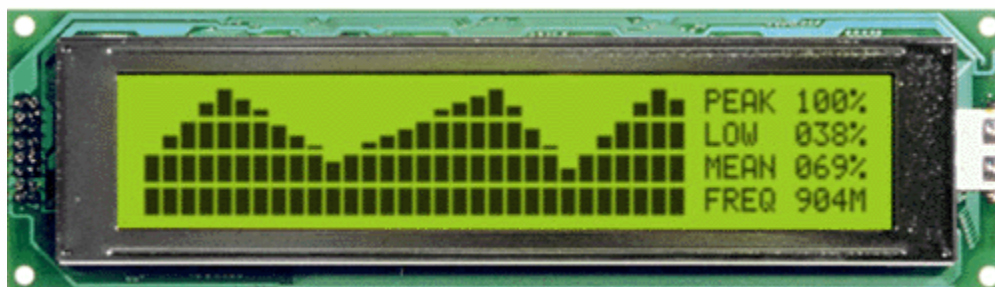


Matrix Orbital Corporation



LCD4041

User Manual



IMPORTANT: READ PAGE 2 BEFORE APPLYING POWER.

Connecting LCD4041

The LCD4041 serial interface has two types of communications: RS-232 and I2C.

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +5Vdc
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

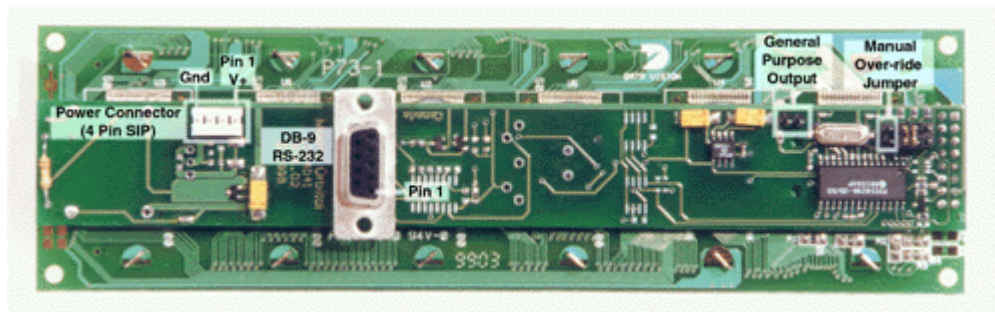
If the sole data source is via RS - 232, the data input is via the DB-9 connector. Pins 2 and 3 of the four pin SIP connector are not used.

Wide Voltage Option (LCD4041-VPT)

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +7 - 15Vdc
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

If the sole data source is via RS - 232, the data input is via the DB-9 connector. Pins 2 and 3 of the four pin SIP connector are not used.



WARNING:

DO NOT APPLY ANY POWER WITH REVERSED POLARIZATION.

DO NOT APPLY ANY VOLTAGE OTHER THAN THE SPECIFIED VOLTAGE.

DO NOT USE ANY CABLES OTHER THAN THE CABLES SUPPLIED BY MATRIX ORBITAL, UNLESS YOU ARE AWARE OF THE MODIFICATIONS REQUIRED.

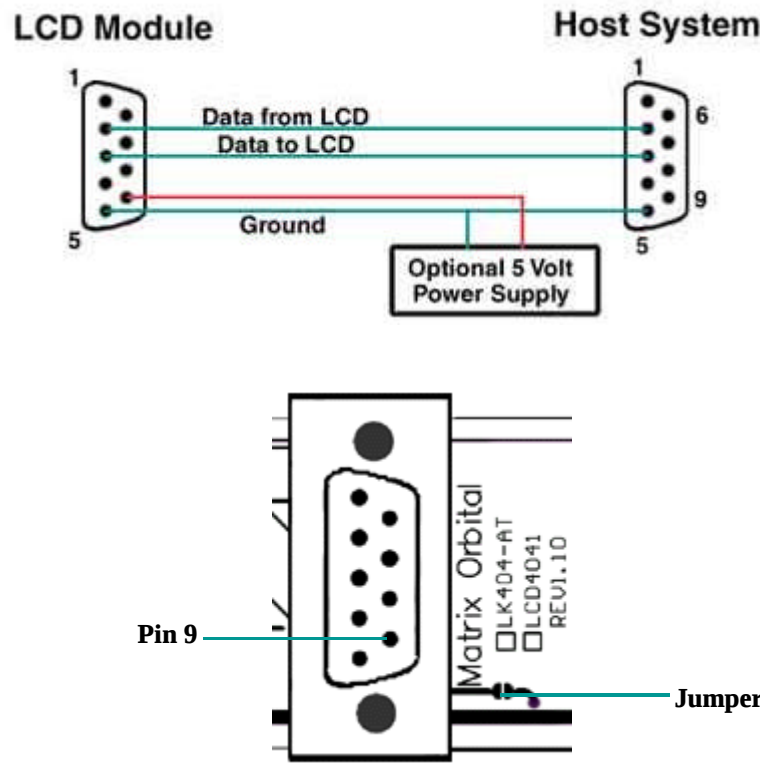
DO NOT UNDER ANY CIRCUMSTANCES USE AN UNMODIFIED FLOPPY DRIVE POWER CABLE.

