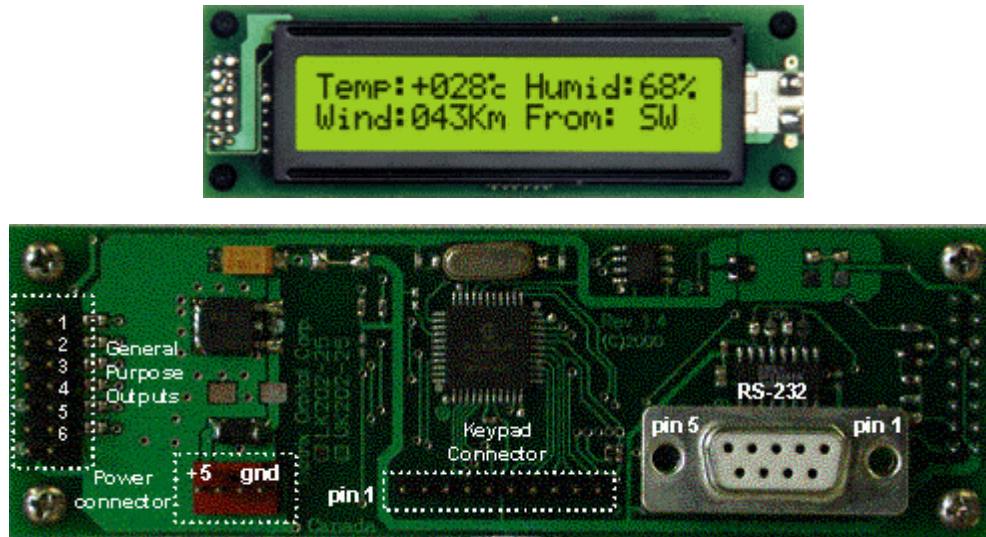


Spec Sheet

for the

Matrix Orbital LK202-25 Graphical LCD

Section 1: General Description and How Used

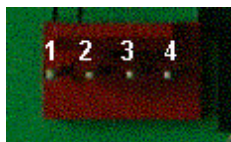


Features of this device:

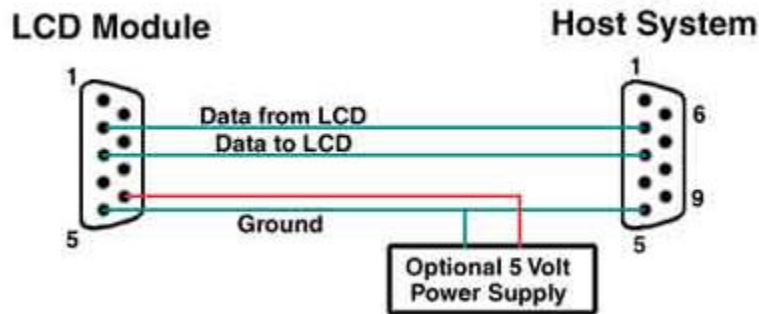
- Displaying sensor readings.
- Giving the current system status.
- Displaying bar graphs.
- Controlling 6 general purpose outputs.

This device is not a stand alone sensor. It allows the user to send feedback directly to the 40 character 2 line display using I²C or RS232 communication. RS232 interface requires a 4 pin connector to supply the power, a +5V power supply, and a spare RS232 port. The I2c interface uses the 4 pin connector in the following configuration:

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



An easy test of the LCD uses a PC serial port to send the LCD commands over an RS232 interface using a hyperterminal. The serial cable configuration is shown below:



