MATRIX ORBITAL

MOU-AL202
Technical Manual

Revision: 1.0

Contents

1 Getting Started

Figure 1: MOU-AL202

The MOU-AL202 is an intelligent LCD display designed to decrease development time by providing an instant solution to any project. With the ability to communicate via USB protocol, the versatile MOU-AL202 can be easliy interfaced to any PC or USB host. The ease of use is further enhanced by an intuitive command structure to allow display settings such as backlight brightness, and contrast to be software controlled. General purpose outputs allow the controller to switch up to three electronic or electro-mechanical devices by issuing commands to the display unit. These can be used for controlling LEDs, relays, etc.. Additionally, up to thirty-two custom characters such as character sets for bar graphs, and medium numbers may be stored in the non-volatile memory to be easily recalled and displayed at any time.

1.1 Display Options Available

The MOU-AL202 comes in a wide variety of colors, to allow you to select the display which will best fit your project needs. These options can be found on our e-commerce website at http://www.matrixorbital.com. To contact a sales associate for more information on any of these options, see Section 11.5 for contact information.

1.2 Accessories

NOTE Matrix Orbital provides all the interface accessories needed to get your display up and running. You will find these accessories and others on our e-commerce website at http://www.matrixorbital.com. To contact a sales associate see Section 11.5 on page 37 for contact information.

Figure 2: 3ft mini-B USB

1.3 Features

- 20 column by 2 line alphanumeric liquid crystal display
- USB communication protocol
- Three, 5V -20mA, general purpose outputs for a variety of applications
- Lightning fast communication, default 19.2 kbps serial communication speed
- Built in font with provision for up to 8 user defined characters
- Five custom character memory banks, which enable storage of up to forty custom characters
- Fully buffered so that no delays in transmission are ever necessary
- Ability to add a customized splash / startup screen
- Horizontal or vertical bar graphs
- Medium digit capability
- Software controlled contrast and brightness with configurable time-out setting up to 90 minutes

1.4 Connecting to a PC

The MOU-AL202 connects seamlessly to a PC and it is an excellent means of testing the functionality. To connect your display to a PC, you will require a USB cable such as the one pictured in figure 2.

1. In order to connect your USB display to a personal computer simply plug the mini-B USB cable from the PC to the USB connector on the display.
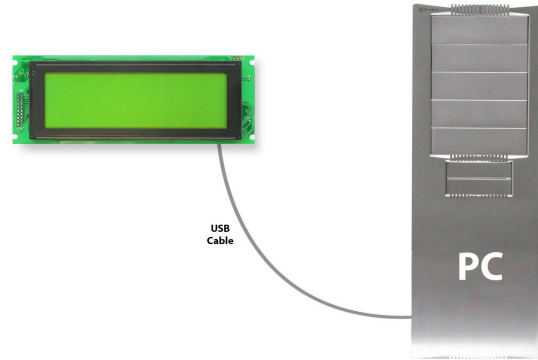
NOTE The MOU-AL202 unit can also be powered via a standard PC power cable, shown in figure 3.
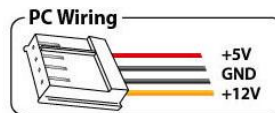
Figure 3: Alternate Display Power Cable

1.5 Installing the Software

1.5.1 Drivers

In order to communicate with any Matrix Orbital USB display, the proper drivers for the unit must first be correctly installed on the controlling PC or device. To preform this operation, follow the steps listed below:

1. Go to the website location: http://www.matrixorbital.ca/drivers/
2. Download or copy the appropriate USB drivers into a directory.
3. Uncompress the files. They will be a self extracting ZIP file.
4. Connect the USB cable to the display and the computer.
5. Windows will give a prompt for drivers for a USB , Serial Device.
6. Select 'Specify location', and navigate to the directory the file was uncompressed to.
7. Test the display using a software tool such as uProject.

1.5.2 uProject

uProject was designed by Matrix Orbital to provide a simple and easy to use interface that will allow you to test all of the features of our alpha numeric displays.

To install uProject from the Matrix Orbital website, follow the following steps:

1. Go to the website location: http://www.matrixorbital.ca/software/software_alpha/uproject/
2. Click on "Download Here"
3. Locate the file uProject.exe on your desktop
4. Double click on "uProject.exe"

Be sure to check the information selected in the COM Setup the first time uProject is run. Although the display is connected via a USB Cable, it will create its own, virtual, Comport which will be displayed in the uProject environment. Once this information is entered correctly the program can be used to control all functions of the graphic display.

| Comport | The serial port the display is plugged in to. |
| Baudrate | The communication speed the display module is set to. (Default 19,200) |

Figure 4: uProject Settings

NOTES

- uProject and other alphanumeric software may also be downloaded from Matrix Orbital's support site at http://www.matrixorbital.ca/software/software_alpha/

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2   Hardware Information

Refer to the following diagram for this chapter:

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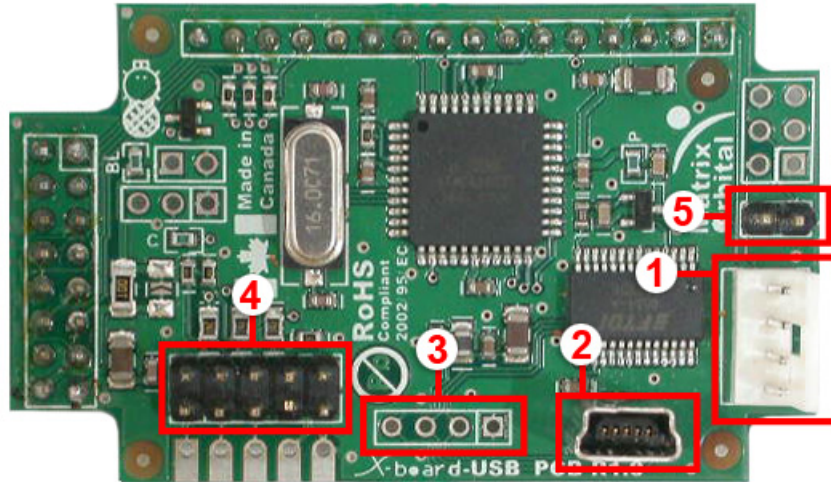
1 Alternate Power Connector	3 Alternate USB Header (Optional)
2 USB Header	4 GPOs

Figure 5: MOU-AL202

2.1   Alternate Power Connector

The MOU-AL202 provides a Power Connector to allow the device to be powered externally. This connector can be coupled to the standard 4-wire power connector available in most PC power supplies. In order to power the device externally, you must first remove a single USB power select jumper. The jumper to remove is the USB jumper labeled "p" as seen in figure 7.