DB-9 Connector Pin Out

RS - 232 port: This connector is wired so that a standard “straight through” 9 pin D-sub cable may be used to connect the modules on a standard serial port such as comm ports on PCs. Note that this device complies to the EIA232 standard in that it uses signal levels from +/- 3V to +/- 12V. It will not operate correctly at TTL (0 to +5V) levels.

Pin Number	Description
2	Data Out
3	Data In
5	Ground
9	+5Vdc

Note: Signals are shown as interpreted by the Liquid Crystal Display module.



Power may be provided to the module by pin 9 of the DB-9 connector instead of through the 4-pin SIP. If power is to be applied using the DB-9, it must be a regulated +5Vdc supply. If the user intends to use pin 9 as the power source, the user must solder the 5 volt jumper point beside the DB-9 connector. If you have any further questions or concerns don't hesitate to contact Matrix Orbital at support@matrix-orbital.com.

WARNING: USE THIS METHOD OF POWER UP AT YOUR OWN RISK. APPLICATION OF A VOLTAGE TO PIN 9 GREATER THAN 5.5VOLTS WILL CAUSE IMMEDIATE DESTRUCTION OF UNIT AND VOID THE WARRANTY.

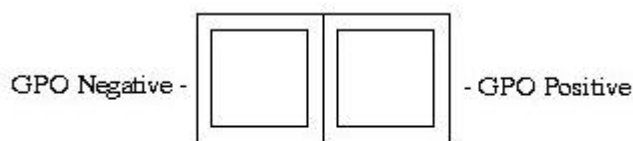
Note: This applies to wide voltage units (V and VPT extensions) as well as standard 5 volt units.

General Purpose Output (GPO)

The GPO is meant to be used as a pair. The positive side of the GPO is connected to a power source of +5Vdc supplied by the module at 20mA. The negative side of the GPO is able to find a path to ground through a 240 ohm resistor. This resistor will limit the current flow through a GPO to approximately 20mA in the event of a short circuit.

If the device which is being driven by a GPO requires a relatively high current (such as a relay) and has an internal resistance of it's own greater than 250 ohms, then, the 240 ohm resistor may be shorted. You will find this resistor directly below the negative pin of the general purpose output.

Note: This operation requires soldering. The GPO does not have any over current or over/under voltage protection so care must be taken if the user decides to connect the negative side differently. For instance if the external device is a relay it must be fully clamped to absorb any generated back electromotive force (EMF)



Command Set

Write Text

This section of the manual allows the user to send commands to the LCD to alter the appearance or behavior of the display. To utilize a command, the user must send a command prefix followed by the command in the format described in this portion of the manual. Any characters sent without a command prefix will be interpreted as text and will be displayed on the module at the current cursor position. The current cursor position will be incremented for each character received. Please note that unless line wrap is turned on, the text will follow the memory map of the module.

The command set discusses in detail what the LCD's capabilities of and how to execute each command. The basic format of all the commands

listed in this segment that do not require parameters is:

<command prefix> <command>

For commands that do require parameters however the format is as follows:

<command prefix> <command> [<parameter> <parameter>]

Set I²C Address

ASCII '3', Hex 33, Decimal 51

Syntax 0xFE 0x33

To write the I²C address of the module, send a command prefix followed by the character '3', followed by a write address. This command sets the I²C write address of the module. This value must be an even number and the read address is one higher. For example if the I²C write address is set to 0x50, then the read address is 0x51. The change in address is immediate. This address is 0x50 by default, and is reset temporarily back to that value when the "Manual Over-ride" jumper is used on power up. Refer to the Appendix for more details.