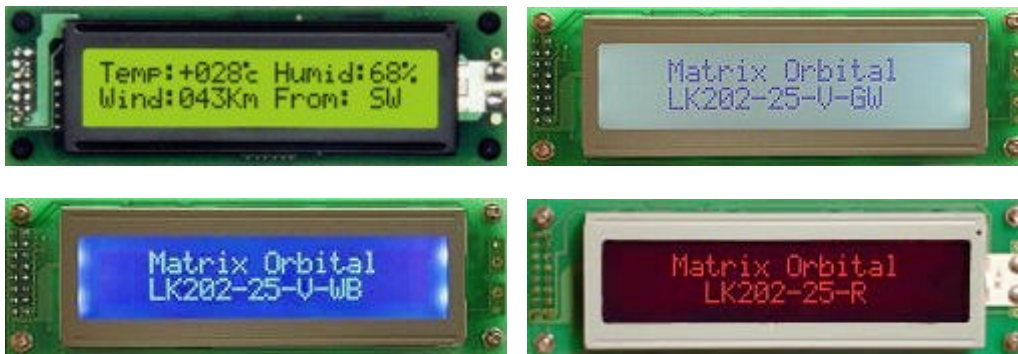
Section 2: Specifications (Taken from Matrix Orbital website)

Environmental Specifications	
	Standard Temperature
Operating Temperature	0°C to +50°C
Storage Temperature	-20°C to +70°C
Operating Relative Humidity	20 to 80% non condensing
Vibration (non-operating)	10 to 55 to 10 Hz (Frequency)
	1.0 mm (Total Amplitudes)
	30 minutes (Duration)
	X, Y, Z each direction
Shock (Non-operation)	593 m/S ² , 10 mS

Electrical Specifications	
Supply Voltage	4.75 - 5.25 Vdc (optional 8 - 15 VDC)
Supply Current	9 mA typical
Supply Backlight Current	115 mA typical

Optical Characteristics	
Number of Characters	40 (20 characters by 2 lines)
Matrix format	5 x 7 with underline
Display Area	82.2 x 18.20 mm XxY
Character Size	2.4 x 4.7 mm (XxY), not including underline
Character Pitch	3.55 mm
Line pitch	5.35 mm
Dot Size	0.55 x 0.55 mm (XxY)
Dot Pitch	0.6 x 0.6 mm (XxY)
LED Backlight Life	100,000 hours typical
Color of Illumination	Yellow Green

Section 3: Sources and Pricing



Variety of display colors available.

Matrix Orbital (www.matrixorbital.com)

Standard Green Display

Price: \$63.00 each

Part Number: LK202-25

Section 4: Interfacing and Code

Matrix Orbital LK202-25 General Command Structure

The general form of a command being received on either the I²C or RS232 interface is of the following form:

0xFE <command code> <parameters>

All commands are prefixed with the Hex value of 0xFE, then the code for the desired command is sent followed by any parameters needed for that particular command. The following are tables of the commands available:

Text Commands

Command	Syntax	Default	Notes
Auto line wrap on	FE 43 254 67 254 'C'	On R	Enables line wrapping (not word wrap).
Auto line wrap off	FE 44 254 68 254 'D'	On R	Disables line wrapping.
Auto scroll on	FE 51 254 81 254 'Q'	Off R	Enables scroll at bottom of screen. Text will push display up one line to make room for new line.
Auto scroll off	FE 52 254 82 254 'R'	Off R	Disables auto scroll. Text will wrap to top left and overwrite existing text.
Set cursor position	FE 47 [col] [row] 254 71 [col] [row] 254 'G' [col] [row]	N/A	Moves cursor to the specified column and row. The cursor marks the text insertion point in this and all commands.
Send cursor home	FE 48 254 72 254 'H'		This command moves the cursor to the top left of the display area.
Underline cursor on	FE 4A 254 74 254 'J'	Off R	Turns on the underline cursor.
Underline cursor off	FE 4B 254 75 254 'K'	R	Turns off the underline cursor.
Block cursor on	FE 53 254 83 254 'S'	On	Turns on the blinking block cursor.
Block cursor off	FE 54 254 84 254 'T'		Turns off the blinking block cursor.
Cursor left	FE 4C 254 76 254 'L'		Moves the cursor one position to the left. If the cursor is already at the beginning of a line it will move to the end of the other line.
Cursor right	FE 4D 254 77		Moves the cursor one position to the right. If the cursor is already at the end of a line it will move to the beginning of the other line.

