

# Chapter 8

## Digital and Analog Interfacing Methods

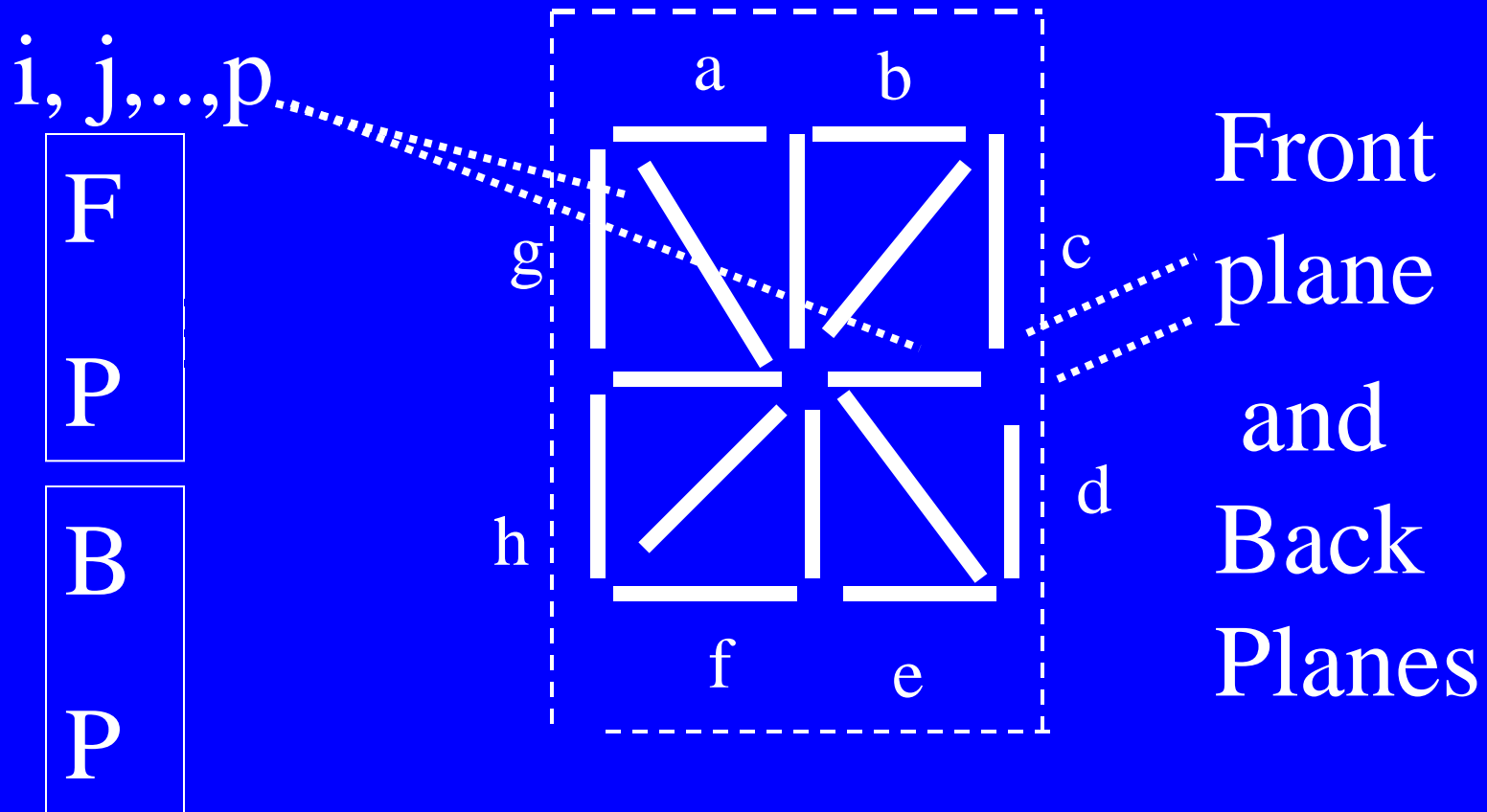
# **Lesson 3**

## **Alphanumeric and Dot-Matrix Display Devices**

# **Alphanumeric Display Devices**

# Sixteen Segments display

# 16-Segments Display



# An LCD Display unit

- 32 Inter-connections if each segment two electrodes connected in 16-segment character display
- Only 8-inter-connections for 1/4 multiplexed two (front and back) planes display - Motorola
- Philips 1/3 and Intersil 1/2 multiplexed planes display