Pin **1**	NC
Pin **2**	GND
Pin **3**	GND
Pin **4**	+5V
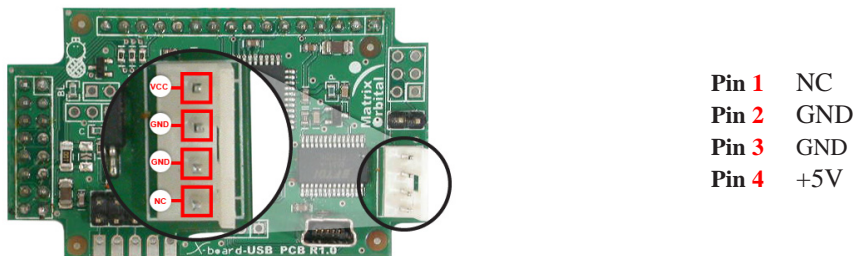
Figure 6: Alternate Power Connector
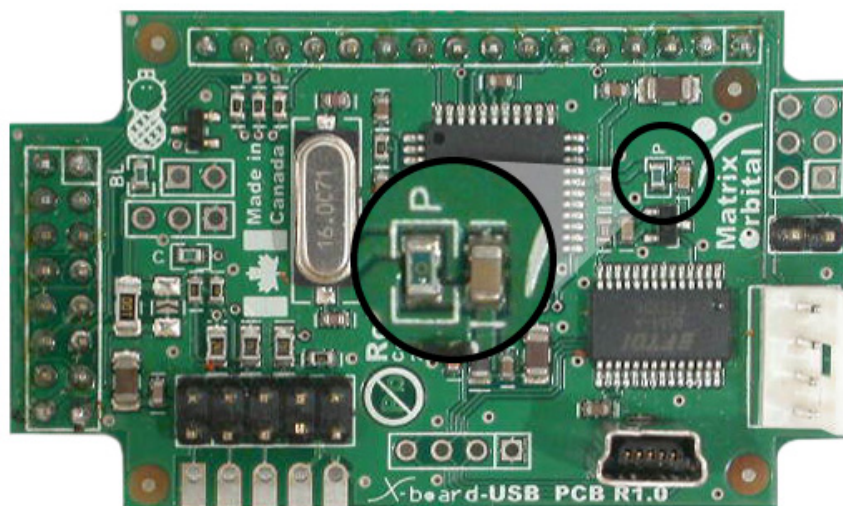
Figure 7: Power Select Jumper

2.2 USB Header

The USB header provides USB connector for communication and power of the display. An alternate power option for the display can be seen in figure 6.
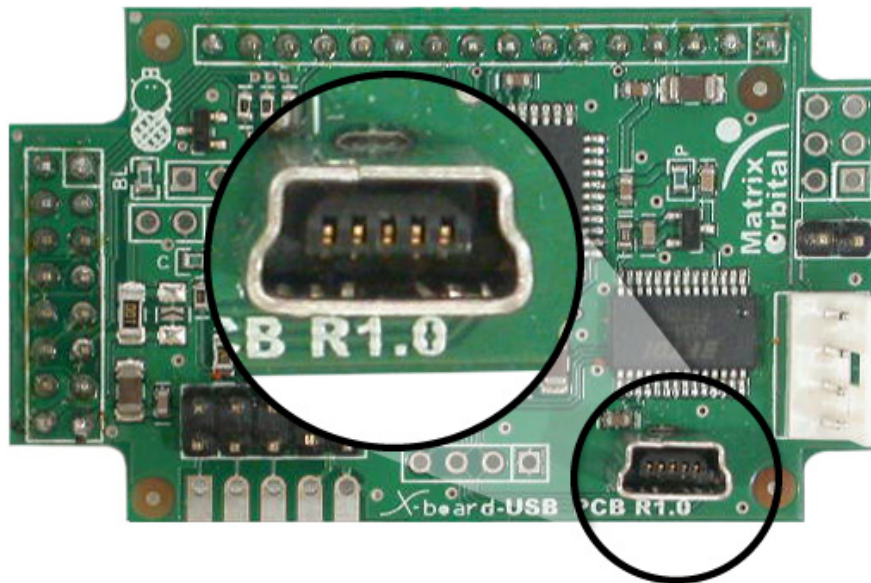
Figure 8: USB Header

Table 1: Power Requirements

	Standard
Supply Voltage	+5Vdc ±0.25V
Supply Current	44mA (Backlight Off)
Backlight Current	113mA (Backlight On)

WARNINGS

- Do not apply any power with reversed polarization.
- Do not apply any voltage other than the specified voltage.

2.3 Alternate USB Header

The MOU-AL202 also offers an alternative, USB header option to permit USB communication with the device through a standard onboard header. Please note the the display normally does not come with the

Alternate USB header, it will have to be ordered as a custom. Please talk to your sales representative if you would like this option.
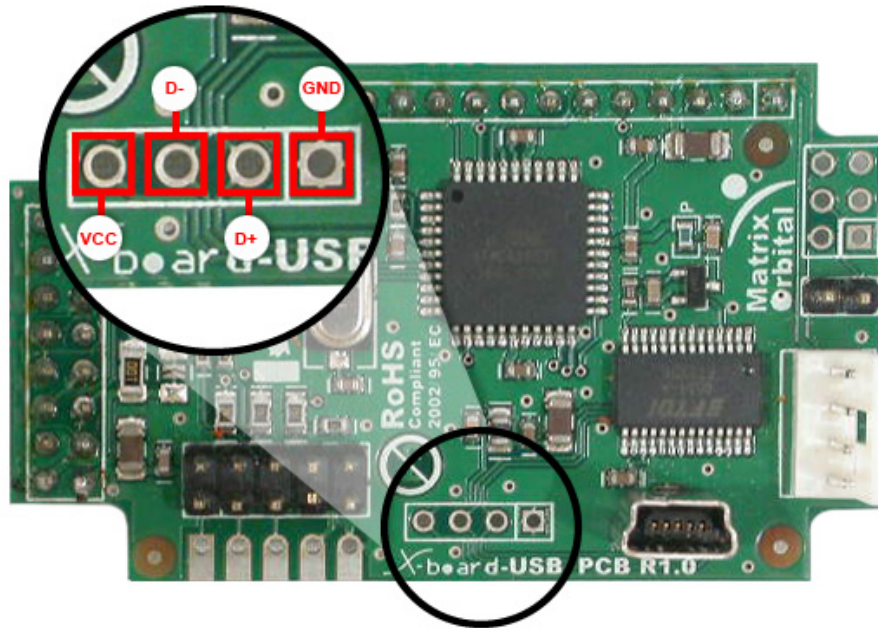
Figure 9: Alternate USB Header

