

CMPE 310 Systems Design and Programming

L11: Chapter 11 – BASIC I/O Interface

UMBC

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L11 Objectives

- * Describe the function of each pin of the 8279
 - * Diagram how the 8279 is connected to the x86/88 PC
 - * Program the 8279 by use of the chip control word

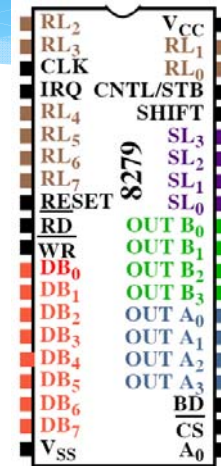
Programmable Keyboard/Display Interface – 8279

- * A programmable keyboard and display interfacing chip.
 - * Scans and encodes up to a 64-key keyboard.
 - * Controls up to a 16-digit numerical display.
- * Four main segments
 - * Keyboard , Scan , Display, CPU Interface
- * Keyboard section
 - * RL0-RL7 can be connected to eight columns of a matrix keyboard
 - * Shift and CNTL/STB (Control/Strobe)
 - * Built-in FIFO 8 character buffer.
 - * Keys are automatically debounced



Programmable Keyboard/Display Interface – 8279

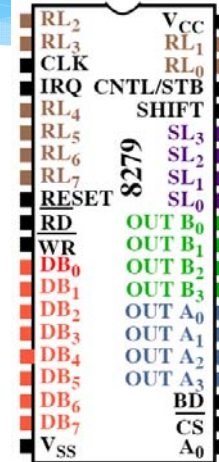
- * Display Section
 - * A₀-A₃ and B₀-B₃ output lines
 - * Internal 16 byte display RAM (16x8) that stores the coded display information.
 - * BD line used to blank displays
- * Scan Section
 - * SL₀-SL₃ scan lines
 - * Used by keyboard and display section for proper function
- * CPU Interface section
 - * DB₀-DB₇ bidirectional data lines
 - * IRQ line
 - * RD line
 - * WR line
 - * CS line
 - * RESET line
 - * Buffer address line (A₀)



Pinout Definition 8279

- * $\overline{A_0}$: Address buffer selects data (0) or control/status (1) for reads and writes between microprocessor and 8279.

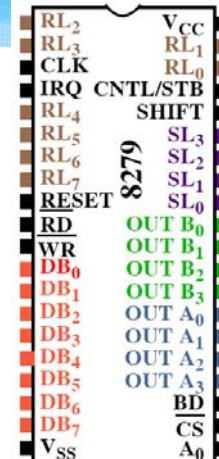
- * BD: Blank display is an output that blanks the displays.
- * CLK: Used internally for timing. Max is 3 MHz.
- * CNTL/STB: Control/strobe connected to the control key on the keyboard
- * \overline{CS} : Chip select enables programming, reading the keyboard, etc.
- * DB7-DB0: bidirectional pins that connect to data bus on microprocessor.



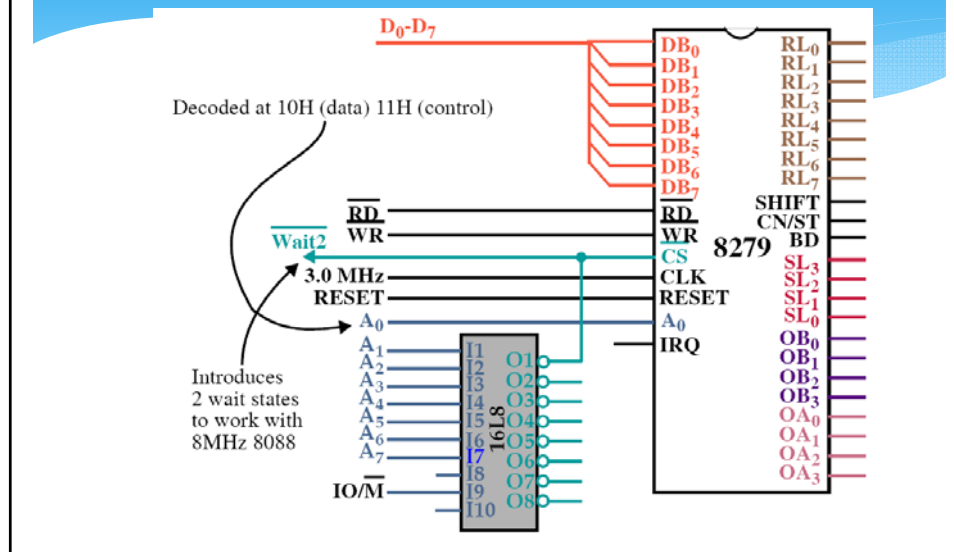
Pinout Definition 8279

- * IRQ: Interrupt request, becomes 1 when a key is pressed, data is available.

