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Subject	How to use the DOT Matrix Display on **JUMP*tec*®** Boards
Related Products	**All JUMP*tec*®** Modules with DOT Matrix Display support

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29.09.00	H. Bruhn	Initial release
15.04.02	M.Ciolacu	Updated PC/104 and schematics adapter LPT to character LCD
16.04.02	C.Hoch	Updated DIMM-PC
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1. Table of contents

2. Introduction

Lots of customers seem to have a problem understanding the function and access of the DOT-MATRIX display (also called character LCD), which is part of the DIMM-PCs starter kit. This function is also supported on some of the PC/104 boards.

Character LCD support is available on following JUMP*tec*® CPU boards:

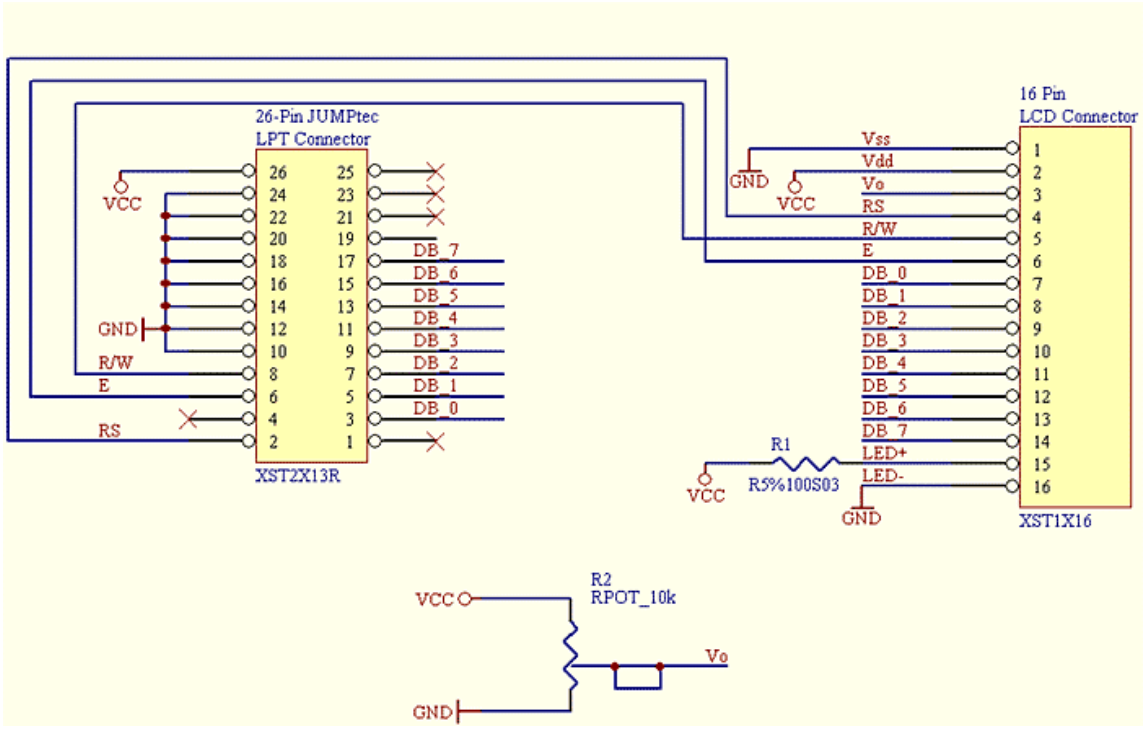
Table 1: JUMP*tec*® boards with character LCD support

DIMM-PC	PC/104
DIMM-PC/386-B	MOPSplus
DIMM-PC/386-IE	MOPS/386A
DIMM-PC/486-I	MOPS/MZ
DIMM-PC/520-I	MOPS/lcdMZ
DIMM-PC/586-IE	

3. Background Information

The character LCD is interfaced through the signals of the parallel port (LPT). The printer port and the character LCD can not be used at the same time.
The system BIOS contains a compressed extension bios to support a DOT MATRIX module on the parallel port. This extension is copied to Shadow RAM if the ALCD support is enabled. Use the ALCDINIT.EXE, available from JUMP*tec*® technical support, to enable or disable ALCD and to set the parameters of the attached module.
The character LCD can be programmed with standard INT10h software interrupt calls.

