

DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK–

Lesson-9: Parallel Port Interfacings with LCD Controller and Touch Screen

1. LCD Controller

LCD controller— A processing element (single purpose processor)

- Processing element generates all required signals for LCD matrix displays (multi-lane).
- Interfaces Eight-bit *parallel output port B* pins PB0-PB7, which sends commands for programming the controller and send data for display

Port Interfacing — Parallel port outputs and control signals

- Three control signals IO PC0-PC2 as inputs to LCD controller
- PB0 to PB7 8 input/output bits for parallel set of 8 IO bits for commands and data

Control Bits

- LCD controller is sent control words and data words for initialization and programming by setting the PB0-PB7, PC0 and PC1 outputs for each word to LCD controller.

Register Select Control bit

- One bit PC0 at an output port for RS (register select).
- When RS is reset as 0, the PB0-PB7 communicates a control word to control register of the LCD controller.
- When RS is set as 1, the PB0-PB7 communicates data to LCD controller

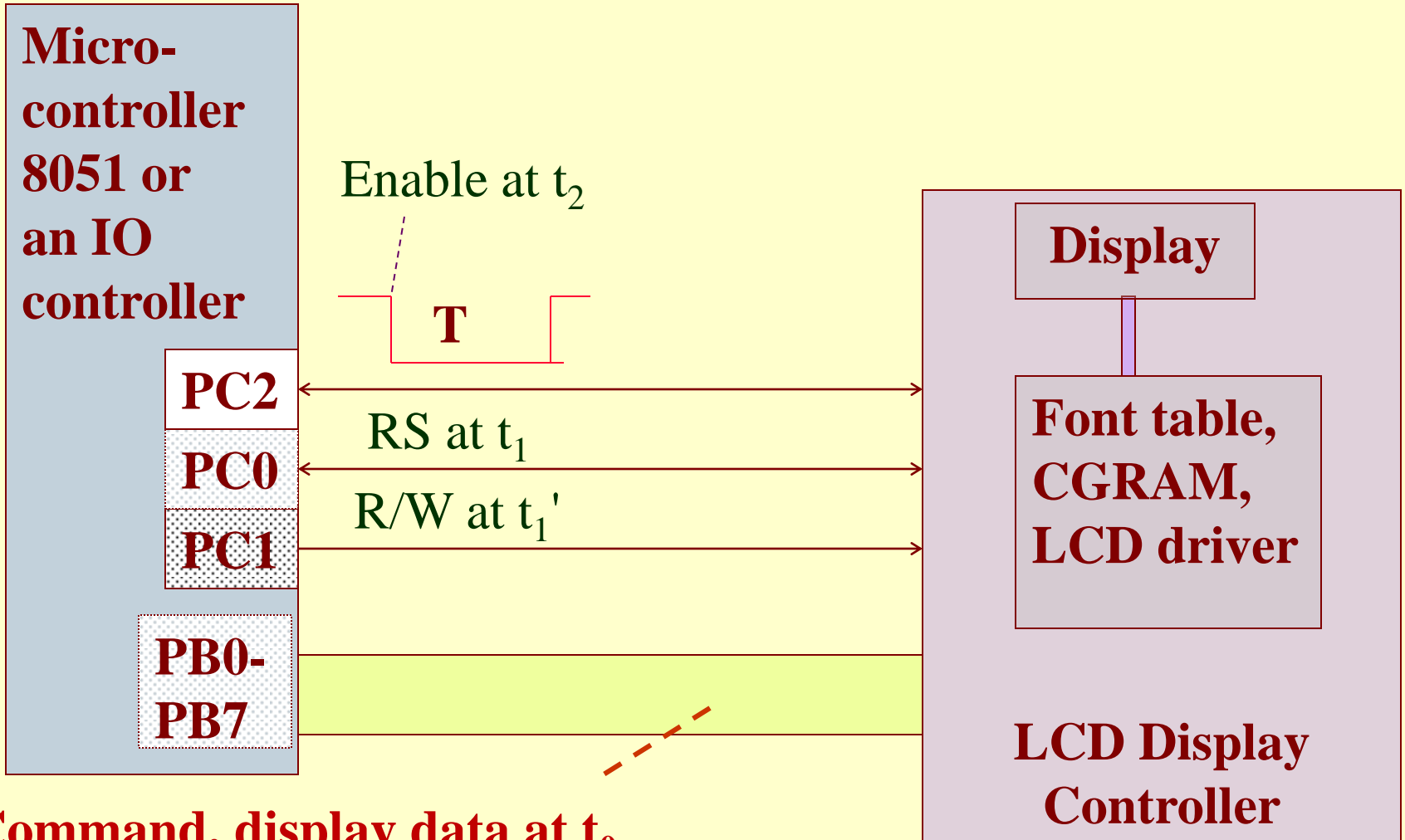
R/W (read/write) Control bit

- One bit PC1 at an output port
- Set to 1 when status register of LCD controller is read using PB0-PB7.
- PC1 is reset to 0 when write into LCD controller using PB0-PB7 bits.

Enable Control bit

- After setting R/W, RS and data-bits the LCD controller enables
- Enables by setting 1 at E pin.
- LCD controller connects to one bit PC2 at an output port for E (enable). There is an interval depending on the LCD controller, the controller is disabled. This is because during this interval, the LCD controller cannot accept instructions or data through output of other port pins.

Interfacing LCD Controller



Command, display data at t_0
and Status bits at t_3

Enabling Pulse Interval T

- Assume a command instruction to clear display. The internal processing element to clear the bytes at all the N addresses in N characters LCD display. It takes time, T , for example, $150 \mu\text{s}$
