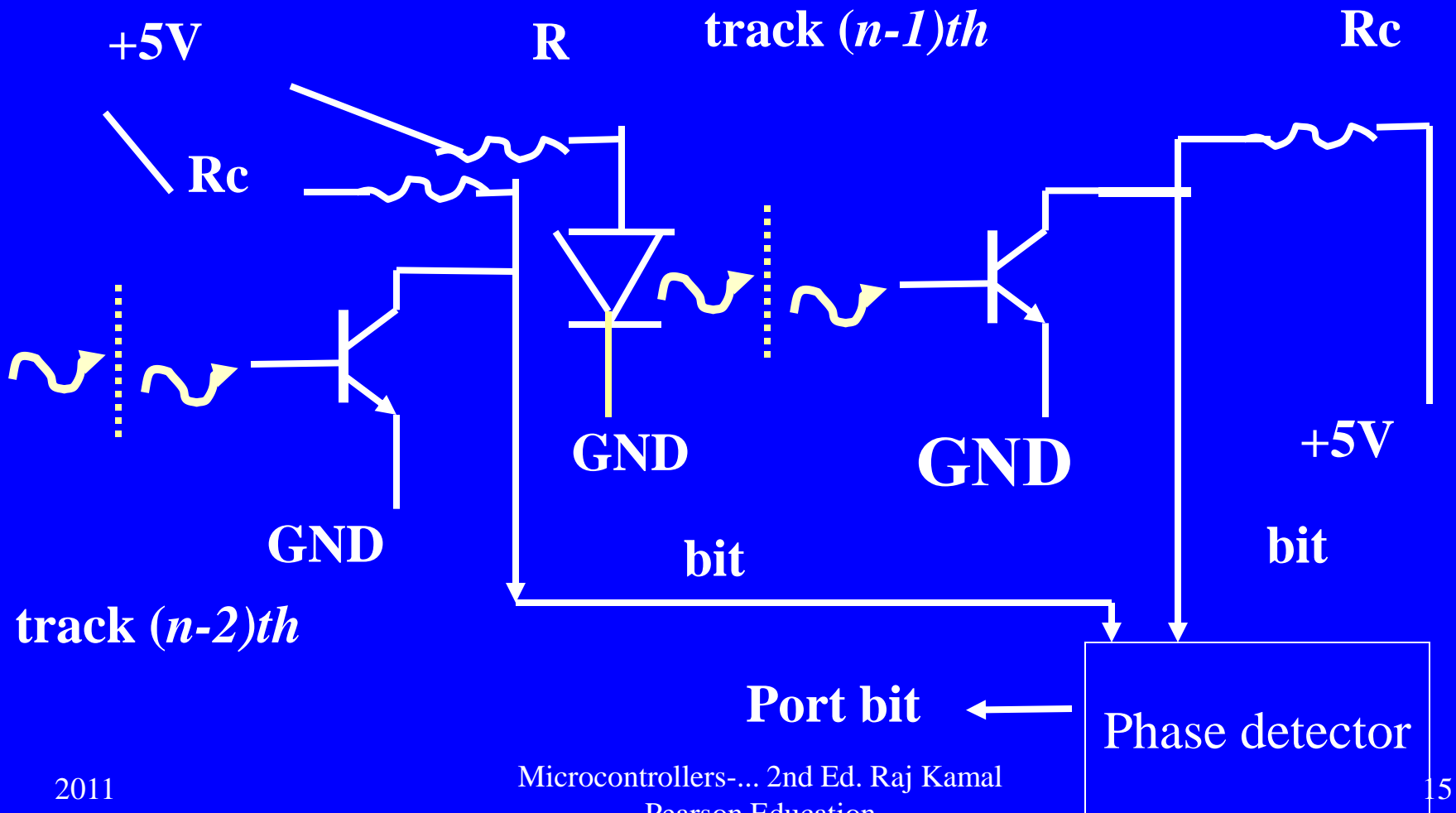
# MCU Interface Circuit for 6 Track Encoder