# An LCD Display segment

- Facing front and end planes in-phase inputs (FP and BP pair)– display off
- Facing front and end planes out-of phase inputs (FP and BP pair)– display on by reflectivity change or transmission change

# An LCD Display unit

- Two (front and back) planes, each plane transparent electrode encapsulating liquid crystal
- DC component below 50 mV, negligible dc current,
- 50 Hz or 60Hz pulse input for each plane



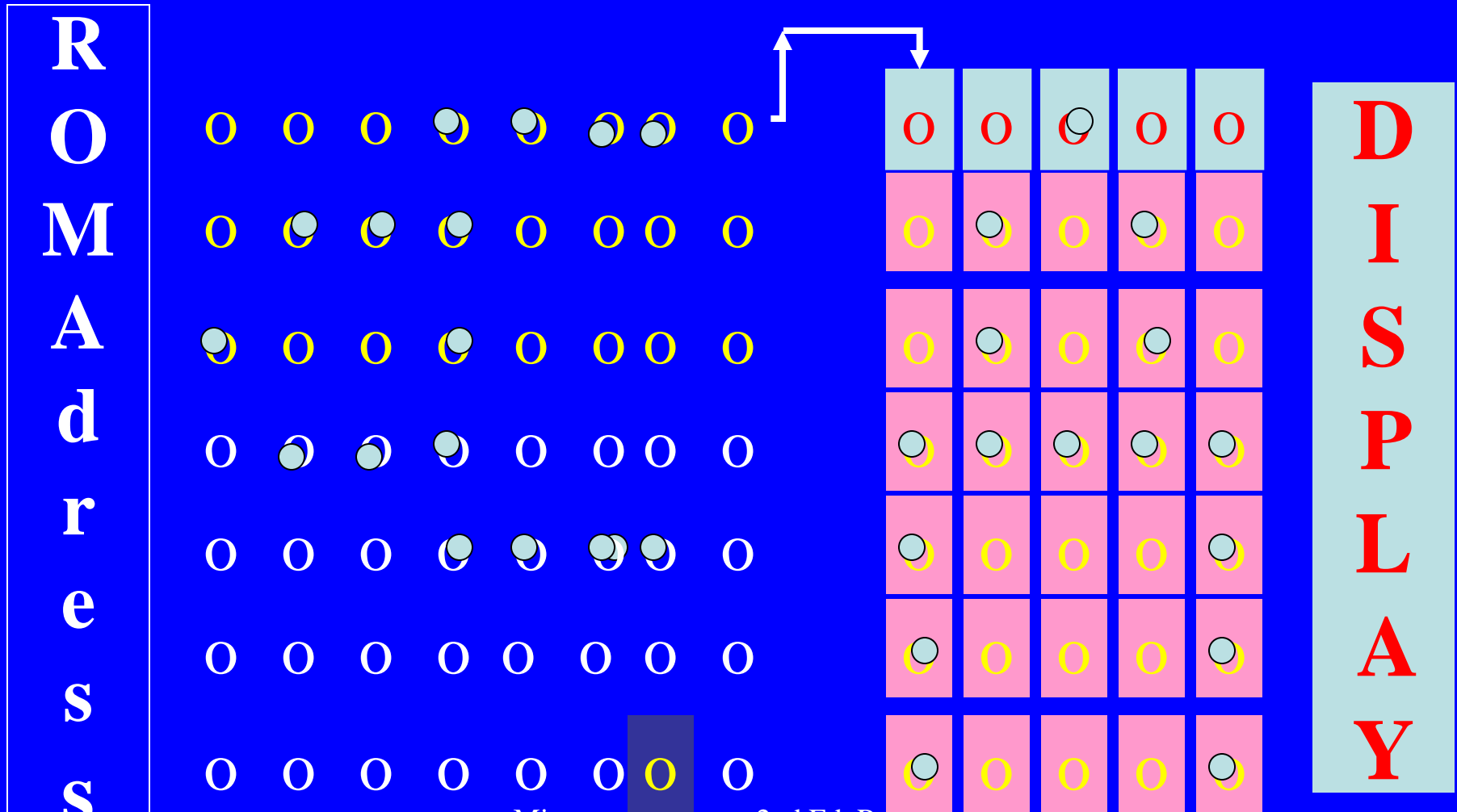