- When first 1 is written at PC2, then 0 is written for enabling pulse 0 using $150 \mu\text{s}$ delay program,

Enabling Pulse Interval T

- PC2 output creates a –ve going pulse (1 followed by 0) at LCD controller. It disables transfer of any control word or data for a period of T to enable internal processing.

LCD controller

- M displayed character ROM addresses.
M = 128 for 128 ASCII codes.
- For Each distinct ASCII character, there is 64-bit graphic.
- LCD controller has internal CGRAM (Character graphic RAM).
- For each ASCII character, 8 bytes are sent from the ROM to the CGRAM.

CGRAM

- Has N addresses. $N = 64$ for 64 characters that can be displayed.
- An address changes by incrementing or decrementing cursor position to previous address on the screen or next address on the screen.
- Sending appropriate control words followed by data, the LCD controller is programmed to display up to characters on the screen when $N = 64$.

2. Touch screen

Touch screen

- An input device cum LCD display device.
- Interfaced for the output through output port O to an LCD display device controller.
- Interfaced for an additional input port I for a byte
- The byte corresponds to the address of touched position on display screen.

Touch screen

- Resistive or capacitive type.
- Touching at a position on the screen,
- A change in resistance or capacitance,
- The change dependent on touched position.
- A touch can be by a finger or stylus.
- The stylus about one-fifth thinner than a pencil and about half of the length of the pencil

Mobile touch screen

- Device facilitates the GUIs (Graphic User Interfaces).
- Display menus, icons as well as virtual keypad.

Mobile touch screen

- Using the keypad on screen and stylus, a set of characters can be entered for creating or editing SMS message or e-mail or new contact or word pad file.
- A handheld stylus is held like a pencil and is used to touch the virtual keypad and then the device selects menu and commands on the screen