NOTE   This component is optional and must be custom ordered

2.4   General Purpose Outputs

A unique feature of the MOU-AL202 is the ability to control relays and other external devices using a General Purpose Output, which can provide up to 20 mA of current and +5Vdc from the positive side of the GPO. This is limited by a 240 ohm resistor which is located to the above right of the GPOs as pictured below in figure 10. 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 its own greater than 250 ohms, then the 240 ohm resistor may be removed and replaced with a Jumper.
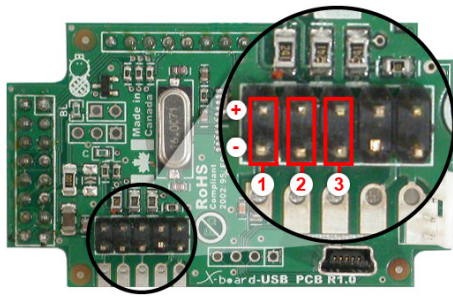
+	+5VDC at 20 mA
-	Ground (0VDC)

Figure 10: General Purpose Output

⚠️ **WARNING**   If connecting a relay, be sure that it is fully clamped using a diode and capacitor in order to absorb any electro-motive force (EMF) which will be generated.

3   Troubleshooting

3.1   The display does not turn on when power is applied.

- First, check the USB cable which you are using for continuity. If you don't have an ohm meter, try using a different USB cable, if this does not help try using a different power supply.

- Second, ensure that the correct drivers are properly installed. For the latest drivers, visit the Matrix Orbital website at http://www.matrixorbital.ca/drivers/. If you require additional support to resolve this matter, please contact Matrix Orbital using one of the mehods described in section 11.5.

- The last step will be to check the USB Cable on the MOU-AL202. If the USB Cable has become loose, or you are unable to resolve the issue, please contact Matrix Orbital, see section 11.5 for contact information.

3.2   The display module is not communicating.

- Ensure that the host system and display module are both communicating on the same baud rate. The default baud rate for the display module is 19200 bps.

3.3 The display module is communicating, however text cannot be displayed.

- A common cause may be that the brightness or contrast settings have been set to low. The solution to this problem is to change the settings. A good tool to do this with is uProject. See 1.5.2 for more information.

4 Text

4.1 Introduction

The MOU-AL202 is an intelligent display module, designed to reduce the amount of code necessary to begin displaying data. This means that it is able to display all characters and strings that are sent to it, which are defined in the current character set. The display module will begin displaying text at the top left corner of the display area, known as home, and continue to print to the display as if it was a page on a typewriter. When the text reaches the bottom right row, it is able to automatically scroll all of the lines up and continue to display text, with the auto scroll option set to on.

4.1.1 Character Set

Figure 11: Character Set

4.1.2 Control Characters

In addition to a full text set, the MOU-AL202 display supports the following ASCII Control characters:

0x08 Backspace

0x0C Clear screen / New page

0x0D Carriage return

0x0A Line feed / New line

4.2 Auto Scroll On

Syntax	Hexadecimal	0xFE 0x51
	Decimal	254 81
	ASCII	254 "Q"
Description	When auto scrolling is on, it causes the display to shift the entire display's contents up to make room for a new line of text when the text reaches the end of the last row.	
Remembered	Yes	
Default	On	

4.3   Auto Scroll Off

Syntax	Hexadecimal	0xFE 0x52
	Decimal	254 82
	ASCII	254 "R"
Description	When auto scrolling is disabled the text will wrap to the top left corner of the display area when the text reaches the end of last row.	
Remembered	Yes	

4.4   Clear Screen

Syntax	Hexadecimal	0xFE 0x58
	Decimal	254 88
	ASCII	254 "X"
Description	This command will immediately clear all of the contents of the display.	
Remembered	No	

4.5   Changing the Startup Screen

Syntax	Hexadecimal	0xFE 0x40
	Decimal	254 64
	ASCII	254 "@"
Description	In order to change the text that is displayed by the MOU-AL202 when it starts up simply send the command bytes 254 64 followed by the characters that you wish to display, starting from the top left. This command will automatically line wrap the characters that are sent to it.	
Remembered	Yes	

4.6 Set Auto Line Wrap On

Syntax	Hexadecimal	0xFE 0x43
	Decimal	254 67
	ASCII	254 "C"
Description	Enabling Auto Line Wrap will allow the cursor to automatically wrap over to the next line when the current line is full.	

NOTE	Line wraps may occur in the middle of a word.

Remembered	Yes

4.7 Set Auto Line Wrap Off

Syntax	Hexadecimal	0xFE 0x44
	Decimal	254 68
	ASCII	254 "D"
Description	Disabling Auto Line Wrap will allow you to have full control over the cursor position. This means that once the cursor has advanced to the end of a line, it will not wrap over to the next line, unless given the 'Set Cursor Position' Command.	

NOTE	All characters written to the display past the end of a line will be lost.

Remembered	Yes

4.8 Set Cursor Position

Syntax	Hexadecimal	0xFE 0x47 [col] [row]
	Decimal	254 71 [col] [row]
	ASCII	254 "G" [col] [row]

Parameters	Parameter	Length	Description
	col	1	Column
	row	1	Row

Description	This command will allow you to manually set the cursor position, which controls the text insertion point, by specifying the [col] and [row] of the new proposed cursor position.