# **Dot-Matrix Display Devices**

# Dot matrix LCD Display screen

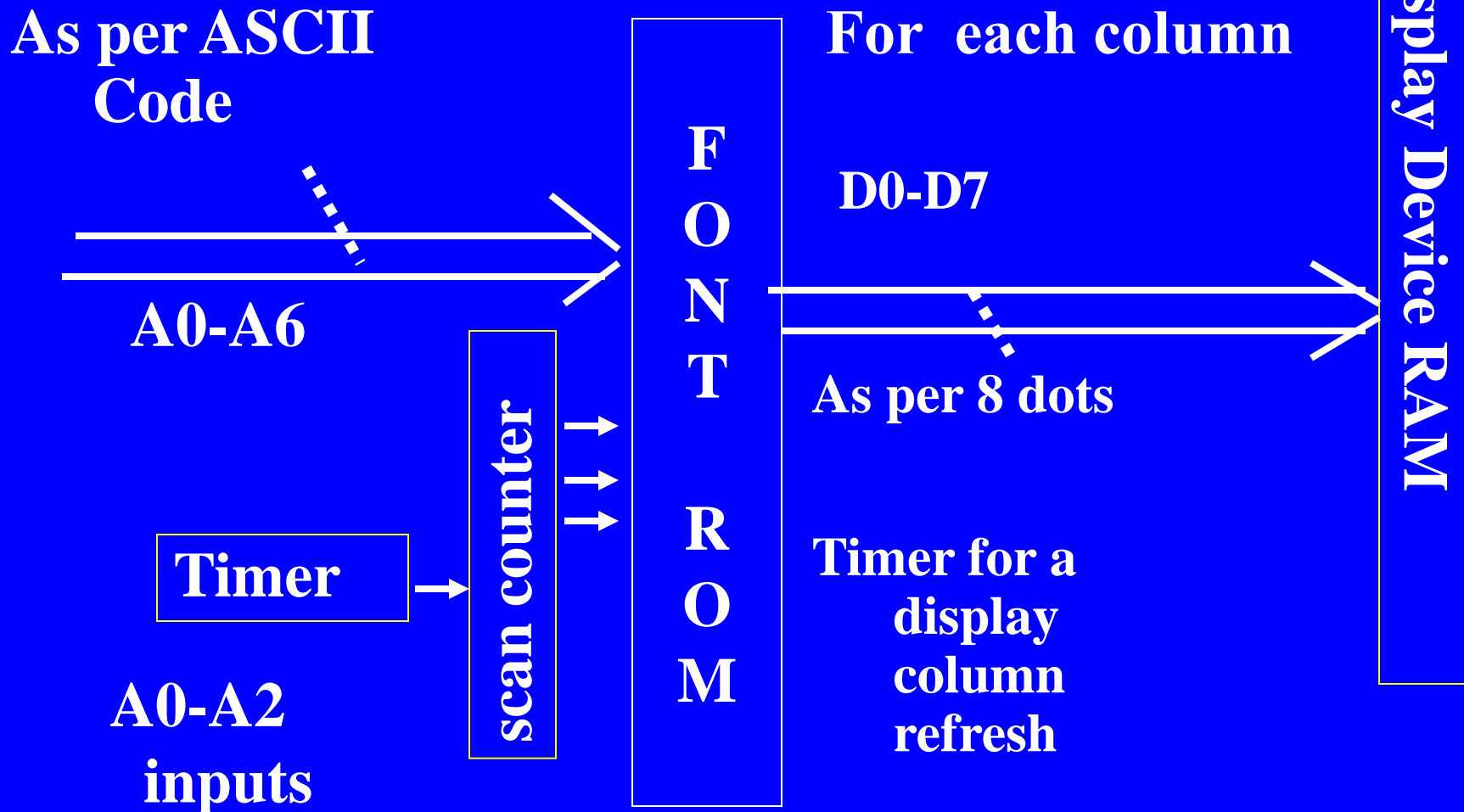


ICONS and  
Menu for  
Inputs on  
display

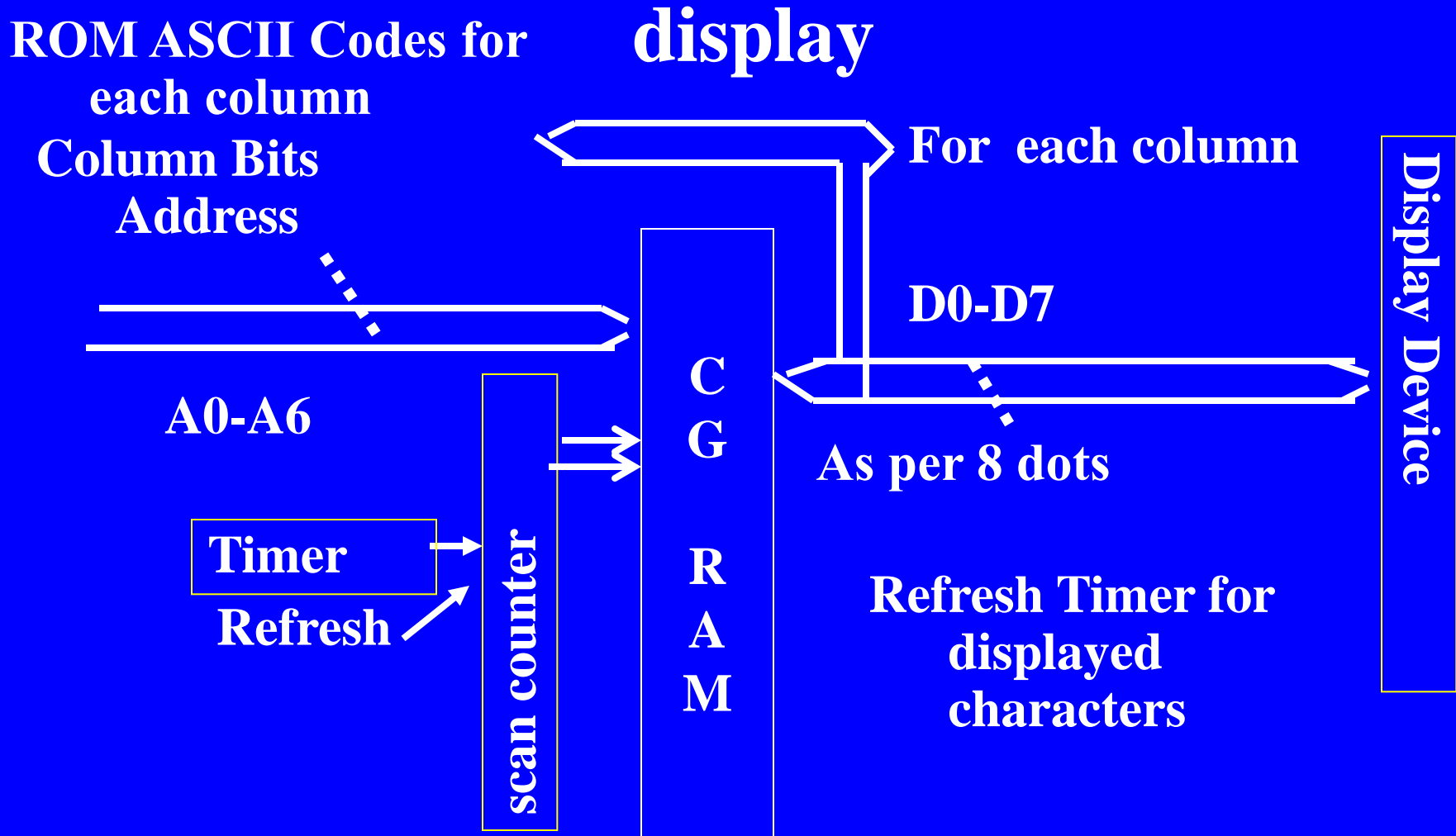
# 5 x 7 Dots/Character Display Dot-matrix Devices