	254 'M'		
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Keypad Interface Commands

Command	Syntax	Default	Notes
Auto repeat mode on	FE 7E [0x00 0x01] 254 126 [0 1] 254 '~' [0 1]	Off R	Applies to keypad only. 0x00 = 200 ms typematic, 0x01 = key down/key up codes sent.
Auto repeat mode off	FE 60 254 96 254 ''	Off R	Applies to keypad only.
Auto transmit key presses on	FE 41 254 65 254 'A'	On R	Sets auto transmit mode for keypad. Key presses are transmitted to host without polling.
Auto transmit key presses off	FE 4F 254 79 254 'O'	Off R	Up to 10 key presses buffered until polled.
Clear key buffer	FE 45 254 69 254 'E'	N/A	Clear unread key presses.
Poll keypad	FE 26 254 38 254 '&'	N/A	Returns buffered key presses to application. Returns 0x00 if no key presses. High order bit set unless this is the last/only key press.
Set debounce time	FE 55 [time] 254 85 [time] 2 54 'U' [time]	52ms R	Resolution: 1 = 0.6554 ms [time] is a numeric multiplier.

Bar Graph and Special Character Commands

Command	Syntax	Notes
Initialize thick vertical bar graph	FE 76 254 118 254 'v'	Initializes the user character set to make wide vertical bar graphs.
Initialize thin vertical bar graph	FE 73 254 115 254 's'	Initializes the user character set to make narrow vertical bar graphs.
Initialize horizontal bar graph	FE 68 254 104 254 'h'	Initializes the user character set to make horizontal bar graphs.
Define custom character	FE 4E [c][8 bytes] 254 78 [c][8 bytes] 254 'N' [c][8 bytes]	Defines one of 8 custom "user" characters. Character number is [c] between 0x00 and 0x07. The 8 bytes are described in section 5.1.6.
Draw vertical bar graph	FE 3D [col][length] 254 61 [col][length] 254 '=' [col][length]	Draws a vertical bar graph at column [col] of length [length]. Length is measured in pixels (0x00 to 0x14). User must first use the 'v' or 's' command to initialize characters.

Draw horizontal bar graph	FE 7C [c][r][d][length] 254 124 [c][r][d][length] 254 'l' [c][r][d][length]	Draws a horizontal bar graph starting at column [c] on row [r] with direction [d] (0 is right, 1 is left) of length [length]. Length is measured in pixels (0x00 to 0x64 if starting in column 1). User must first use the 'h' command to initialize characters.
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Miscellaneous Commands

Command	Syntax	Default	Notes
Remember	FE 93 [0 1] 254 147	Off	Turn the "remember" function on [1] or off [0].
Clear display	FE 58 254 88 254 'X'	N/A	Clears screen of text and graphics, places text cursor at top left.
Set contrast	FE 50 [contrast] 254 80 [contrast] 254 'P' [contrast]	0x80 128	Sets display contrast. Compensates for viewing angle. Contrast is a value between 0 and 255 (hex 0 to FF). Larger = darker.
Set contrast and save	FE 91 [contrast] 254 145 [contrast]	0x80 128	Same as "set contrast" but saves [contrast] as default.
Backlight on	FE 42 [minutes] 254 66 [minutes] 254 'B' [minutes]	On R	Backlight will stay on for [minutes]. If [minutes] = 0 backlight will stay on permanently. Maximum value for [minutes] is 100.
Backlight off	FE 46 254 70 254 'F'	On R	Turns backlight off.
Load startup screen	FE 40 [40 char] 254 64 [40 char] 254 '@' [40 char]	Matrix Orbital LK202-25	Loads new startup screen (40 characters). Screen is saved for subsequent power ups.
General purpose output off	FE 56 [gpo #] 254 86 [gpo #] 254 'V' [gpo #]	Off	Turns a general purpose output OFF. [gpo #] may be from 1 to 6. See section 2.2 for further details.
General purpose output on	FE 57 [gpo #] 254 87 [gpo #] 254 'W' [gpo #]	Off	Turns a general purpose output ON. [gpo #] may be from 1 to 6. See section 2.2 for further details.
Set I2C address	FE 33 [address] 254 51 [address] 254 '3' [address]	0x50	Value is write address and must be even, read address is 1 higher.