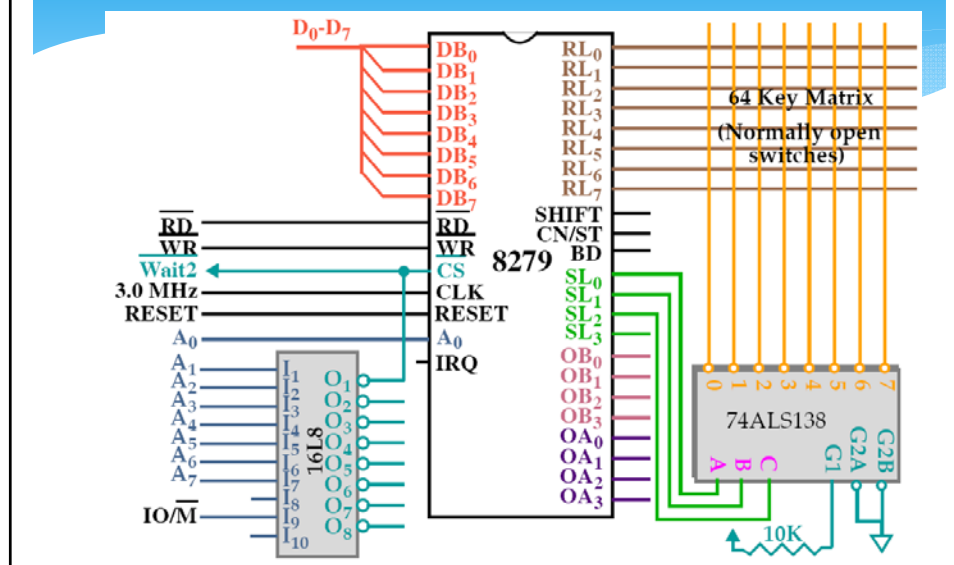
- * OUT A₃-A₀/B₃-B₀: Outputs that sends data to the most significant/least significant nibble of display.
- * RD(WR): Connects to microprocessor's IORC or RD signal, reads data/status registers.
- * RESET: Connects to system RESET.
- * RL₇-RL₀: Return lines are inputs used to sense key depression in the keyboard matrix.
- * Shift: Connects to Shift key on keyboard.
- * SL₃-SL₀: Scan line outputs scan both the keyboard and displays.



8279 Interfaced to the 8088



Keyboard Interface of 8279



Keyboard Interface of 8279

- * The keyboard matrix can be any size from 2x2 to 8x8.
- * Pins SL2-SL0 sequentially scan each column through a counting operation.
 - * The 74LS138 drives o's on one line at a time.
 - * The 8279 scans RL pins synchronously with the scan.
 - * RL pins incorporate internal pull-ups, no need for external resistor pull-ups.
- * The 8279 must be programmed first.

<i>D₇</i>	<i>D₆</i>	<i>D₅</i>	<i>Function</i>	<i>Purpose</i>
0	0	0	Mode set	Selects the number of display positions, type of key scan...
0	0	1	Clock	Programs internal clk, sets scan and debounce times.
0	1	0	Read FIFO	Selects type of FIFO read and address of the read.
0	1	1	Read Display	Selects type of display read and address of the read.
1	0	0	Write Display	Selects type of write and the address of the write.
1	0	1	Display write inhibit	Allows half-bytes to be blanked.
1	1	0	Clear	Clears the display or FIFO
1	1	1	End interrupt	Clears the IRQ signal to the microprocessor.

- * The first 3 bits of the byte sent to control port selects one of 8 control words.

Keyboard Interface of 8279

- * First three bits given below select one of 8 control registers (opcode).
- * **Command Word o: 000DDMMM**
 - * **Mode set: Opcode 000.**
 - * DD sets displays mode.
 - * MMM sets keyboard mode.
 - * DD field selects either:
 - * 8- or 16-digit display
 - * Whether new data are entered to the rightmost or leftmost display position.

<i>DD</i>	<i>Function</i>
00	8-digit display with left entry
01	16-digit display with left entry
10	8-digit display with right entry
11	16-digit display with right entry

Keyboard Interface of 8279

MMM field:

MMM	Function
000	Encoded keyboard with 2-key lockout
001	Decoded keyboard with 2-key lockout
010	Encoded keyboard with N-key rollover
011	Decoded keyboard with N-key rollover
100	Encoded sensor matrix
101	Decoded sensor matrix
110	Strobed keyboard, encoded display scan
111	Strobed keyboard, decoded display scan

- * **Encoded:** SL outputs are active-high, follow binary bit pattern 0-7 or 0-15.
- * **Decoded:** SL outputs are active-low (only one low at any time).
Pattern output: 1110, 1101, 1011, 0111.
- * **Strobed:** An active high pulse on the CNTL/STB input pin strobes data from the RL pins into an internal FIFO for reading by microprocessor later.
- * **2-key lockout:** Prevents 2 keys from being recognized if pressed simultaneously
- * **N-key rollover:** Accepts all keys pressed from 1st to last.

