

OVERVIEW

The Layad Circuits Mini LED Matrix Display module is a low-cost, user-friendly, and complete solution for projects that need to display text at close and medium ranges. It has an 8x64 LED matrix panel capable of displaying up to 32 characters at a time in static mode and 64 characters in scrolling mode. The panel consists of a total of 512 bright and powerful LEDs capable of rendering text visible at a distance of up to 10 meters.

The Layad Circuits Mini LED Matrix Display module is composed of eight chained individual 8x8 LED matrix modules neatly arranged on a compact ~2-cm-by-23-cm board. It has a built-in processor that handles all the driving algorithm of the chained LED matrix modules. There is no need for the user to write complex code or heavy processing to handle multiple display drivers. The module will function out-of-the-box, no soldering or assembly is required. The overhead on the host



Figure 1 Layad Circuits Mini LED Matrix Display (Perspective View)

The Layad Circuits Mini LED Matrix Display module is operated by sending simple ASCII commands through its serial interface port. The syntax of the commands is very similar to the popular and widely used AT commands. The module is capable of rendering text in scrolling or static mode. Scrolling speed, text alignment, and display brightness can be easily adjusted using the proper commands. The module has two built-in fonts and is also capable of inverting the active states of the LEDs.

The Layad Circuits Mini LED Matrix Display module has four on-board user buttons that can be utilized for other purposes. When pressed, these buttons will send out a

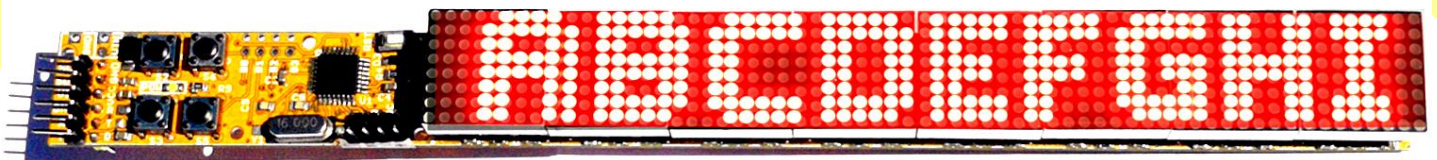


Figure 2 Layad Circuits Mini LED Matrix Display (Top View)

microcontroller (MCU) is therefore very minimal to almost none. The module is part of Layad Circuits' Kimat series of products where ease of use is a priority.

corresponding key to the serial port. These buttons can be used for control-related functions that may be required by the application.

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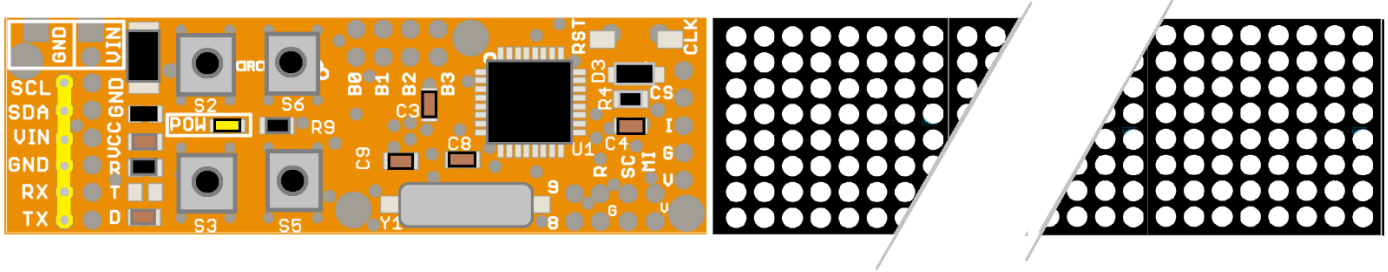


Figure 3 Top view showing controller circuit section in orange

FEATURES

- 8 x 64 LED Matrix Panel
- Built-in Processor for Handling Display-related Processes
- Bright and Powerful Display Visible at up to 10 Meters
- UART Interface for Serial Commands
 - 9600 baud, 8 databits, 1 stop bit, no parity
 - 5V Logic Level
- Simple and User-friendly Protocol similar to AT Commands
- 2 Built-in Fonts
- Static and Scrolling Modes
- Configurable Scrolling Speed, Text Alignment, and Display Brightness
- On-board User Buttons

APPLICATIONS

Below is a list of a few examples of applications for the Mini LED Matrix Display module.