NOTE   If the cursor position is set past the end of a line it will wrap to the beginning of the next line.

Remembered	No

4.9   Go Home

Syntax	Hexadecimal	0xFE 0x48
	Decimal	254 72
	ASCII	254 "H"
Description	This command will return the cursor to the top left corner of the display area, identified as row one, column one.	

Remembered	No

4.10   Move Cursor Back

Syntax	Hexadecimal	0xFE 0x4C
	Decimal	254 76
	ASCII	254 "L"
Description	This command will move the cursor back one space. If this command is sent when the cursor is at the home position the cursor will wrap to the last row / column position if line wrap is on. Sending this command will not effect the text displayed on the module, however any characters that are sent will over write the current characters that are being displayed.	

Remembered	No

4.11   Move Cursor Forward

Syntax	Hexadecimal	0xFE 0x4D
	Decimal	254 77
	ASCII	254 "M"

Description	This command will move the cursor forward one space. If this command is sent when the cursor is at the bottom right position the cursor will wrap back to the home position if line wrap is on. Sending this command will not effect the text displayed on the module, however any characters that are sent will over write the current characters that are being displayed.

Remembered   No

4.12   Underline Cursor On

Syntax	Hexadecimal	0xFE 0x4A
	Decimal	254 74
	ASCII	254 "J"
Description	This command will cause the MOU-AL202 to display an underline cursor at the current text insertion point.	

Remembered   Yes

4.13   Underline Cursor Off

Syntax	Hexadecimal	0xFE 0x4B
	Decimal	254 75
	ASCII	254 "K"
Description	This command will turn the the underline cursor off.	

Remembered   Yes

4.14   Blinking Block Cursor On

Syntax	Hexadecimal	0xFE 0x53
	Decimal	254 83
	ASCII	254 "S"
Description	This command will cause the MOU-AL202 to display a block cursor at the current text insertion point.	

Remembered   Yes

4.15   Blinking Block Cursor Off

Syntax	Hexadecimal	0xFE 0x54
	Decimal	254 84
	ASCII	254 "T"
Description	This command will turn the block cursor off.	
Remembered	Yes	

5 Special Characters

5.1 Introduction

The MOU-AL202 has the ability to create four different sets of eight custom characters and save them to internal banks of memory. Each set of eight can be recalled from memory at any time, and selected characters can be written to the display screen. Characters and sets can be created at any time, saved for later use, and displayed to the screen through the intuitive command structure described below.

5.2 Creating a Custom Character

Syntax	Hexadecimal	0xFE 0x4E [refID] [data]	
	Decimal	254 78 [refID] [data]	
	ASCII	254 "N" [refID] [data]	
Parameters	Parameter	Length	Description
	refID	1	Character reference ID (0-7).
	data	8	Character data.

Description   The MOU-AL202 allows for upta to eight custom defined characters to
                  be added onto the the character set. A custom character is a five by eight
                  pixel matrix with each row represented by a byte value. For example:

Custom Character 'h'					Decimal	Hex
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	**1**	**1**	*0*	22	0x16
1	**1**	*0*	*0*	**1**	25	0x19
1	*0*	*0*	*0*	**1**	17	0x11
1	*0*	*0*	*0*	**1**	17	0x11

Each bit value of one, in the table, represents an on pixel, whereas a value
of zero represents a pixel that is turned off. Therefore in order to define
custom character 'h' you would send the command byte prefix 254 fol-
lowed by the command 78. Next, you will have to select the memory
location in which you wish to save the character in. The available mem-
ory locations for this command are zero through to seven. After sending
the memory location, or [refID], you may then send the eight byte custom
character data in sequence from the top to the bottom.
Once you have defined a custom character you may display it by sending
the display module the [refID]. For example if a custom character was
saved in position one, the command to display the custom character, at
the current cursor position, would be simply to send the number one to
the display module without quotes.

Remembered   No

5.3   Saving Custom Characters

Syntax   Hexadecimal   0xFE 0xC1 [Bank] [ID] [Data]
                  Decimal   254 193 [Bank] [ID] [Data]

Parameters | Parameter | Length | Description |
                  |---|---|---|
                  | Bank | 1 | Memory bank to save to (0-4). |
                  | ID | 1 | Character ID (0-7) |
                  | Data | 8 | Character Definition |

Description	New to the MOU-AL202 has added five non-volatile memory banks for custom character storage. This is intended to allow you to create your own custom bar graphs, medium/large numbers and startup screen. However, each memory bank may be used to store a set of any eight custom characters; with the only provision being that memory bank zero contains the characters that will be used in the startup screen. By default the memory banks will be loaded as follows:

[Bank]	Description
0	Startup screen characters.
1	Horizontal bars
2	Vertical bars
3	Medium numbers

In order to save new custom characters into a memory bank, follow the same process as you would for creating a custom character, see Section 5.2 on page 16, only use 254 193 [Bank Number] before sending the [ID] and character [Data].

Remembered	Yes

5.4 Loading Custom Characters

Syntax	Hexadecimal	0xFE 0xC0 [Bank]
	Decimal	254 192 [Bank]

Parameters	Parameter	Length	Description
	Bank	1	Memory bank to save to (0-4).

Description	This command is used to load the custom characters into the volatile memory so that they may be used. If custom bar graph or number characters are stored in the memory banks, this command may be used instead of initializing the bar graph / number. To use this command send the command bytes followed by the [Bank] that contains the custom character data that you want to retrieve.

Remembered	No

5.5 Save Startup Screen Custom Characters

Syntax	Hexadecimal	0xFE 0xC2 [refID] [data]
	Decimal	254 194 [refID] [data]

Parameters	Parameter	Length	Description
	refID	1	Character reference ID (0-7).
	data	8	Character data.

Description
Using this command you may create the custom characters. that will be stored in memory bank zero, which will be used in the startup screen. For more information about creating custom characters see *Section 5.2 on page 16*.