Set Serial Number

ASCII '4', Hex 34, Decimal 52

Syntax 0xFE 0x34 <serial number byte one> <serial number byte two>

To set the serial number of the module, send a command prefix followed by the character '4', followed by two values defining the first and second serial byte. This command sets the two byte serial number of the module. Upon the execution of this command, the module will echo these two bytes back over the RS-232 interface. The serial number may be set only once. Any future attempt to execute this command will result in no change and the module will return to the originally set serial number.

Read Serial Number

ASCII '5', Hex 35, Decimal 53

Syntax 0xFE 0x35

To read the serial number, send a command prefix followed by the character '5'. This command will return, over the RS-232 interface, the serial number of the module as it was previously stored.

Read Version Number

ASCII '6', Hex 36, Decimal 54

Syntax 0xFE 0x36

To read the version number send a command prefix followed by the character '6'. This command will return, over the RS-232 interface, the firmware revision number of the module as it is stored.

Read Module Type Value

ASCII '7', Hex 37, Decimal 55

Syntax 0xFE 0x37

To read the module type value, send a command prefix followed by the character '7'. This command will return, over the RS-232 interface, the model type value of the module. Values for various modules at the time of this publication are as follows:

LCD0821 – 0x01	LCD2021 – 0x03	LCD1641 – 0x04
LCD2041 – 0x05	LCD4021 – 0x06	LCD4041 – 0x07
LK202-25 – 0x08	LK204-25 – 0x09	LK404-55 – 0x0A
VFD2021 – 0x0B	VFD2041 – 0x0C	VFD4021 – 0x0D
VK202-25 – 0x0E	VK204-25 – 0x0F	GLC12232 – 0x10
GLC12864 – 0x11	GLC128128 – 0x12	GLC24064 – 0x13
GLK12864-25 – 0x14	GLK24064-25 – 0x15	GLK128128-25 – 0x21
GLK12232-25 – 0x22	LK404-AT – 0x31	VFD1621 – 0x32
LK402-12 – 0x33	LK162-12 – 0x34	LK204-25PC - 0x35

Set RS - 232 Port Speed

ASCII '9', Hex 39, Decimal 57

Syntax 0xFE 0x39 <speed>

To set the RS-232 port speed, send a command prefix followed by the character '9', followed by a value defining the desired <speed>. This command sets the LCD's RS-232 port to the specified <speed>. The change takes place immediately. <speed> is a single byte specifying the desired port <speed> Valid speeds are shown in the table below. The LCD can be manually reset to 19,200 baud in the event of an error during transmission (including transmitting a value not listed below). Refer to the appendix for details.

Hex Value	Speed
FF Hex	1200 baud
81 Hex	2400 baud
20 Hex	9600 baud
0F Hex	19200 baud

Load New Start Up Screen

ASCII '@', Hex 40, Decimal 64

Syntax 0xFE 0x40 <160 characters>

This command allows you to load a new start up screen. To execute this you must send a command prefix followed by the character '@', followed by 160 characters to format the screen to your specifications. The characters on the module should be formatted as shown in the diagram.

Character 1	-----	Character 40
Character 41	-----	Character 80
Character 81	-----	Character 120
Character 121	-----	Character 160

Set Contrast

ASCII 'P', Hex 50, Decimal 80

Syntax 0xFE 0x39 <contrast>

To set the contrast of the display, send a command prefix followed by the character 'P', followed by a hex value defining the contrast. This command sets the display's contrast to <contrast>, where <contrast> is a value between 0x00 and 0xFF (between 0 and 255). Lower values cause “on” elements in the display area to appear lighter, while higher values cause “on” elements to appear darker. Lighting conditions will affect the actual value used for optimal viewing. Individual LCD modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the LCD backlight is on may differ from values used when backlight is off.