- Promotional and Exhibition Stands
- Office and Store Reception Counters
- Custom Vehicle Signage
- Digital Message and Score Boards
- Digital Menu and Price Sign Boards
- Generic Signage and Character Display Applications
- Menu-based Applications
- and many others

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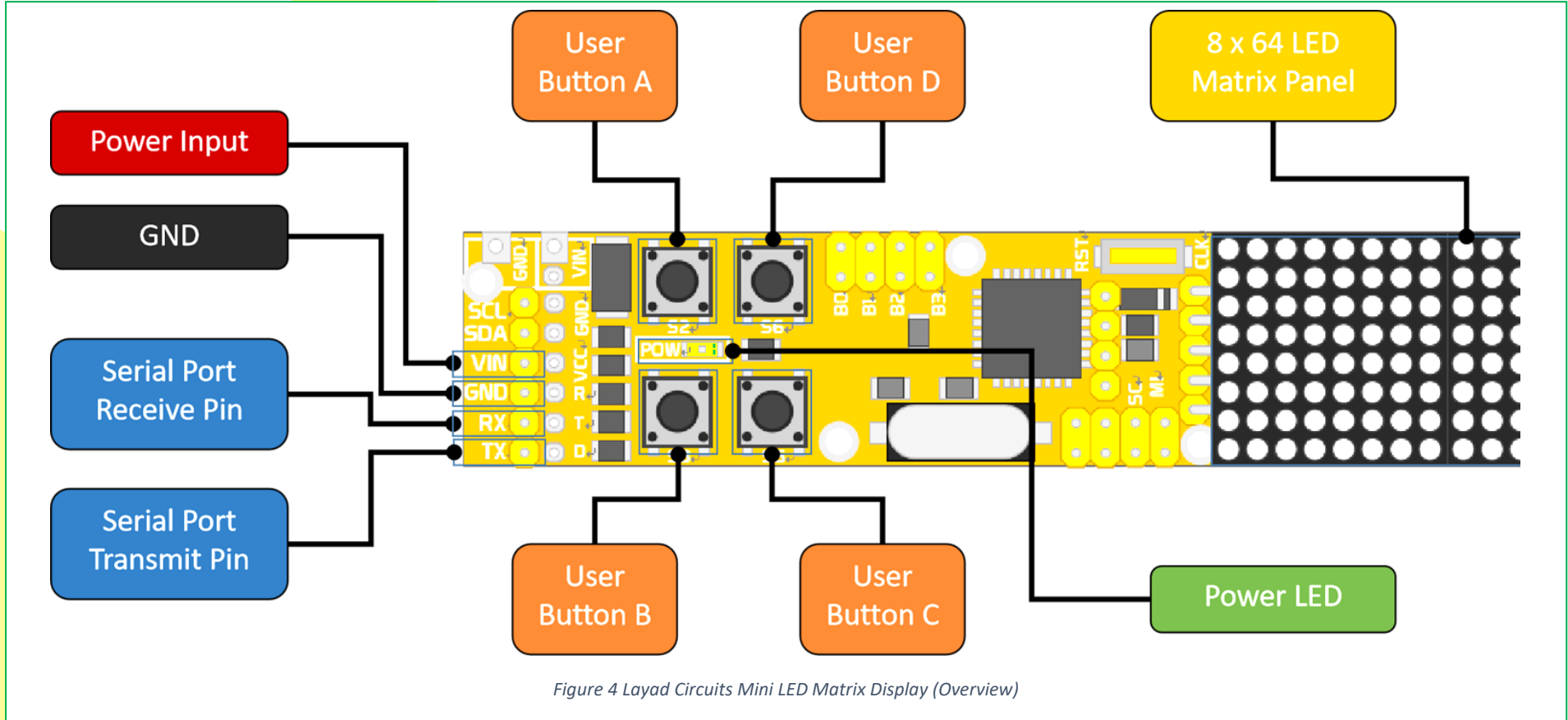