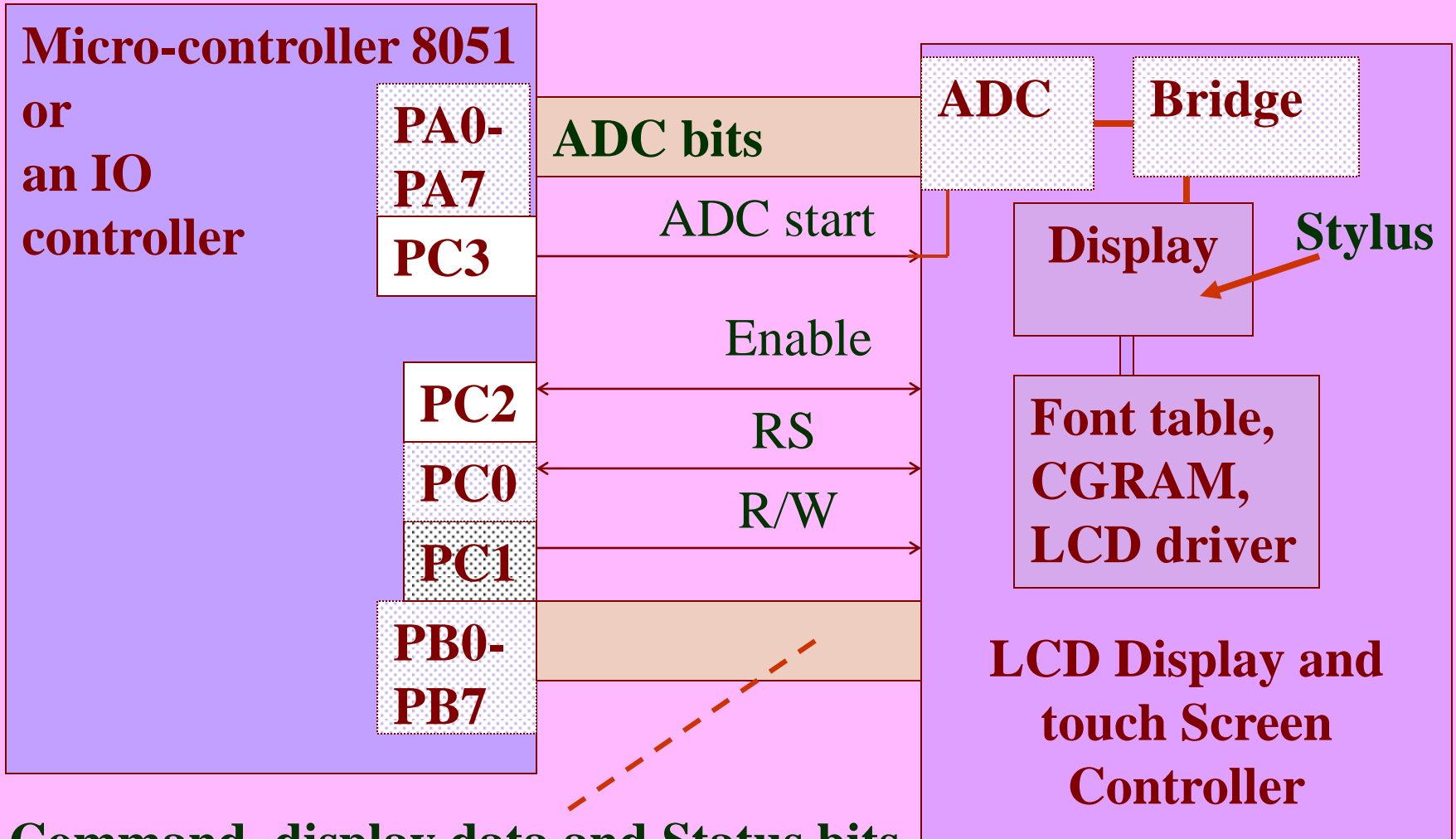
Sensing a touched Position

- The resistance or capacitance — a part of a bridge circuit,
- The circuit generates analog voltage as per the touched screen position.
- An 8-bit ADC is given input from a bridge circuit and the 8-bit ADC output connects to an 8-bit input port *I*.

Parallel port inputs, outputs and control signals to controller (a processing element as single purpose processor)

- Three control signals IO PC0-PC2 as inputs to the LCD controller
- PB0 to PB7 8 input/output bits for parallel set of 8 IO bits for commands and data and for status bits
- Control signal ADC start at PC3 to sense screen (x, y) touched position data using PA0-PA7

Interfacing Controller at Touch Screen



Control Bits

- Controller is sent control words and data words for initialization and programming by setting the PB0-PB7, PC0 and PC1 outputs for each word to controller.
- Touch screen ADC sent control bit PC3 for start of ADC

Summary

We learnt

- LCD controller has LCD driver, font table, and CGRAM for the display control
- Parallel port having 8 bit output data and 3 control bits E, RS and R/W used to interface to an LCD controller

We learnt

- Touch screen device facilitates the GUIs.
- Display menus, icons as well as a virtual keypad
- Parallel port having 8 output data and 4 bits for E, RS and R/W and ADC start used to interface to controller for touch screen

End of Lesson 9 of Chapter 5
on
Parallel Port Interfacings with LCD
Controller and Touch Screen