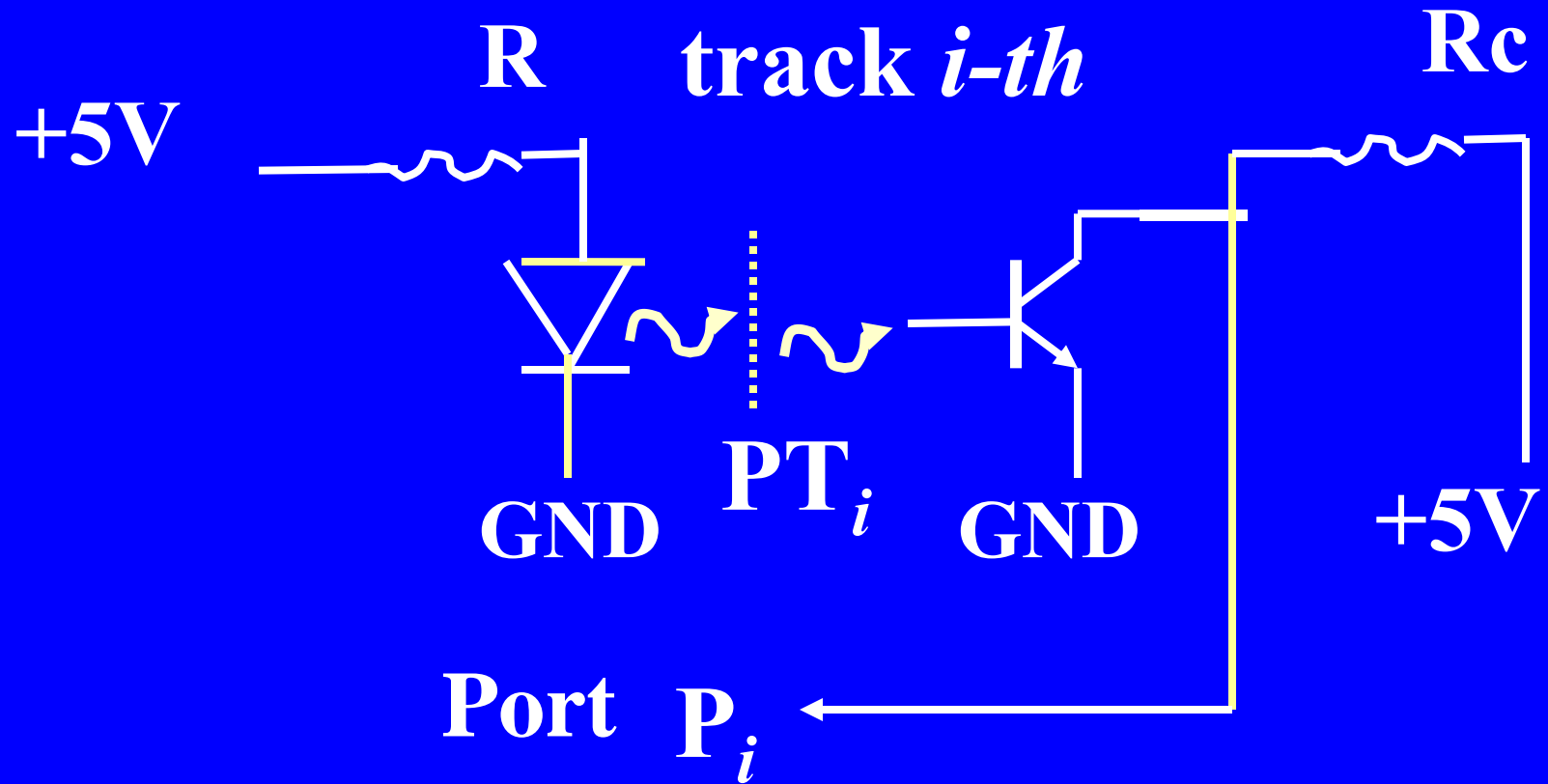
# Absolute Rotatory Encoder LED-PT Pairs