Figure 4 Layad Circuits Mini LED Matrix Display (Overview)

POWER REQUIREMENTS

The Mini LED Matrix Display module operates at 5 volts and has a typical current draw of 100-300 mA when displaying normal text. Current may peak up to 2 A when all LEDs are lit. For optimum performance, a stable 5V DC power supply with a current rating of 3A or more is recommended.

A lower current rating may also be considered when the application is guaranteed to use lower brightness settings and avoid turning on most of the LEDs. As a general approximation rule, simple text requires around a third of the LEDs to be on or around 500mA at higher brightness. Therefore, a 1A rating may be used for this case.

When used with an Arduino and powered only from a computer USB port, it is advised to keep the brightness level at a minimum to reduce current consumption. This setup is not recommended. A proper power supply should be used when deploying the project.

UART INTERFACE

The Mini LED Matrix Display module is operated by sending commands to it in ASCII format. The baud rate is 9600 baud. Serial port configuration is 8 databits, 1 stop bit, no parity. Logic level is 5V. The simple, user-friendly protocol is very similar to AT commands. See the section "SERIAL COMMANDS REFERENCE" for more information regarding the serial commands.

PIN FUNCTIONS

The Mini LED Matrix Display module has a 6-pin, single-row, 2.54mm pitched header for interfacing with an external host MCU. However, not all of the pins in this header are relevant to the user. Below are descriptions of the pins that are of importance to the user.

Pin	Function/Operation/Remarks
VIN	Power source: 5 Vdc with a recommended current rating of at least 3A.
GND	Ground pin
RXD	Serial Receive Pin. Connect to Transmit pin of the host MCU.
TXD	Serial Transmit Pin. Connect to Receive pin of the host MCU.
SDA	Reserved
SCL	Reserved

USER BUTTONS

The Mini LED Matrix Display module has on-board user buttons that will send out a corresponding character to the serial port when pressed. These buttons can be utilized for any purpose required by the user.

The user buttons, their labels, and their transmitted character are shown in the table below.

User Button	Character Sent when Pressed
S2	'A'
S3	'B'
S5	'C'
S6	'D'

PRECAUTIONS

- Use level shifters when using 3.3V microcontrollers to safely connect the device to your host controller.

SERIAL COMMANDS REFERENCE

BASIC SYNTAX

The syntax of a command is

LC+<COMMAND>=<PARAMETER><CR>

where

LC+ is a standard, fixed prefix,

COMMAND is the name of the command,

PARAMETER should be supplied depending on the command, and

CR is the ASCII character “Carriage Return”, which is used to terminate a complete command.

After receiving and **successfully** executing a complete command, the device will reply with

<COMMAND><CR><LF>OK<CR><LF>

where

COMMAND is the complete command string (echoed back) and

LF is the ASCII character “Line Feed”.

On the other hand, if the command was **rejected.**, the reply will be

<CR><LF>ERROR<CR><LF>

Note that for rejected commands, the complete command string is not echoed back by the device.

Throughout this section, only the responses “OK” or “ERROR” for each command are presented. The echoed command string and the characters <CR> and <LF> are omitted intentionally for brevity.