Set Contrast and Save Value

Hex 91, Decimal 145

Syntax 0xFE 0x91

This command works in exactly the same way as the “Set Contrast” command. The only difference is it saves the contrast value in the memory of the module, whereas, the previous command only changes the value for the duration of use.

Auto Line Wrap On

ASCII 'C', Hex 43, Decimal 67

Syntax 0xFE 0x43

This command enables the automatic line wrap function. Transmitted characters which overrun the width of the display will automatically wrap to the next line. The bottom line wraps to line 1 of the display. To carry out this command the user must send a command prefix followed the character 'C'.

Auto Line Wrap Off

ASCII 'D', Hex 44, Decimal 68

Syntax 0xFE 0x44

This command disables the automatic line wrapping function. To turn off the auto line wrapping, send a command prefix followed by the character 'D'.

Auto Scroll On

ASCII 'Q', Hex 51, Decimal 81

Syntax 0xFE 0x51

To turn the automatic line scrolling on, send a command prefix followed by the character 'Q'. In combination with the “Auto Line Wrap” command the text will automatically wrap and scroll up.

Note: “Auto Line Wrap” must be enabled for “Auto Scroll” to work properly.

Auto Scroll Off

ASCII 'R', Hex 52, Decimal 82

Syntax 0xFE 0x82

To turn the automatic line scrolling off, send a command prefix followed by the character 'R'.

Backlight On

ASCII 'B', Hex 42, Decimal 66

Syntax 0xFE 0x42 <number of minutes>

To turn the backlight on, send a command prefix followed by the character 'B' as well as the number of minutes for the backlight to be activated. If <minutes> is sent as zero then the backlight will remain on indefinitely. The maximum value for <minutes> is 100. Example:

<command prefix>	0xFE
<command>	0x42
<minutes>	0 to 100

Backlight Off

ASCII 'F', Hex 46, Decimal 70

Syntax 0xFE 0x46

To turn the backlight off, send a command prefix followed by the character 'F'.

Clear Display

ASCII 'X', Hex 58, Decimal 88

Syntax 0xFE 0x58

This command clears any text and graphics off the display. To clear the display, send a command prefix followed the character 'X'.

Cursor On

ASCII 'J', Hex 4A, Decimal 74

Syntax 0xFE 0x4A

To turn the cursor on at the current position, send a command prefix followed by the character 'J'. Note cursor is on by default at power up.

Cursor Off

ASCII 'K', Hex 4B, Decimal 75

Syntax 0xFE 0x4B

To turn the cursor off at the current position , send a command prefix followed by the character 'K'.

Cursor Left

ASCII 'L', Hex 4C, Decimal 76

Syntax 0xFE 0x4C

To move the cursor one space to the left of current position, send a command prefix followed by the character 'L'.

Cursor Right

ASCII 'M', Hex 4D, Decimal 77

Syntax 0xFE 0x4D

To move the cursor one space to the right of the current position, send a command prefix followed by the character 'M'.

Cursor Blink On

ASCII 'S', Hex 53, Decimal 83

Syntax 0xFE 0x53

To turn on the blinking cursor at the current position, send a command prefix followed by the character 'S'. Please note that the blinking cursor is on by default at power up.

Cursor Blink Off

ASCII 'T', Hex 54, Decimal 84

Syntax 0xFE 0x54

To turn off the blinking cursor at the current position send a command prefix followed by the character 'T'.

Create Custom Character

ASCII 'N', Hex 4E, Decimal 78

Syntax 0xFE 0x4E <character between 0x00 and 0x07> <8 bytes>

This command creates a custom character. For the LCD4041 the user can have up to eight custom characters. To execute this command, send a command prefix followed by the character 'N'. The display will now await the number which identifies the custom character. This number must be between 0x00 and 0x07. When the module determines what character it's working on, then the user must send 8 bytes. This defines the display character. See the diagram below for an explanation of the display character structure.

Diagram A

MSB								LSB
*	*	*	1	2	3	4	5	Data Byte 1
*	*	*	6	7	8	9	10	Data Byte 2
*	*	*	11	12	13	14	15	Data Byte 3
*	*	*	16	17	18	19	20	Data Byte 4
*	*	*	21	22	23	24	25	Data Byte 5
*	*	*	26	27	28	29	30	Data Byte 6
*	*	*	31	32	33	34	35	Data Byte 7
*	*	*	36	37	38	39	40	Data Byte 8

Pixel Layout of Display Characters

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
Cursor Line				

General Purpose Output On

ASCII 'W', Hex 57, Decimal 87

Syntax 0xFE 0x57

To turn the general output purpose on, send a command prefix followed by the character 'V'.