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NOTES

- Changes only take place once the power has been cycled.
- This command is the same as sending CMD 254 / 193 / 0 / [ID] / [DATA]

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Remembered   Yes

5.6 Initialize Medium Number

Syntax	Hexadecimal	0xFE 0x6D
	Decimal	254 109
	ASCII	254 "m"

Description
This command will load the default medium number characters into the volatile memory. If you have stored your own custom medium numbers, use the 'Load Custom Characters' command to load your custom character data into the volatile memory. This command will allow you to use the 'Place Medium Numbers' command.

Remembered   No

5.7 Place Medium Numbers

Syntax	Hexadecimal	0xFE 0x6F [Row] [Col] [Digit]
	Decimal	254 111 [Row] [Col] [Digit]
	ASCII	254 "o" [Row] [Col] [Digit]

Parameters	Parameter	Length	Description
	Row	1	The row number.
	Col	1	The column number.
	Digit	1	Medium number to place (0-9).

Description
This command will place a medium number (two columns high) at the [row] and [col] specified.

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NOTE   Medium Numbers must be initialized before this command is executed.

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Remembered   No

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5.8 Initialize Horizontal Bar

Syntax	Hexadecimal	0xFE 0x68
	Decimal	254 104
	ASCII	254 "h"
Description	This command will load the default horizontal bar characters into the volatile memory. If you have stored your own custom horizontal bar data, use the 'Load Custom Characters' command instead to load your custom bar data into the volatile memory. This command will allow you to use the 'Place Horizontal Bar' command.	

Remembered	No

5.9 Place Horizontal Bar Graph

Syntax	Hexadecimal	0xFE 0x7C [Col] [Row] [Dir] [Length]	
	Decimal	254 124 [Col] [Row] [Dir] [Length]	
	ASCII	254 "|" [Col] [Row] [Dir] [Length]	
Parameters	Parameter	Length	Description
	Col	1	The column number.
	Row	1	The row number.
	Dir	1	The direction of the bar data (0 or 1).
	Length	1	The length of the bar data.
Description	This command will place a bar graph at [row], [column]. A [Dir] value of zero will cause the bar to go right, and one will cause the bar to go left. The [Length] is the size in pixels of the bar graph.		

NOTES

- Horizontal Bars must be initialized before this command is executed.
- Bar graphs may be one directional only.

Remembered	No

5.10 Initialize Narrow Vertical Bar

Syntax	Hexadecimal	0xFE 0x73
	Decimal	254 115
	ASCII	254 "s"

Description		This command will load the narrow vertical bar characters into the volatile memory. If you have stored your own custom vertical bar data, use the 'Load Custom Characters' command instead to load your custom bar data into the volatile memory. This command will allow you to use the 'Place Vertical Bar' command.

NOTE Narrow bars have a width of two pixels.

Remembered	No

5.11 Initialize Wide Vertical Bar

Syntax	Hexadecimal	0xFE 0x76
	Decimal	254 118
	ASCII	254 "v"
Description		This command will load the wide vertical bar characters into the volatile memory. If you have stored your own custom vertical bar data, use the 'Load Custom Characters' command instead to load your custom bar data into the volatile memory. This command will allow you to use the 'Place Vertical Bar' command.

NOTE Wide bars have a width of five pixels.

Remembered	No

5.12 Place Vertical Bar

Syntax	Hexadecimal	0xFE 0x3D [Column] [Length]
	Decimal	254 61 [Column] [Length]
	ASCII	254 "=" [Column] [Length]

	Parameter	Length	Description
Parameters	Column	1	The column number.
	Length	1	The length of the bar data.

Description	This command will place a bar graph at the specified [Column] with the specified [Length]. The [Length] is the size in pixels of the bar graph.

NOTES

- A Vertical Bar style must be initialized before this command is executed.
- Bar graphs may be one directional only.

Remembered	No

6 General Purpose Output

6.1 Introduction

General purpose outputs allow you to connect devices, such as LEDs, to the MOU-AL202 and supply them with up to 20mA of current at 5V. The MOU-AL202 has 3 GPOs which are software controlled, with functions to turn them on/off and set the power state for the next startup.

6.2 General Purpose Output Off

Syntax	Hexadecimal	0xFE 0x56 [Num]	
	Decimal	254 86 [Num]	
	ASCII	254 "V" [Num]	
Parameters	Parameter	Length	Description
	Num	1	GPO number.
Description	This command turns OFF general purpose output [num].		

NOTE   OFF means that the output is pulled HIGH.

Remembered	Yes

6.3 General Purpose Output On

Syntax	Hexadecimal	0xFE 0x57 [Num]	
	Decimal	254 87 [Num]	
	ASCII	254 "W" [Num]	
Parameters	Parameter	Length	Description
	Num	1	GPO number.

Description	This command turns ON general purpose output [num]. The standard GPO's on the MOU-AL202 output 20mA of current at 5V.

NOTE	ON means the output is pulled LOW.

Remembered	Yes

6.4 Set Startup GPO state

Syntax	Hexadecimal	0xFE 0xC3 [Num] [state]	
	Decimal	254 195 [Num] [state]	
Parameters	Parameter	Length	Description
	Num	1	GPO number.
	state	1	Startup state (0: Off, 1: On)
Description	This command will set the startup state for the GPO on the next power up. A value of one will cause the GPO to be off on the next startup while a value of one will cause the GPO to be on.		

NOTE	This command does not affect the current state of the GPO.

Remembered	Always

7 Display Functions

7.1 Introduction

The MOU-AL202 employs software controlled display settings, which allow for control over, clearing the screen, changing the brightness and contrast or setting timers for turning it on or off. The combination of these allow you complete software control over your display's appearance.

7.2 Display On

Syntax	Hexadecimal	0xFE 0x42 [min]	
	Decimal	254 66 [min]	
	ASCII	254 "B" [min]	
Parameters	Parameter	Length	Description
	min	1	Minutes before turning the display on (0 to 90).

Description	This command turns the backlight on after the [minutes] timer has expired, with a ninety minute maximum timer. A time of 0 specifies that the backlight should turn on immediately and stay on. When this command is sent while the remember function is on, the timer will reset and begin after power up.

Remembered	Yes
Default	0

7.3 Display Off

Syntax	Hexadecimal	0xFE 0x46
	Decimal	254 70
	ASCII	254 "F"
Description	This command turns the backlight off immediately. The backlight will remain off until a 'Display On' command has been received.	