Keyboard Interface of 8279

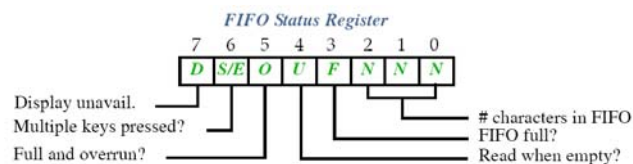
- * **Command Word 1: 001PPPPP**
 - * The **clock command word** programs the internal clock driver
 - * The code PPPPP (5-bit prescaler) divides the clock input pin (CLK) to achieve the desired operating frequency (designed to run at 100KHz)
 - * e.g. 100KHz requires 01010 for a 1 MHz CLK input.
 - * Command word 1: 00101010 = 2AH
- * **Command Word 2: 010Z0AAA**
 - * The **read FIFO control word** selects the address (AAA) of a keystroke from the FIFO buffer (000 to 111).
 - * Z selects auto-increment for the address.
 - * Z and AAA bits are don't cares for keyboard scanning
 - * Command word 2: 01000000=40H
- * **Command Word 3: 011ZAAAA**
 - * The **display read control word** selects the read address of one of the display RAM positions for reading through the data port.

Keyboard Interface of 8279

- * **Command Word 4: 100ZAAAA**
 - * Selects **write address** -- Z selects auto-increment so subsequent writes go to subsequent display positions.
- * **Command Word 5: 1010WWBB**
 - * The **display write inhibit control word** inhibits writing to either the leftmost 4 bits of the display (left W) or rightmost 4 bits.
 - * BB works similarly except that they blank (turn off) half of the output pins.
- * **Command Word 6: 1100CCFA**
 - * The **clear control word** clears the display, FIFO or both
 - * Bit F clears FIFO and the display RAM status, and sets address pointer to 000.
 - * If CC are 00 or 01, all display RAM locations become 00000000.
 - * If CC is 10 → 00100000, if CC is 11 → 11111111.
- * **Command Word 7: 1110E000**
 - * **End of Interrupt control word** is issued to clear IRQ pin in sensor matrix mode

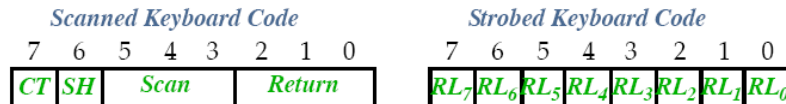
Keyboard Interface of 8279

- * Clock must be programmed first. If 3.0 MHz drives CLK input, PPMPP is programmed to 30 or 11110.
- * Keyboard type is programmed next.
 - * The previous example illustrates an encoded keyboard, external decoder used to drive matrix.
- * Program the FIFO.
- * Once done, a procedure is needed to read data from the keyboard.
 - * To determine if a character has been typed, the FIFO status register is checked.
 - * When the control port is addressed by the IN instruction, the contents of the FIFO status word is copied into register AL:



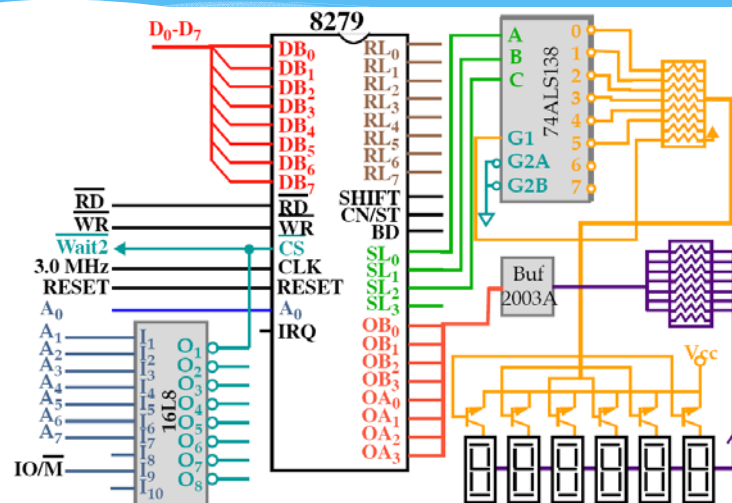
BASIC I/O Interface

- * Code given in text for reading keyboard.
- * Data returned from 8279 contains raw data that need to be translated to ASCII:



- * Row and column number are given the rightmost 6 bits (scan/return).
- * This can be converted to ASCII using the XLAT instruction with an ASCII code lookup table.
- * The CT and SH indicate whether the control or shift keys were pressed.
- * The Strobed Keyboard code is just the state of the RLx bits at the time a 1 was 'strobed' on the strobe input pin.

Six Digit Display Interface of 8279



Next Time

- * 8254 Programmable Interval Timer