# CHARACTER Fonts ROM 128 x 8 Bits



# Graphic RAM 128 x 8 Bits dot matrix



# LCD Display Controller

# LCD Display Controllers

- Hitachi 44780, Optrex DMC 16xxx, 20xxx, 24xxx,... 8 char x 1 line to 40 char x 2 lines
- 40 -pins
- Accepts ASCII/Column Bytes as Inputs

# LCD Display Controller

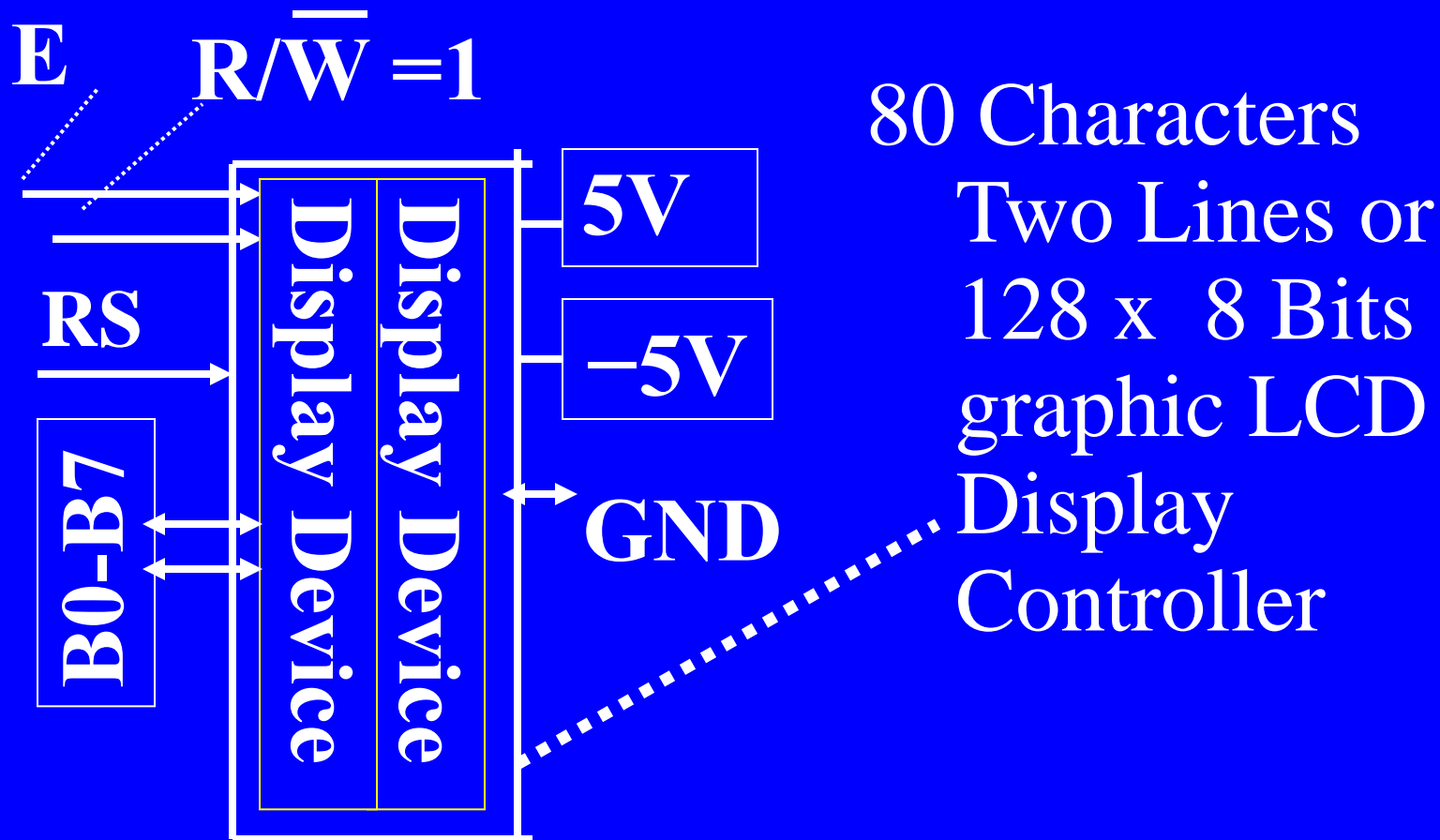
- Controller for display 8 char x1 to 80 chars/2 lines
- Programmable for 4 bit inputs twice or 8-bit input once, for one line/two lines
- Cursor programmable to shift right/left, visible/invisible and blink