Remembered	Yes

7.4 Set Brightness

Syntax	Hexadecimal	0xFE 0x99 [brightness]	
	Decimal	254 153 [brightness]	
Parameters	Parameter	Length	Description
	brightness	1	Display brightness setting (0 to 255).
Description	This command sets the display [brightness]. If the remember function is on, this command acts the same as 'Set and Save Brightness'.		

Remembered	Yes
Default	255

7.5 Set and Save Brightness

Syntax	Hexadecimal	0xFE 0x98 [brightness]	
	Decimal	254 152 [brightness]	
Parameters	Parameter	Length	Description
	brightness	1	Backlight setting (0 to 255).
Description	This command sets and saves the display [brightness] as default.		

Remembered	Always

7.6   Set Contrast

Syntax	Hexadecimal	0xFE 0x50 [contrast]
	Decimal	254 80 [contrast]
	ASCII	254 "P" [contrast]

Parameters	Parameter	Length	Description
	contrast	1	Contrast value (0 to 255).

Description	This command sets the display's contrast to [contrast], where [contrast] is a value between 0x00 and 0xFF (between 0 to 255). Lower values cause 'on' elements in the display area to appear lighter, while higher values cause 'on' elements to appear darker. Lighting and temperature conditions will affect the actual value used for optimal viewing. Individual display modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the display backlight is on may differ from values used when backlight is off. This command does not save the [contrast] value, and is lost after power down; but this command has the option of remembering the settings when issued with the Remember function 'on' . When this is the case, this command is the same as the Set and Save Contrast command.

Remembered	Yes
Default	128

7.7   Set and Save Contrast

Syntax	Hexadecimal	0xFE 0x91 [contrast]
	Decimal	254 145 [contrast]

Parameters	Parameter	Length	Description
	contrast	1	Contrast value (0 to 255).

Description	This command sets the display's contrast to [contrast], where [contrast] is a value between 0x00 and 0xFF (between 0 to 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 display modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the display backlight is on may differ from values used when backlight is off.

NOTE   This command saves the [contrast] value so that it is not lost after power down.

Remembered	Yes
Default	128

8 Data Security

8.1 Introduction

Ensuring that your MOU-AL202 display's exactly what you want it to can be the difference between a projects success and failure. This is why we incorporate features such as Data Lock into the MOU-AL202 With this new feature you now are in control over of how and when settings will be changed so there is no need to worry about the module acting exactly like you expected it to because all the settings may be locked and remembered for the next power up.

8.2 Set Remember

Syntax	Hexadecimal	0xFE 0x93 [switch]	
	Decimal	254 147 [switch]	
Parameters	Parameter	Length	Description
	switch	1	0: Do not remember, 1: Remember
Description	This command allows you to switch the remember function on and off. To use the remember function, set remember to on, then set all of the settings that you wish to save, settings that are listed as 'Remember: Yes' support being saved into the non-volatile memory. After you have set all of the commands that you wish to save, you may then cycle the power and check the display settings to ensure that all the settings have been saved. If you wish to use remember again after cycling the power, you must set it to on again.		

NOTES

- Writing to non-volatile memory is time consuming and slows down the operation of the display.
- Non-volatile memory has a 'write limit' and may only be changed approximately 100,000 times.

Remembered	No
Default	Do not remember

8.3   Data Lock

Syntax
Hexadecimal	0xFE 0xCA 0xF5 0xA0 [level]
Decimal	254 202 245 160 [level]

Parameters

Parameter	Length	Description
level	1	Sets the data lock level

Description

Paranoia allows you to lock the module from displaying information, as well as enables the protection of the filesystem and module settings.

Each bit corresponds corresponds to a different lock level, while sending a zero will unlock your display as the following tables explains:

Bit	Data Lock Level	Description
0-2	Reserved	Should be left 0
3	Communication Speed Lock	When this bit is set (1) the Baud Rate and I2C Slave address are locked
4	Setting Lock	When this bit is set (1) the display settings such as backlight, contrast and GPO settings are locked. (Internal EEPROM)
5	Reserved	Should be left 0
6	Command Lock	When this bit is set (1) all commands but commands 202/203 are locked. (cmd lock)
7	Display Lock	When this bit is set (1) the module is locked from displaying any new information. (text lock)

NOTES

- Sending a new data lock level will override the previous data lock level.
- Data lock levels may be combined.

Remembered   Always
Default   0
Examples

Hex	Dec	Binary	Description
0x00	0	0	Unlock
0x50	80	01010000	Setting and Command Lock

8.4   Set and Save Data Lock

Syntax	Hexadecimal	0xFE 0xCB 0xF5 0xA0 [level]	
	Decimal	254 203 245 160 [level]	
Parameters	Parameter	Length	Description
	level	1	Sets the data lock level
Description	This command will set and save the data lock level. See the Data Lock section for more information.		
Remembered	Always		
Default	0		

8.5   Writes the Customer Data

Syntax	Hexadecimal	0xFE 0x34 [data]	
	Decimal	254 52 [data]	
	ASCII	254 "4" [data]	
Parameters	Parameter	Length	Description
	data	16	Writes the customer data
Description	Writes the customer Data. 16 Bytes of data can be saved in non-volatile memory.		
Remembered	No		

8.6   Reads the Customer Data

Syntax	Hexadecimal	0xFE 0x35
	Decimal	254 53
	ASCII	254 "5"
Description	Reads whatever was written by Write Customer Data.	
Remembered	No	

9   Miscellaneous

9.1   Introduction

This chapter covers the 'Report Version Number' and 'Read Module Type' commands. These commands can be particularly useful to find out more information about the display module before contacting technical support.