3.1. Adapter LPT – character LCD



Schematics adapter LPT to character LCD

3.2. Connector pinout and signal explanation

Table 2: Pinout adapter LPT to character LCD

26-pin JUMP*tec*® LPT connector	LPT Signal	16-pin LCD connector	LCD Signal	Signal description LCD
1	/Strobe	-	-	-
3	Data 0	7	DB0	Data bit 0
5	Data 1	8	DB1	Data bit 1
7	Data 2	9	DB2	Data bit 2
9	Data 3	10	DB3	Data bit 3
11	Data 4	11	DB4	Data bit 4
13	Data 5	12	DB5	Data bit 5
15	Data 6	13	DB6	Data bit 6
17	Data 7	14	DB7	Data bit 7
19	/ACK	-	-	-
21	BUSY	-	-	-
23	PAPER out	-	-	-
25	SEL out	-	-	-
2	/AUTOFD	4	RS	RS register select on LCD 1 = data signal, 0 = instruction signal
4	/ERROR	-	-	Not used
6	/INIT	6	E	EN enable signal for data assumption
8	SEL in	5	R/W	R/W read/write from /to LCD 1 = read mode, 0 = write mode
26	VCC	2	Vdd	+ 5 V
10, 12, 14, 16, 18, 20, 22, 24.	GND	1	Vss	Signal Ground
-	-	3	Vo	Input voltage for LCD (0V to +5V)
-	-	15	LED+	Backlight anode
-	-	16	LED-	Backlight cathode

When connecting the character LCD through the LPT connector, additional circuitry for the "LCD drive voltage" and "Backlight anode voltage" is required. See schematics.

3.3. General adaption hints

The display used should be equipped with a Hitachi HD44780 controller or a compatible one. This is a standard controller for parallel port interfaced DOT-MATRIX displays. For direct programming of these LCD-displays please refer to the controllers manual. With this information a software programmer can directly access the DOT-MATRIX display by himself. There are also some 3rd party driver programs available on the free market to support the HD44780 controller.

This direct programming may be a bit too complex for many applications. We have designed a special BIOS extension, which is integrated in the JUMP*tec*® AG module system BIOS. This interface can be accessed through BIOS calls of the software interrupt INT 10hex. This interface can only be used with operating systems that allow you to access BIOS interrupts (e.g. DOS). Other operating systems like protected mode or real time OS cannot use this feature. A customer using these higher level OS's can only do direct programming through the LPT-port I/O-addresses.

3.4. Installation under DOS

a) Boot up your system having a DOS in the boot device.

b) Press the <DEL> key when you are asked to enter the BIOS setup.

c) Choose the PERIPHERAL SETUP.

d) Change PARALLEL PORT MODE to “EXTENDED” (the extended mode offers a bidirectional communication of the LPT-port, which is required to send data in both directions to and from the character LCD).

e) Leave the BIOS setup by saving the new configuration.

f) Now the system will come up to a DOS prompt.

g) You now require the special configuration utility, ALCDINIT.EXE. This file is available at www.jumptec.de.

h) Start the configuration utility ALCDINIT.EXE with the suitable parameters.

3.5. The configuration utility

The configuration utility “alcdinit.exe” is required to tell the BIOS extension about the mode and the type of the DOT-MATRIX display used.
The user can configure the matrix interface with “alcdinit.exe” utility program:

alcdinit <mode> <columns> <lin> <la1> <la2> <la3> <la4>

mode	**= ON**	the display interface will be prepared for direct mode
	= COPY	the display interface will be prepared for copy mode
lin		number of LCD lines (normally 2 or 4)
columns		number of LCD columns (normally 16, 20 or 40)
la?		starting address of LCD lines; refer to the datasheet for your display

Example 1: **ALCDINIT ON 20 4 00 40 14 54**

Configures a DOT-MATRIX that has 4 lines and 20 columns, the line start address is 00hex for line 1, 40hex for line 2, 14hex for line 3 and 54hex for line 4.

The line address for each display may be different, therefore this information should be looked up in the displays datasheet. However the common configuration for:
- ***2 line*** displays are 00hex 40hex 00hex 40hex
- ***4 line*** displays are 00hex 40hex 14 hex 54hex.

If this configuration does not work, contact the display supplier for details.

- **The COPY mode (copy to display)**

The COPY mode is a good mode for testing the general function of the DOT-MATRIX display. This mode directs all text mode outputs going to the standard CRT-monitor also to the DOT-MATRIX display. Of course the output is limited to the size of the character-LCD. On a display with 2 lines and 16 characters the same output will appear that can be seen on the CRT-monitor in the first two lines up to character number 16.

A DOT-MATRIX LCD has no video memory, therefore scrolling in the CRT output will not be supported. Please note that a DOS operating system sometimes does not use line 1 on the CRT-monitor therefore the first output line is number 2. If this is the case then line 1 from the DOS-side may not show any characters on the DOT-MATRIX display.