# LCD Display Controller

- Accepts Commands for control functions settings- clear display, return home, entry mode, display on/off, address for CG RAM

# Hitachi 44780, DMC 20xxx, ...



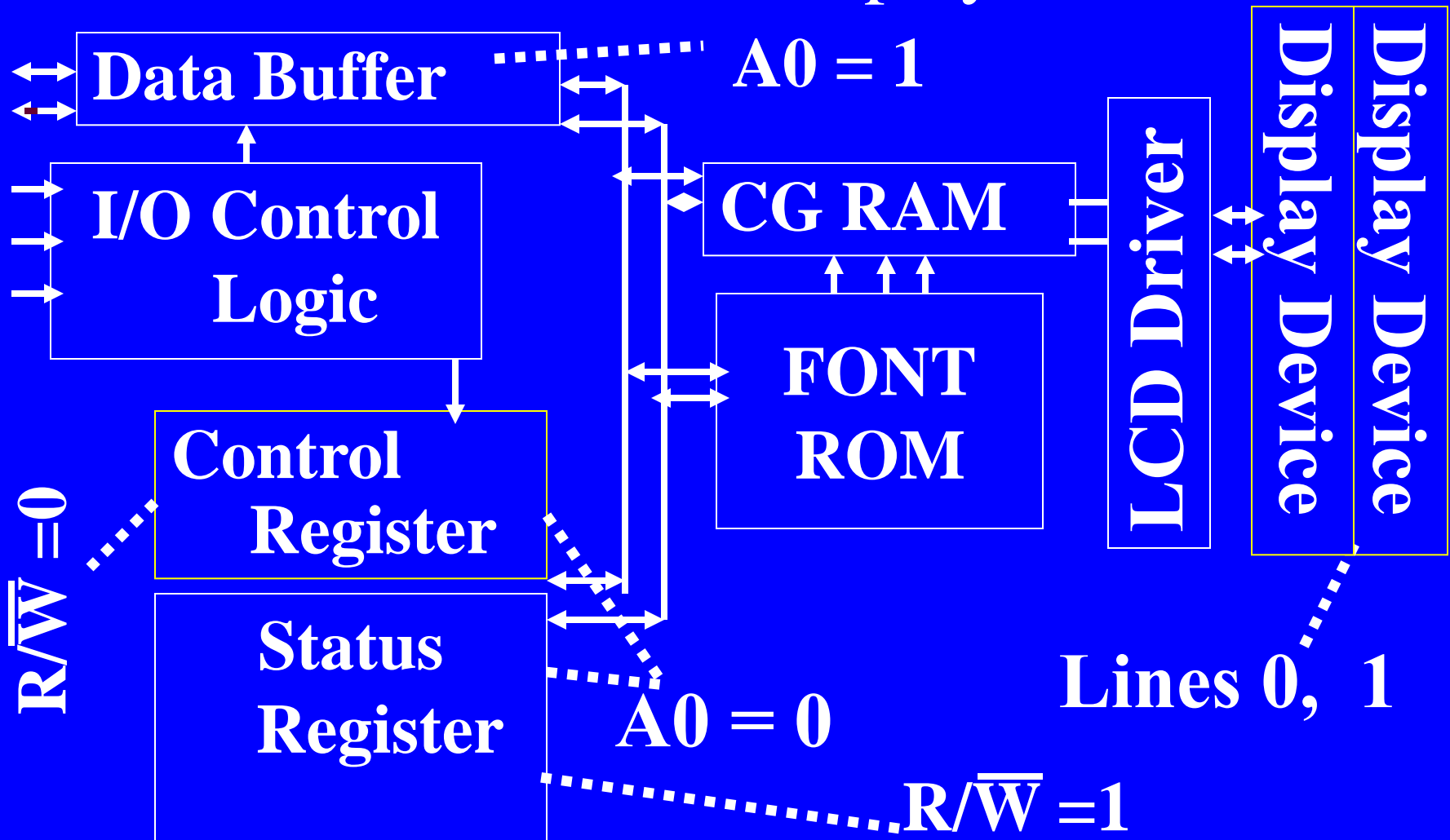
# An LCD Display Controller (LCDC)

- Read the data from LCDC, Writes Data into LCDC,
- Writes Commands into LCDC and Read Status from LCDC
- $\overline{RS}$  (Register Select)= 0— select data
- $\overline{RS} = 1$ , select register (Control/status).
- $R/\overline{W} = 1$ — read, and  $R/\overline{W} = 0$ — write

# An LCDC

- $E = 0$  - disable read/write from or into LCD
- $E = 1$  for  $t > 0.45 \mu\text{s}$  - enable read/write from or into LCD

# 80 Characters/Two Lines or 128 x 8 Bits LCD Display



# **Dot-matrix Displays and Pins in Hitachi 44780, DMC16xxx**

## Sub units

- Data Bus Buffer
- Control/Status Register
- Font ROM
- CG RAM
- Timing Control,  $\overline{R/W}$  and  $\overline{RS}$  Logic