9.2   Read Version Number

Syntax   Hexadecimal   0xFE 0x36
                    Decimal   254 54
                    ASCII   254 "6"
Description   This command will return a byte representing the version of the module,
                    see the following table as an example:

Hex Value	Version Number
0x10	Version 1.0
0x20	Version 2.0
0x42	Version 4.2

Remembered   No

9.3   Read Module Type

Syntax   Hexadecimal   0xFE 0x37
                    Decimal   254 55
                    ASCII   254 "7"

Description   This command will return a hex value corresponding to the the model number of the module see the following table:

Hex	Product ID	Hex	Product ID
1	LCD0821	38	LK204-24-USB
2	LCD2021	39	VK204-24-USB
5	LCD2041	3A	PK162-12
6	LCD4021	3B	VK162-12
7	LCD4041	3C	MOS-AP-162A
8	LK202-25	3D	PK202-25
9	LK204-25	3E	MOS-AL-162A
A	LK404-55	40	MOS-AV-202A
B	VFD2021	41	MOS-AP-202A
C	VFD2041	42	PK202-24-USB
D	VFD4021	43	MOS-AL-082
E	VK202-25	44	MOS-AL-204
F	VK204-25	45	MOS-AV-204
10	GLC12232	46	MOS-AL-402
13	GLC24064	47	MOS-AV-402
15	GLK24064-25	48	LK082-12
22	GLK12232-25-WBL	49	VK402-12
24	GLK12232-25-SM	4A	VK404-55
26	GLK24064-16-1U	4B	LK402-25
27	GLK19264-7-1U	4C	VK402-25
28	GLK12232-16-WBL	4D	PK204-25
29	GLK12232-16-SM	54	XBoard-U
31	LK404-AT	55	LK202-25-USB
32	MOS-AV-162A	56	VK202-25-USB
33	LK402-12	57	LK204-25-USB
34	LK162-12	58	VK204-25-USB
35	LK204-25PC	72	GLK240128-25
36	LK202-24-USB	73	LK404-25
37	VK202-24-USB	74	VK404-25

Remembered   No

10 Command Summary

10.1 Text

Description	Syntax		Page
Auto Scroll On	Hexadecimal	0xFE 0x51	11
	Decimal	254 81	
	ASCII	254 "Q"	

Description	Syntax		Page
Auto Scroll Off	Hexadecimal	0xFE 0x52	12
	Decimal	254 82	
	ASCII	254 "R"	
Clear Screen	Hexadecimal	0xFE 0x58	12
	Decimal	254 88	
	ASCII	254 "X"	
Changing the Startup Screen	Hexadecimal	0xFE 0x40	12
	Decimal	254 64	
	ASCII	254 "@"	
Set Auto Line Wrap On	Hexadecimal	0xFE 0x43	13
	Decimal	254 67	
	ASCII	254 "C"	
Set Auto Line Wrap Off	Hexadecimal	0xFE 0x44	13
	Decimal	254 68	
	ASCII	254 "D"	
Set Cursor Position	Hexadecimal	0xFE 0x47 [col] [row]	13
	Decimal	254 71 [col] [row]	
	ASCII	254 "G" [col] [row]	
Go Home	Hexadecimal	0xFE 0x48	14
	Decimal	254 72	
	ASCII	254 "H"	
Move Cursor Back	Hexadecimal	0xFE 0x4C	14
	Decimal	254 76	
	ASCII	254 "L"	
Move Cursor Forward	Hexadecimal	0xFE 0x4D	14
	Decimal	254 77	
	ASCII	254 "M"	
Underline Cursor On	Hexadecimal	0xFE 0x4A	15
	Decimal	254 74	
	ASCII	254 "J"	
Underline Cursor Off	Hexadecimal	0xFE 0x4B	15
	Decimal	254 75	
	ASCII	254 "K"	
Blinking Block Cursor On	Hexadecimal	0xFE 0x53	15
	Decimal	254 83	
	ASCII	254 "S"	
Blinking Block Cursor Off	Hexadecimal	0xFE 0x54	15
	Decimal	254 84	
	ASCII	254 "T"	

10.2   Special Characters

Description	Syntax		Page
Creating a Custom Character	Hexadecimal	0xFE 0x4E [refID] [data]	16
	Decimal	254 78 [refID] [data]	
	ASCII	254 "N" [refID] [data]	
Saving Custom Characters	Hexadecimal	0xFE 0xC1 [Bank] [ID] [Data]	17
	Decimal	254 193 [Bank] [ID] [Data]	
Loading Custom Characters	Hexadecimal	0xFE 0xC0 [Bank]	18
	Decimal	254 192 [Bank]	
Save Startup Screen Custom Characters	Hexadecimal	0xFE 0xC2 [refID] [data]	18
	Decimal	254 194 [refID] [data]	
Initialize Medium Number	Hexadecimal	0xFE 0x6D	19
	Decimal	254 109	
	ASCII	254 "m"	
Place Medium Numbers	Hexadecimal	0xFE 0x6F [Row] [Col] [Digit]	19
	Decimal	254 111 [Row] [Col] [Digit]	
	ASCII	254 "o" [Row] [Col] [Digit]	
Initialize Horizontal Bar	Hexadecimal	0xFE 0x68	20
	Decimal	254 104	
	ASCII	254 "h"	
Place Horizontal Bar Graph	Hexadecimal	0xFE 0x7C [Col] [Row] [Dir] [Length]	20
	Decimal	254 124 [Col] [Row] [Dir] [Length]	
	ASCII	254 "|" [Col] [Row] [Dir] [Length]	
Initialize Narrow Vertical Bar	Hexadecimal	0xFE 0x73	20
	Decimal	254 115	
	ASCII	254 "s"	
Initialize Wide Vertical Bar	Hexadecimal	0xFE 0x76	21
	Decimal	254 118	
	ASCII	254 "v"	
Place Vertical Bar	Hexadecimal	0xFE 0x3D [Column] [Length]	21
	Decimal	254 61 [Column] [Length]	
	ASCII	254 "=" [Column] [Length]	

10.3   General Purpose Output

Description	Syntax		Page
General Purpose Output Off	Hexadecimal	0xFE 0x56 [Num]	22
	Decimal	254 86 [Num]	
	ASCII	254 "V" [Num]	
General Purpose Output On	Hexadecimal	0xFE 0x57 [Num]	22
	Decimal	254 87 [Num]	
	ASCII	254 "W" [Num]	
Set Startup GPO state	Hexadecimal	0xFE 0xC3 [Num] [state]	23
	Decimal	254 195 [Num] [state]	