# Absolute Rotatory Encoder LED-PT Pairs

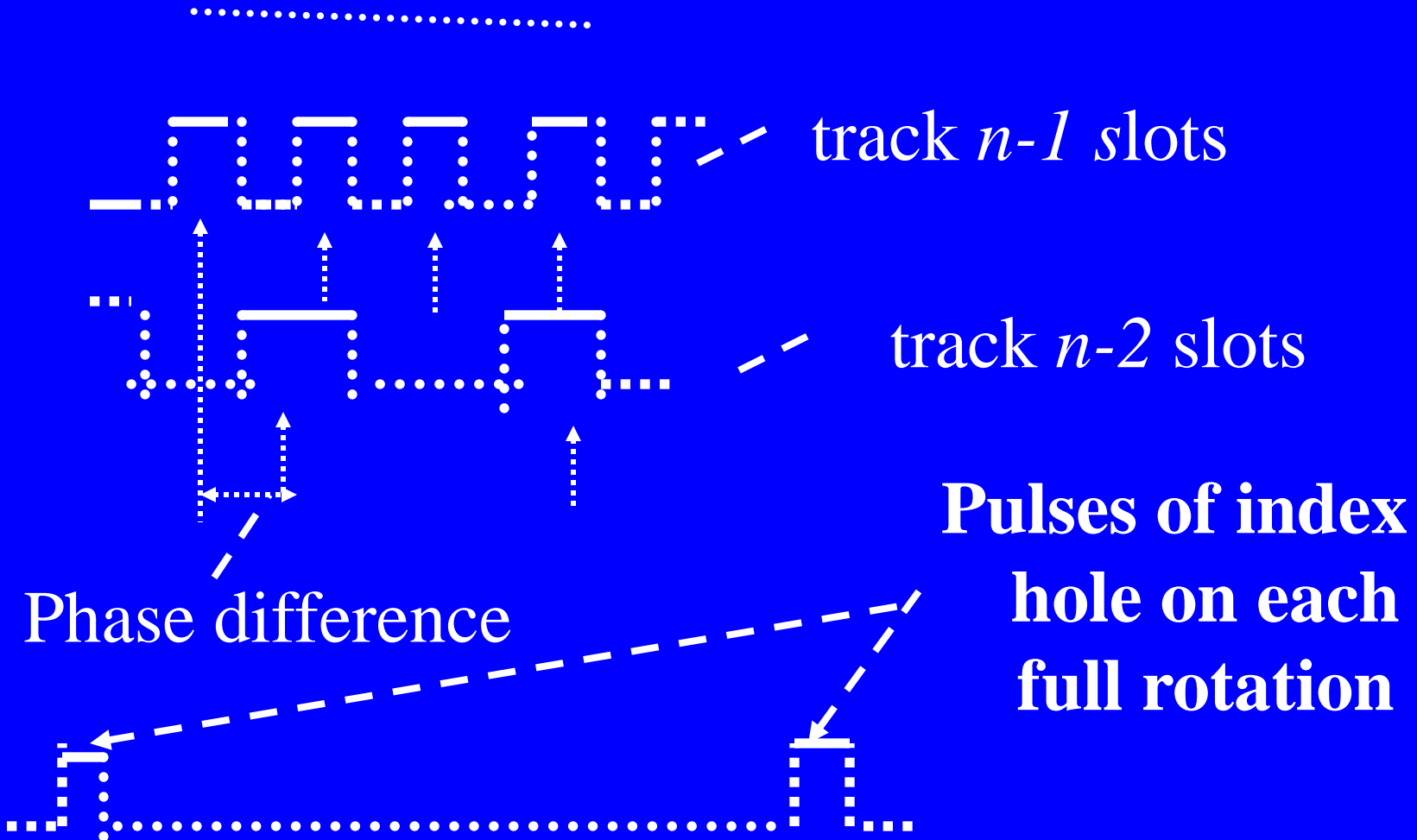


# Absolute Rotatory Encoder LED-PT Pair at each track





# Pulses for Inputs from $n-1$ and $n-2$ and hole as shaft rotates



# Summary

# We learnt

## Absolute Rotatory encoder

- $(n+1)$  LED-phototransistor pairs, one pair is for the hole and one each for the  $n$ - tracks *0th* .... up to  $(n-1)th$

# We learnt

## Absolute Rotatory encoder

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

# **End of Lesson 12 Part b**

## **Optical Rotatory Absolute Encoders**

THANK YOU

# Lesson 2