**Pins in Hitachi 44780, DMC16xxx**

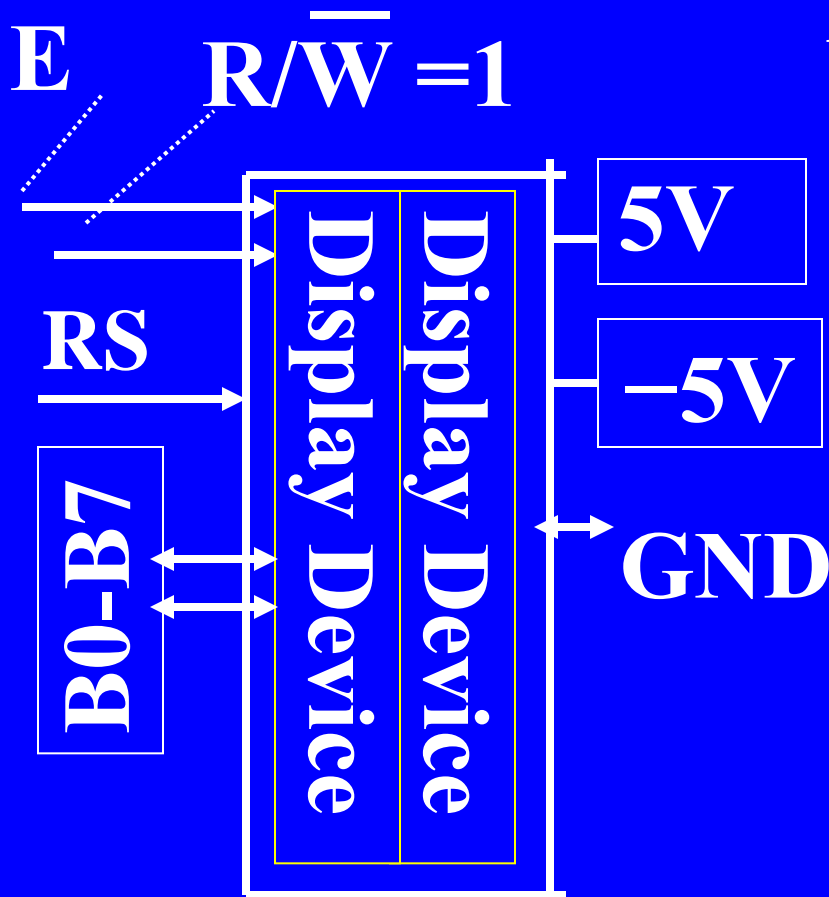


# Table 8.7 - Block Functions

# Table 8.8 - Each Pin signals

# Interfacing and Programming the Display controller

# Interface circuit in Hitachi 44780, DMC 20xxx, ...



E at P1.6,  $\overline{R/\overline{W}}$  at P1.5,  
RS at P1.4, B0-B7 at  
P2.0-P2.7 or

E at Decoder  
through A1-A15,  
A0 to RS and  $\overline{R/\overline{W}}$   
through  $\overline{RD}$  and  
 $\overline{WR}$

# Programming the LCDC by Commands

**When  $E = 1$  for period  $> t = 0.45 \mu\text{s}$ ,  
 $D/\bar{C}$  ( $\bar{RS}$ ) = 0, and  $R/\bar{W}$  = 0 then  
LCDC gets Command bytes**

# Command Bytes

1.  $b7-b0 = 00000000$  Clear display
2.  $b7-b1 = 0000000$   $b0=1$  Return Home of cursor
3.  $b7-b3 = 00000$   $b3, b1 = 1, b2 = 1$  display On, 0 off
4.  $b7-b3 = 00000$   $b3, = 1, b1 = 1$  cursor On, 0 off

5.  $b7-b5 = 000$ ,  $b4 = 1$  move cursor
6.  $b7-b5 = 000$ ,  $b4 = 0$  No move
7.  $b7-b5 = 000$ ,  $b3 = 1$  Shift display on, 0 off,  $b2 = 1$  right shift, 0- left
8.  $b7-b6 = 00$   $b5$  Set interface length (refer text)
9.  $b7 = 0$   $b6 = 1$ ,  $b5$  to  $b0$  CG RAM address

# Write Display Address

10. b7 =1,b6-b0 Display address for FONT ROM displaying a character ASCII Code



# Examples 8.7 and 8.8 for using an LCDC

# Summary

# We learnt

## Character needs 16 Segments

- LCD Character needs 8 inputs in case of multiplexed (1/4,1/3,1/2) front and back planes
- Planes needs 60/60Hz inputs in phase or 180 degree out of phase inputs with negligible dc component

# We learnt

## LCD Controller

- LCD Characters display Multiline, multi-character
- Commands program in different ways

# End of Lesson 3

## Alphanumeric and Dot-Matrix Display Devices