These functions are standard INT 10hex software interrupt calls. A programmer can easily integrate these functions in his application by presetting the input registers with desired values and after this generating a software interrupt 10hex. The tables on the pages below show all the information about input register settings and output register results.

Select Video Mode	Int 10h	
Input:	AH=00h	AL=Desired Mode
Output:	-	
Result on Screen:	The desired video mode is selected. If AL.7=0 the screen is being cleared.	
Result on Display:	If AL.7=0 the display is being cleared and cursor is set to home position. If AL.7=1 the cursor is set to home position.	

Set Cursor Type	Int 10h	
Input:	AH=01h	CH=Cursor Start Line CL=Cursor End Line
Output:	-	
Result on Screen:	Defines the start line and end line of the textmode cursor. CX=0607h selects standard cursor. CX=20xxh disables cursor.	
Result on Display:	CX=20xxh disables the cursor CX=40xxh enables blinking character cursor Any other value in CX enables underlined cursor.	

Set Cursor Position	Int 10h	
Input:	AH=02h BH=Video Page #	DH=Cursor Line DL=Cursor Column
Output:	-	
Result on Screen:	Positions the cursor on one of the available video pages. Valid lines are 0-24, valid columns are 0-79	
Result on Display:	Positions the cursor on the display if BH=0. Valid Lines are 0-3, valid columns are 0-19. If BH≠0 or line or column are invalid, the cursor position will not be changed.	

Write Character (& Attribute)	Int 10h		
Input:	AH=09h or AH=0Ah AL=ASCII Code	BH=Video Page # BL=Attribute or Color	CX=# of Repetitions
Output:	-		
Result on Screen:	Writes character(s) from AL to the screen. Cursor position is not changed.		
Result on Display:	Send character(s) if BH=0. CX is ignored. Cursor position is not changed.		

Write Character	Int 10h	
Input:	AH=0Eh AL=ASCII Code	BH=Video Page # BL=Color
Output:	-	
Result on Screen:	Writes character from AL to the screen. Cursor position is incremented. Beep, Backspace, LineFeed and CR are interpreted correctly.	
Result on Display:	Writes character from AL to the display. Cursor position is incremented. Beep, Backspace, LineFeed and CR are interpreted correctly.	

Set Mode Flags	Int 10h	
Input:	AH=8Bh	AL bit 0 = 0 = Int 10h LCD functions disabled AL bit 0 = 1 = Int 10h LCD functions enabled AL bit 1 = 0 = copy mode off AL bit 1 = 1 = copy mode on AL bit 2 = 0 = cursor auto increment on AL bit 2 = 1 = cursor auto increment off AL bit 3-7 = must be zero
	BX = must be zero CX = must be zero DX = must be zero	
Output:	-	
Description:	This function allows setting various mode flags of the alphanumeric LCD BIOS extension. Int 10h LCD functions enable/disable: When disabled all CopyToDisplay functions and DirectToDisplay functions except the SetModeFlags function are ignored. Copy mode on/off: Used to enable/disable the CopyToDisplay functions. Cursor auto increment on/off: This affects the DirectToDisplay functions WriteCharacter (8Eh) and WriteString (8Fh). When switched off the cursor will not be incremented after the last character displayed. This is useful to avoid scrolling when writing into the lower write corner of the display.	

- **The ON mode (direct to display)**

The ON mode is called “Direct to Display” and offers other functions implemented in the extension BIOS. Every command given by a “Direct to Display” function is immediately transferred to the LC character display and does not affect the screen of a graphic card in the system. These functions must have bit 7 set in register AH when called.

These functions listed on the following pages are suitable for programmers who want to directly access the character LCD with their special outputs. They are also based on the presetting of registers and simple BIOS INT10hex calls.

Clear Screen	Int 10h		
Input:	AH=80h	AL=0xxxxxxxb or 1xxxxxxxb	AL.7=0 ClearScreen AL.7=1 CursorHome
Output:	-		
Result on Display:	If AL.7=0 the display is being cleared and cursor is set to home position. If AL.7=1 the cursor is set to home position.		

Set Cursor Type	Int 10h	
Input:	AH=81h	CH=Cursor Mode
Output:	-	
Result on Display:	CH=00h enables underline Cursor CH=20h disables the cursor CH=40h enables blinking character cursor	

Set Cursor Position	Int 10h		
Input:	AH=82h	DH=Cursor Line DL=Cursor Column	
Output:	-		
Result on Display:	Positions the cursor on the display. Valid Lines are 0-3, valid columns are 0-19. If line or column is invalid, the cursor position will not be changed.		