Note: The output is a current sink (Max 20mA)

General Purpose Output Off

ASCII 'V', Hex 56, Decimal 86

Syntax 0xFE 0x56

To turn the general output purpose off, send a command prefix followed by the character 'W'.

Go To Position

ASCII 'G', Hex 47, Decimal 71

Syntax 0xFE 0x47 <column number> <row number>

Set the current position. Send a command prefix followed by the character 'G' and two numbers defining in order, the column to move to and the row to move to. The format for column 20 and row 3 would be:

<command prefix>	0xFE
<command>	0x47
<column number>	0x14
<row number>	0x03

Go To Top Left

ASCII 'H', Hex 48, Decimal 72

Syntax 0xFE 0x48

To reset the current position to top left, send a command prefix followed by the character 'H'. In the following example the format is displayed for this command.

Initialize Large Digits

ASCII 'n', Hex 6E, Decimal 110

Syntax 0xFE 0x6E

Before any large digits may be created, this command must be executed. It only needs to be sent once to initialize the custom characters for large digits. Due to the fact large digits use pre-determined custom characters, no user custom characters may be displayed or created while digits are in use.

Place Large Digit

ASCII '#', Hex 23, Decimal 35

Syntax 0xFE 0x35 <column number> <digit number>

This command allows the creation of large digits on the LCD screen. To execute this command the user must send a command prefix followed by the character '#' and the column number where the digit is to be placed. Then the user must enter the number of the large digit which is required in hexadecimal. Numbers of almost full display height may be placed along side regular text on four row displays. The column number has a maximum value which is less than the display width because the digits are all three columns wide. The module must be initialized for large digit creation before large digits may be placed. If regular text and large digits are mixed on one screen, the user should always set the display cursor position before placing regular text because the creation of a large digit will leave the cursor position to the bottom right of the large digit and not at the last regular text write position. The format for this command is as follows:

<command prefix>	0xFE
<command>	0x23
<column number>	0x01 to 0x26 (1 to 38 for a 40 column display)
<digit number>	0x00 to 0x09 (numbers 0 to 9)

Initialize Horizontal Bar Graph

ASCII 'h', Hex 68, Decimal 104

Syntax 0xFE 0x68

Before any horizontal bar graphs may be created, this command must be executed. It only needs to be sent once to initialize the custom characters for bar graph creation. Due to the fact bar graphs use custom characters, no user custom characters may be displayed or created while bar graphs are in use.

Make Horizontal Bar Graph

ASCII '|', Hex 7C, Decimal 124

Syntax 0xFE 0x7C <column number> <row number> <direction> <bar length>

This command places a horizontal bar graph at the specified column and row with the specified width. The format of the command is as follows:

<command prefix>	0xFE
<command>	0x7C
<column number>	0x01 to 0x28 for a forty column display
<row number>	0x01 to 0x04 for a four line display
<direction>	0 for left to right, 1 for right to left
<bar length>	0x00 to 0xC8 (0 to 200) for a forty column display

Bar length is in pixel widths. On a forty column display the maximum bar graph width is two hundred pixels (if the bar graph starts at the edge). This is due to the fact that each of the forty columns on the display are five pixels wide. The width of the space between columns is not taken into account.

Initialize Thick Vertical Bar Graph

ASCII 'v', Hex 76, Decimal 118

Syntax 0xFE 0x76

Before any thick vertical bar graphs may be created, this command must be executed. It only needs to be sent once to initialize the custom characters required for bar graph creation. Due to the fact bar graphs use custom characters, no user custom characters may be displayed or created while bar graphs are in use.

Initialize Thin Bar Vertical Graph

ASCII 's', Hex 73, Decimal 115

Syntax 0xFE 0x73

Before any thin vertical bar graphs may be created, this command must be executed. It only needs to be sent once to initialize the custom characters required for bar graph creation. Due to the fact bar graphs use custom characters, no user custom characters may be displayed or created while bar graphs are in use.