Name	PRINT
Description	This command prints a string on the display.
Syntax	LC+PRINT=<text><CR>
Parameter/s	<text> is the string to be printed to the device.
Expected Reply	OK if the command was accepted. ERROR if the command was rejected.
Notes	<p>The device has two built-in fonts - Font1 and Font2. These fonts use variable-width characters, which means that some characters are wider than others when rendered on the display. This also means that the maximum number of characters that can be displayed at a time will vary depending on which characters are being shown.</p> <p>The character W occupies the largest horizontal space for both fonts and thus will result to the least number of characters displayed at a time.</p> <p>The character l (lowercase 'L') occupies the smallest horizontal space for both fonts and thus will result to the most number of characters displayed at a time.</p> <p>When text scrolling is disabled (static mode), the display can render up to 10 W's and 32 l's at a time if using FONT1 (thin font)</p> <p>When text scrolling is disabled (static mode), the display can render up to 8 W's and 21 l's at a time if using FONT2 (thick font)</p> <p>If text scrolling is enabled, the maximum length allowed is 64 characters.</p>
Example	<code>Serial.print(F("LC+PRINT=ABCDEFGH\r"));</code>

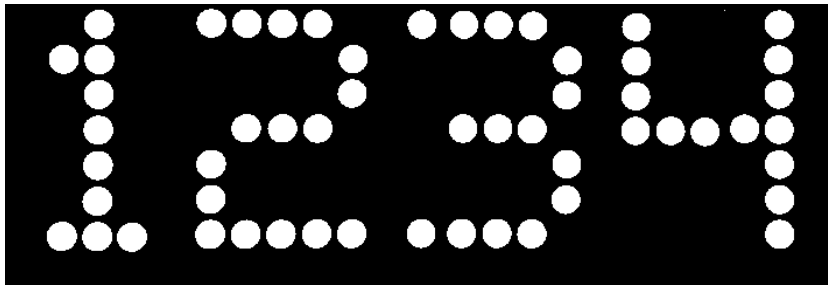
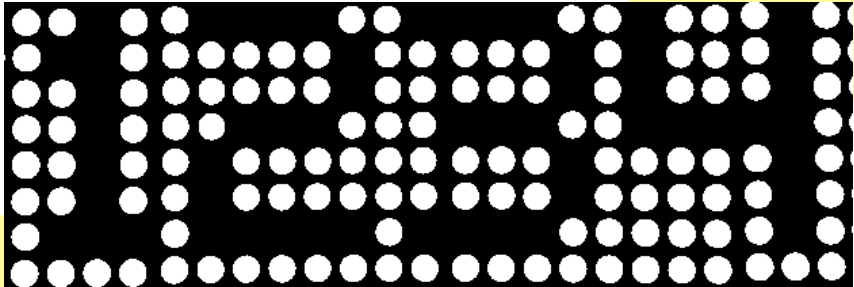
Name	ALIGN								
Description	This command sets the alignment of text on the display.								
Syntax	LC+ALIGN=<loc><CR>								
Parameter/s	<p><loc> is the alignment value and should be one of the following values:</p> <table border="1"> <thead> <tr> <th>loc</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>LEFT</td> <td>Align text to the left.</td> </tr> <tr> <td>CENTER</td> <td>Align text to the center.</td> </tr> <tr> <td>RIGHT</td> <td>Align text to the right.</td> </tr> </tbody> </table>	loc	Description	LEFT	Align text to the left.	CENTER	Align text to the center.	RIGHT	Align text to the right.
loc	Description								
LEFT	Align text to the left.								
CENTER	Align text to the center.								
RIGHT	Align text to the right.								
Expected Reply	<p>OK if the command was accepted. ERROR if the command was rejected.</p>								
Notes	<p>This command is applicable only when text scrolling is disabled. Text alignment is CENTER by default.</p>								
Example	<code>Serial.print(F("LC+ALIGN=LEFT\r"));</code>								

Name	CLEAR
Description	This command clears the display.
Syntax	LC+CLEAR<CR>
Parameter/s	
Expected Reply	OK if the command was accepted. ERROR if the command was rejected.
Notes	
Example	<code>Serial.print(F("LC+CLEAR\r"));</code>