Read module type	FE 37 254 55 254 '7'	see table	Reads the module type. See table in section 6.1.10.
Set RS232 port speed	FE 39 [speed] 254 57 [speed] 254 '9' [speed]	19,200 baud	Sets RS232 speed. See table in section 6.1.11 for values of [speed]
Set Serial Number	FE 34 [byte1][byte2] 254 52 [byte1][byte2] 254 '4' [byte1][byte2]		This is a one-time-use command which works only on units without factory set serial numbers.
Read Serial Number	FE 35 254 53 254 '5'		Reads the two byte serial number of the module.
Read Version Number	FE 36 254 54 254 '6'		Reads the firmware version number of the module.
Enter flow control mode	FE 3A [full] [empty] 254 58 [full] [empty] 254 ':' [full] [empty]	Off	Sets "full" and "empty" marks for the 80 byte display buffer. When buffer reaches [full] display will return 0xFE to host. When buffer reaches [empty] display will return 0xFF.
Exit flow control mode	FE 3B 254 59 254 ';'		Turns off flow control.

Matrix Orbital LK2020-25 Interface to a C6711 DSP

In this example, the Matrix Orbital LK202-25 is interfaced to the C6711 DSP made by Texas Instruments. The LCD is powered and connected using serial communication on the DB-9 pin connector. The DSP is set up to communicate with the LCD over a serial port using the standard UART functions. To make controlling the LCD easier, two shell functions are provided, LCDPrintfLine1 and LCDPrintfLine2. These functions simplify the user interface to the LCD through the DSP but also limit the functionality. Each function is designed to take in a character string and output that string on either the first or second line of the LCD depending on the function called. These functions do not allow for many of the other functions of the LCD such as the creation of special characters or the use of bar graphs. The code for the print functions is shown below:

```
// Function: void LCDPrintfLine1(char *format, ...)
// Parameters:
// Return value: None
// Description:
void LCDPrintfLine1(char *format, ...) {
    va_list ap;
    char sendmsg[25];
    char buffer[120];
    int i;

    /* Initialize the variable argument list pointer
    to the first uninitialized argument */
}
```

```

    va_start(ap, format);

    SmallvSprintf(buffer,format,ap);

    sendmsg[0] = 0xFE;
    sendmsg[1] = 'G';
    sendmsg[2] = 1;
    sendmsg[3] = 1;
    for (i=4;i<25;i++) {
        if (i >= strlen(buffer)+4) {
            sendmsg[i] = ' ';
        } else {
            sendmsg[i] = buffer[i-4];
        }
    }
    SendStr2_UART1(sendmsg,25);
}

// Function: void LCDPrintfLine2(char *format, ...)
// Parameters:
// Return value: None
// Description:
void LCDPrintfLine2(char *format, ...) {

    va_list ap;
    char sendmsg[25];
    char buffer[120];
    int i;

    /* Initialize the variable argument list pointer
    to the first uninitialized argument */
    va_start(ap, format);

    SmallvSprintf(buffer,format,ap);

    sendmsg[0] = 0xFE;
    sendmsg[1] = 'G';
    sendmsg[2] = 1;
    sendmsg[3] = 2;
    for (i=4;i<25;i++) {
        if (i >= strlen(buffer)+4) {
            sendmsg[i] = ' ';
        } else {
            sendmsg[i] = buffer[i-4];
        }
    }
    SendStr2_UART1(sendmsg,25);
}

```

From the code above, it is clear that the message is being sent and the cursor position is being taken care of by the LCDPrintfLine1 and LCDPrintfLine2 functions. The message string is being prepended with the 0xFE, then the character “G” which is the command to move the cursor. Then the row and column positions where the cursor should be placed are sent. Thus the string sent out tells the LCD a command is being sent, the command is a cursor move command, and the position of the cursor is either the 1st row 1st column or 2nd row 1st column, and the message to be displayed.

Section 5: Information

Online Manual: <http://www.matrixorbital.com/manuals/lk20225/>