Make Vertical Bar Graph

ASCII '=', Hex 3D, Decimal 61

Syntax 0xFE 0x3D <column number> <bar length>

This command places a bar graph at the specified column with the specified height. The style of the vertical bar graph whether it be thick or thin is selected by the initialize vertical bar graph command. If thick bar graphs are preferred, the 'v' command should be sent to initialize the bar graph. If a thin vertical bar graph is desired, the 's' command should be sent to initialize the bar graph. The format for the command is as follows:

< command prefix >	0xFE
< command >	0x3D
< column number >	0x01 to 0x28 for a forty column display
< bar length >	0x00 to 0x20 (1 to 32) for a four line display.

Bar height is in pixel widths. On a four line display the maximum bar graph height is thirty-two, this is because each of the lines in the display are eight pixels high. The width of the space between the lines is not taken into account.

Note: Vertical bar graphs may not be used with horizontal bar graphs, and thick bar graphs may not be used with thin bar graphs. This is because all these functions make use of the same “custom character” spaces. As a result, custom characters are also unavailable while any of these functions are in use.

LCD Character Font Chart

					D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1			
					D6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1		
					D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1		
					D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1		
D3	D2	D1	D0			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		
0	0	0	0	0					0	a	P	`	P				—	9	E	0	P		
0	0	0	1	1					!	1	A	a	a				.	7	7	4	a	a	
0	0	1	0	2					"	2	B	R	b	r				Г	И	У	Х	В	В
0	0	1	1	3					#	3	C	S	c	s				Ј	О	Т	Е	Е	∞
0	1	0	0	4					\$	4	D	T	d	t				、	И	Т	†	М	Ω
0	1	0	1	5					%	5	E	U	e	u				*	オ	ナ	1	c	0
0	1	1	0	6					&	6	F	V	f	v				ヲ	カ	ニ	ヨ	P	Σ
0	1	1	1	7					'	7	G	W	g	w				フ	†	ヌ	ヲ	9	π
1	0	0	0	8					(	8	H	X	h	x				4	カ	ホ	リ	フ	又
1	0	0	1	9					)	9	I	Y	i	y				÷	ツ	リ	ル	°	ウ
1	0	1	0	A					*	:	J	Z	j	z				エ	コ	ハ	レ	J	フ
1	0	1	1	B					+	;	K	[	k	[				オ	ウ	ヒ	ロ	°	ア
1	1	0	0	C					.	<	L	¥	l	l				カ	シ	フ	ワ	カ	ア
1	1	0	1	D					—	=	M	I	m	>				ユ	ズ	ハ	シ	ト	÷
1	1	1	0	E					.	>	N	^	n	÷				ヨ	セ	ホ	°	ア	
1	1	1	1	F					/	?	0	_	o	+				ウ	リ	マ	°	0	■

Specification Sheets

Environmental Specifications

	Standard Temp.	Extended Temp.
Operating Temperature	0° to +50° C	-20° to +70° C
Storage Temperature	-20° to +70° C	-40° to +85° C
Operating Relative Humidity	90% max non-condensing	

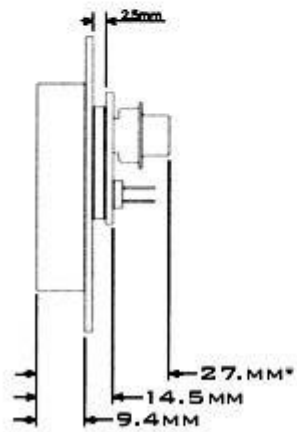
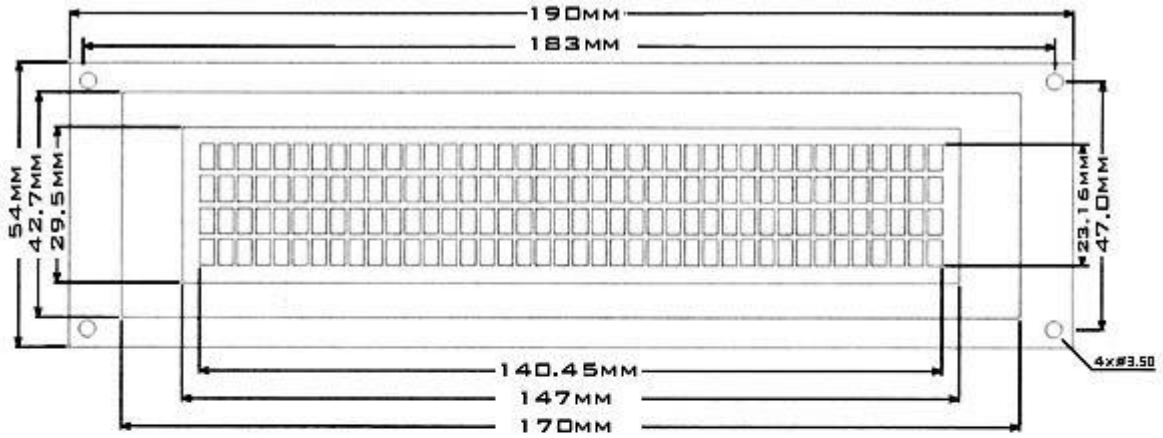
Electrical Specification