Name		BRIGHTNESS									
Description	This command sets the brightness of the display.										
Syntax	LC+BRIGHTNESS =<n><CR>										
Parameter/s	<n> is the brightness level, the value of which should be between 1 and 8.										
	<table border="1"> <thead> <tr> <th>n</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Lowest brightness level</td> </tr> <tr> <td>...</td> <td>...</td> </tr> <tr> <td>8</td> <td>Highest brightness level</td> </tr> </tbody> </table>			n	Description	1	Lowest brightness level	8	Highest brightness level
n	Description										
1	Lowest brightness level										
...	...										
8	Highest brightness level										
Expected Reply	OK if the command was accepted. ERROR if the command was rejected.										
Notes	Default brightness level is 1.										
Example	<code>Serial.print(F("LC+BRIGHTNESS =4\r"));</code>										

Name		SCROLL												
Description	This command configures text scrolling on the display.													
Syntax	LC+SCROLL=<mov><CR>													
Parameter/s	<mov> is the text scrolling configuration, the value of which should be one of the following: <table border="1" data-bbox="418 409 1477 674" style="margin: 10px auto;"> <thead> <tr> <th>mov</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>STOP</td> <td>Disables text scrolling (sets the device to static mode).</td> </tr> <tr> <td>LEFT</td> <td>Sets text scrolling direction to left-to-right.</td> </tr> <tr> <td>RIGHT</td> <td>Sets text scrolling direction from right-to-left.</td> </tr> <tr> <td>UP</td> <td>Sets text scrolling direction to upward.</td> </tr> <tr> <td>DOWN</td> <td>Sets text scrolling direction to downward.</td> </tr> </tbody> </table>		mov	Description	STOP	Disables text scrolling (sets the device to static mode).	LEFT	Sets text scrolling direction to left -to-right.	RIGHT	Sets text scrolling direction from right -to-left.	UP	Sets text scrolling direction to upward.	DOWN	Sets text scrolling direction to downward.
mov	Description													
STOP	Disables text scrolling (sets the device to static mode).													
LEFT	Sets text scrolling direction to left -to-right.													
RIGHT	Sets text scrolling direction from right -to-left.													
UP	Sets text scrolling direction to upward.													
DOWN	Sets text scrolling direction to downward.													
Expected Reply	OK if the command was accepted. ERROR if the command was rejected.													
Notes	Text scrolling is disabled by default.													
Example	<pre>Serial.print(F("LC+SCROLL=LEFT\r"));</pre>													

Name		SCROLLSPEED																				
Description	This command configures the speed of text scrolling on the display.																					
Syntax	LC+SCROLLSPEED=<n><CR>																					
Parameter/s	<p><n> is the interval in milliseconds at which the text scrolls or moves across the display. Take note of the following when choosing the value for <i>n</i>.</p> <p>From n=1 to n=99, text moves or scrolls across the display every <i>n</i> milliseconds. In tabular form:</p> <table border="1" data-bbox="418 512 1474 735"> <thead> <tr> <th>n</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Text moves every 1 ms (fastest).</td> </tr> <tr> <td>2</td> <td>Text moves every 2 ms.</td> </tr> <tr> <td>...</td> <td>...</td> </tr> <tr> <td>50</td> <td>Text moves every 50ms.</td> </tr> </tbody> </table> <p>From n=51 to n=99, the value of <i>n</i> is mapped to between 51 ms and 1000 ms of interval of text movement. In tabular form:</p> <table border="1" data-bbox="418 873 1474 1096"> <thead> <tr> <th>n</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>51</td> <td>Text moves every 51 ms .</td> </tr> <tr> <td>60</td> <td>Text moves every 228 ms.</td> </tr> <tr> <td>80</td> <td>Text moves every 624 ms.</td> </tr> <tr> <td>99</td> <td>Text moves every 1000 ms (slowest).</td> </tr> </tbody> </table>		n	Description	1	Text moves every 1 ms (fastest).	2	Text moves every 2 ms.	50	Text moves every 50ms.	n	Description	51	Text moves every 51 ms .	60	Text moves every 228 ms.	80	Text moves every 624 ms.	99	Text moves every 1000 ms (slowest).
n	Description																					
1	Text moves every 1 ms (fastest).																					
2	Text moves every 2 ms.																					
...	...																					
50	Text moves every 50ms.																					
n	Description																					
51	Text moves every 51 ms .																					
60	Text moves every 228 ms.																					
80	Text moves every 624 ms.																					
99	Text moves every 1000 ms (slowest).																					
Expected Reply	<p>OK if the command was accepted.</p> <p>ERROR if the command was rejected.</p>																					
Notes	The value of <i>n</i> is set to 25 by default.																					
Example	<code>Serial.print(F("LC+SCROLLSPEED=50\r"));</code>																					