10.4   Display Functions

Description	Syntax		Page
Display On	Hexadecimal	0xFE 0x42 [min]	23
	Decimal	254 66 [min]	
	ASCII	254 "B" [min]	
Display Off	Hexadecimal	0xFE 0x46	24
	Decimal	254 70	
	ASCII	254 "F"	
Set Brightness	Hexadecimal	0xFE 0x99 [brightness]	24
	Decimal	254 153 [brightness]	
Set and Save Brightness	Hexadecimal	0xFE 0x98 [brightness]	24
	Decimal	254 152 [brightness]	
Set Contrast	Hexadecimal	0xFE 0x50 [contrast]	25
	Decimal	254 80 [contrast]	
	ASCII	254 "P" [contrast]	
Set and Save Contrast	Hexadecimal	0xFE 0x91 [contrast]	25
	Decimal	254 145 [contrast]	

10.5   Data Security

Description	Syntax		Page
Set Remember	Hexadecimal	0xFE 0x93 [switch]	26
	Decimal	254 147 [switch]	
Data Lock	Hexadecimal	0xFE 0xCA 0xF5 0xA0 [level]	27
	Decimal	254 202 245 160 [level]	
Set and Save Data Lock	Hexadecimal	0xFE 0xCB 0xF5 0xA0 [level]	28
	Decimal	254 203 245 160 [level]	
Writes the Customer Data	Hexadecimal	0xFE 0x34 [data]	28
	Decimal	254 52 [data]	
	ASCII	254 "4" [data]	
Reads the Customer Data	Hexadecimal	0xFE 0x35	28
	Decimal	254 53	
	ASCII	254 "5"	

10.6   Miscellaneous

Description	Syntax		Page
Read Version Number	Hexadecimal	0xFE 0x36	29
	Decimal	254 54	
	ASCII	254 "6"	

Description	Syntax			Page
Read Module Type	Hexadecimal	0xFE 0x37		29
	Decimal	254 55		
	ASCII	254 "7"		

10.7 Command By Number

Command	Description	Page		
Hex	Dec	ASCII		
0x34	52	"4"	Writes the Customer Data	28
0x35	53	"5"	Reads the Customer Data	28
0x36	54	"6"	Read Version Number	29
0x37	55	"7"	Read Module Type	29
0x3D	61	"="	Place Vertical Bar	21
0x40	64	"@"	Changing the Startup Screen	12
0x42	66	"B"	Display On	23
0x43	67	"C"	Set Auto Line Wrap On	13
0x44	68	"D"	Set Auto Line Wrap Off	13
0x46	70	"F"	Display Off	24
0x47	71	"G"	Set Cursor Position	13
0x48	72	"H"	Go Home	14
0x4A	74	"J"	Underline Cursor On	15
0x4B	75	"K"	Underline Cursor Off	15
0x4C	76	"L"	Move Cursor Back	14
0x4D	77	"M"	Move Cursor Forward	14
0x4E	78	"N"	Creating a Custom Character	16
0x50	80	"P"	Set Contrast	25
0x51	81	"Q"	Auto Scroll On	11
0x52	82	"R"	Auto Scroll Off	12
0x53	83	"S"	Blinking Block Cursor On	15
0x54	84	"T"	Blinking Block Cursor Off	15
0x56	86	"V"	General Purpose Output Off	22
0x57	87	"W"	General Purpose Output On	22
0x58	88	"X"	Clear Screen	12
0x68	104	"h"	Initialize Horizontal Bar	20
0x6D	109	"m"	Initialize Medium Number	19
0x6F	111	"o"	Place Medium Numbers	19
0x73	115	"s"	Initialize Narrow Vertical Bar	20
0x76	118	"v"	Initialize Wide Vertical Bar	21
0x7C	124	"|"	Place Horizontal Bar Graph	20
0x91	145		Set and Save Contrast	25
0x93	147		Set Remember	26
0x98	152		Set and Save Brightness	24
0x99	153		Set Brightness	24
0xC0	192		Loading Custom Characters	18

Command	Description	Page		
Hex	Dec	ASCII		
0xC1	193		Saving Custom Characters	17
0xC2	194		Save Startup Screen Custom Characters	18
0xC3	195		Set Startup GPO state	23

11 Appendix

11.1 Specifications

11.1.1 Environmental

Table 50: Environmental Specifications

Operating Temperature	0°C to +50°C
Storage Temperature	-20°C to +70°C
Operating Relative Humidity	90% max non-condensing
Vibration (Operating)	4.9 m/s^2 XYZ directions
Vibration (Non-Operating)	19.6 m/s^2 XYZ directions
Shock (Operating)	29.4 m/s^2 XYZ directions
Shock (Non-Operating)	490 m/s^2 XYZ directions

11.1.2 Electrical

Table 51: Electrical Specifications

Supply Voltage	+5Vdc ±0.25V
Backlight On	113mA typical
Backlight Off	44mA

11.2 Optical Characteristics

11.3 Physical Layout

11.4 Definitions

MSB Most Significant Byte

LSB Least Significant Byte

Table 52: Optical Characteristics

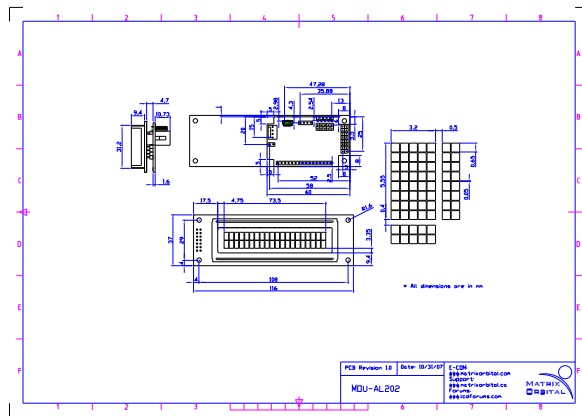| Character x Lines	20 columns x 2 rows
Module Size	116.00 mm x 37.00 mm x 26.43 mm
Character Size	5.55 mm x 3.20 mm
Active Area	79.00 mm x 17.00 mm
LED Backlight Life	100,000 hours typical (20,000 hours for white backlight)

Figure 12: Physical Diagram

11.5   Contacting Matrix Orbital

Telephone

    Sales and Support: 1(403)229-2737

On The Web

    Sales: http://www.MatrixOrbital.com

    Support: http://www.MatrixOrbital.ca

    Forums: http://www.lcdforums.com