Supply Voltage	4.75 - 5.25 Vdc (optional 7 - 15Vdc)
Supply Current	25mA typical
Backlight Supply Current	150mA typical

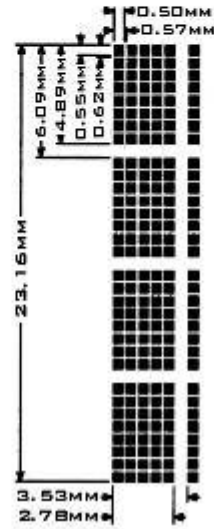
Optical Specifications

Number of characters	160 (40 Characters x 4 Lines)
Matrix format	5 x 7 with underline
Display area	140.45 x 23.16mm (XxY)
Character size	2.78 x 4.89mm (XxY), not including underline
Character pitch	3.53mm
Line pitch	6.09mm
Dot size	0.50 x 0.55mm (XxY)
Dot pitch	0.57 x 0.62mm (XxY)
LED Backlight life	100,000 hours typical
Color of illumination	Yellow green

LCD4041



* Max depth 20.6mm
without connectors



Appendix

Hexadecimal

Hex numbers are specified in C language convention as 0xUL - where U is the upper nibble and L is the lower nibble. Eg: 0xFE is 1111 1110 in binary. This is equivalent to ULH or ULh as in the binary number

1111	1110
upper	lower
nibble	nibble

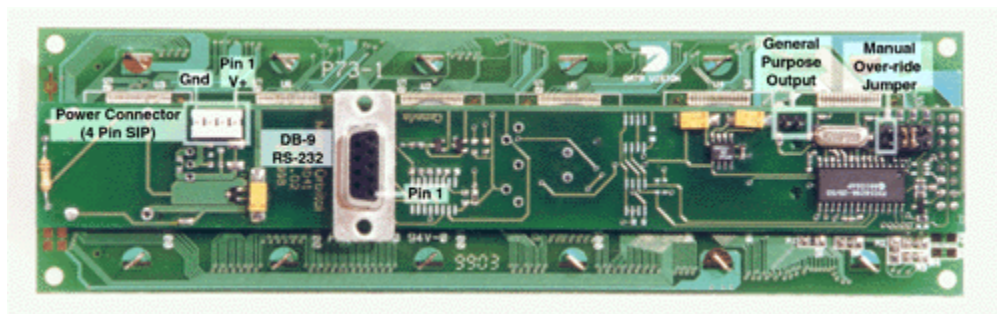
.....which would be FEH or FEh

Manual Over-ride

Manual override should only be required in one instance. If for some reason the module is set at a baud rate which cannot be produced by the host system and all communication to the display is lost, then the user should follow this simple procedure:

- 1) Turn off the display
- 2) Place a jumper on the two pin strip header indicated on the diagram as the Manual Over-ride Jumper.
- 3) Power up the display.
- 4) Remove the jumper and change the RS-232 port settings to a baud rate recognized by the host system using the "Set RS-232 Port Speed" command.
- 5) Turn off the display.
- 6) Power up the display.

Refer to the "Set RS-232 Port Speed" command for acceptable baud rates.



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Toll Free Facsimile: 1 800 237 6948
Email: sales@jameco.com
WWW: <http://www.jameco.com/>

Note: Currently only carries LCD2041, LK204-25

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