Get Cursor Position	Int 10h		
Input:	AH=83h		
Output:	DH = Cursor Line	DL = Cursor Column	
Result on Display:	-		

Enable/Disable Display	Int 10h	
Input:	AH=84h	AL=0 Disable Display AL=1 Enable Display
Output:	-	
Result on Display:	Display is enabled or disabled. The display content is not affected by disabling the display. Display content may be altered while display is off. If ”copy to display” mode is selected in setup, display is enabled by default. Otherwise display is disabled by default.	

Define User Character	Int 10h	
Input:	AH=85h	ES:DI=Pointer to 8 Bytes of definition data AL=Character #
Output:	-	
Result:	Defines one of the 8 user programmable characters. AL is the number of the character to define (valid values are 0-7). ES:DI points to an array of 8 bytes that define the pixels of the new character. To display one of the characters use the function ”Write Character” with ASCI-values 0-7.	

Write Character	Int 10h	
Input:	AH=8Eh AL=ASCII Code	
Output:	-	
Result on Display:	Writes character from AL to the screen. Cursor position is incremented. Beep, Backspace, LineFeed and CR are interpreted correctly.	

Write String	Int 10h	
Input:	AH=8Fh	ES:DI = Pointer to null-terminated string
Output:	-	
Result on Display:	Writes characters from the null-terminated string pointed to by ES:DI to the display. Cursor position is incremented. Beep, Backspace, LineFeed and CR are interpreted correctly.	

Send Raw Character	Int 10h	(will be implemented with BIOS R114)
Input:	AH=90h	AL=Character to send
Output:	-	
Result on Display:	Sends the raw data from AL directly to the display. Cursor position is not changed. No control codes are interpreted.	

Send Raw Control	Int 10h	(will be implemented with BIOS R114)
Input:	AH=91h	AL=Control Code to send
Output:	-	
Result on Display:	Sends the raw data from AL directly to the display's control register. Cursor position is not changed. No codes are interpreted.	

4. Special solutions on JUMP*tec*® products

4.1. DIMM-PC Starter Kit

(For all DIMM-PC's listed in Table 1.)

The character LCD is interfaced through the signals of the parallel port. The LPT signals coming from the DIMM-PC bus are routed to two connectors on the starter kit, the standard DSUB26 connector for printer connection and the 32 pin header for DOT MATRIX displays. A customer cannot use a DOT matrix display and a printer at the same time.

The connector on the backplane (X10) where the DOT-MATRIX display is connected has the following pinout:

Table 3.: LCD connector pinout and signal explanation of DIMM-PC starter kit

Pinout X10	Name	Function on LCD
1,2	GND	Ground
3,4	VCC	+5V
5,6	VEE	LCD drive voltage (contrast adjusted through potentiometer 0 to +5V)
7,8	/AFD_A	RS register select on LCD 1 = data signal, 0 = instruction signal
9,10	/SLIN_A	R/W read/write from /to LCD 1 = read mode, 0 = write mode
11,12	/INIT_A	EN enable signal for data assumption
13,14	PD0_A	Data bit 0
15,16	PD1_A	Data bit 1
17,18	PD2_A	Data bit 2
19,20	PD3_A	Data bit 3
21,22	PD4_A	Data bit 4
23,24	PD5_A	Data bit 5
25,26	PD6_A	Data bit 6
27,28	PD7_A	Data bit 7
29,30	VCC (100Ω)	Backlight+ (VCC with 100Ω series resistor)
31,32	GND	Backlight-

4.2. MOPS/plus, MOPS/386A

An interface with 16 signals is offered for connecting LCD-DOT-Matrix to the MOPS/plus and MOPS/386A
The LCD-DOT-Matrix Interface is using the signals of the onboard parallel port. In most cases this will cause problems when the parallel port is used with any device parallel to the LCD. A customer cannot use a DOT Matrix display and a printer at the same time.

Table 4: LCD connector pinout and signal explanation of matrix display connector

Pinout 16-pin LCD con.	Signal name	Function for LCD
1	GND	Ground
2	VCC	Supply voltage for logic
3	VEE	LCD drive voltage (contrast adjusted through potentiometer 0 to +5V)
4	RS	RS register select on LCD 1 = data signal, 0 = instruction signal
5	R/W	R/W read/write from /to LCD 1 = read mode, 0 = write mode
6	Enable	chip enable signal for data assumption
7	DB0	Data bit 0
8	DB1	Data bit 1
9	DB2	Data bit 2
10	DB3	Data bit 3
11	DB4	Data bit 4
12	DB5	Data bit 5
13	DB6	Data bit 6
14	DB7	Data bit 7
15	Backlight +	Backlight anode (VCC with 100Ω series resistor)
16	Backlight -	Backlight cathode