Name		INVERT						
Description	This command configures inversion of LED active status on the display. Normally a LED is turned on if activated, and turned off if deactivated. This logic can be reversed if required by the application.							
Syntax	LC+INVERT=<s><CR>							
Parameter/s	<p><s> is the state of inversion. The value for s should be one of the following:</p> <table border="1"> <thead> <tr> <th>s</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>ON</td> <td>LED inversion is enabled..</td> </tr> <tr> <td>OFF</td> <td>LED inversion is disabled..</td> </tr> </tbody> </table> <p>When inversion is disabled, the string "1234" would look like as shown below. The white color will be replaced with the actual color of the LEDs on the panel.</p>  <p>When inversion is enabled, the string "1234" would look like as shown below. Again, the white color will be replaced with the actual color of the LEDs on the panel.</p> 		s	Description	ON	LED inversion is enabled..	OFF	LED inversion is disabled..
s	Description							
ON	LED inversion is enabled..							
OFF	LED inversion is disabled..							
Expected Reply	OK if the command was accepted. ERROR if the command was rejected.							
Notes	LED status inversion is disabled by default.							
Example	<pre>Serial.print(F("LC+INVERT=ON\r"));</pre>							

Name	FONT						
Description	This command sets the font to be used by the display.						
Syntax	LC+FONT=< <i>f</i> ><CR>						
Parameter/s	<p><<i>f</i>> is the text font to be used. The value for <i>f</i> should be one of the following:</p> <table border="1"> <thead> <tr> <th>f</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>FONT1</td> <td>Thin font.</td> </tr> <tr> <td>FONT2</td> <td>Thick font.</td> </tr> </tbody> </table>	f	Description	FONT1	Thin font.	FONT2	Thick font.
f	Description						
FONT1	Thin font.						
FONT2	Thick font.						
Expected Reply	<p>OK if the command was accepted. ERROR if the command was rejected.</p>						
Notes	<p>Default text font is FONT2.</p> <p>Fonts Font1 and Font2 use variable-width characters, which means that some characters are wider than others when rendered on the display. This also means that the maximum number of characters that can be displayed at a time will vary depending on which characters are being shown on the display. For more information, see the command "PRINT".</p>						
Example	<code>Serial.print(F("LC+FONT=FONT2\r"));</code>						

ARDUINO REFERENCE EXAMPLE

This demo prints a string on the Mini LED Matrix Display. Text scrolling is enabled then disabled every 10 seconds. Likewise, the font and displayed text are changed every 10 seconds.

Setup procedure:

1. Connect pin 10 of the Arduino Uno to pin TX of the Mini LED Matrix Display.
2. Connect pin 11 of the Arduino Uno to pin RX of the Mini LED Matrix Display.
3. Connect a GND pin of the Arduino Uno to a GND pin of the Mini LED Matrix Display.
4. Compile and upload this demo to the Arduino Uno.
5. Remove then apply power to the Arduino Uno and the Mini LED Matrix at the same time.
6. The demo should now run after 5 seconds.

Wiring:

Arduino Uno	Mini LED Matrix Display
GND	GND
10	TX
11	RX

Code:

```

/*****
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Revision: 1.0 - 2020/08/07 - initial creation
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*****/
#include <SoftwareSerial.h>
SoftwareSerial mySerial(10, 11); // RX, TX

void setup() {
  // put your setup code here, to run once:
  mySerial.begin(9600);
  delay(5000);
  mySerial.print(F("LC+PRINT=ABCDEFGH\r"));
}

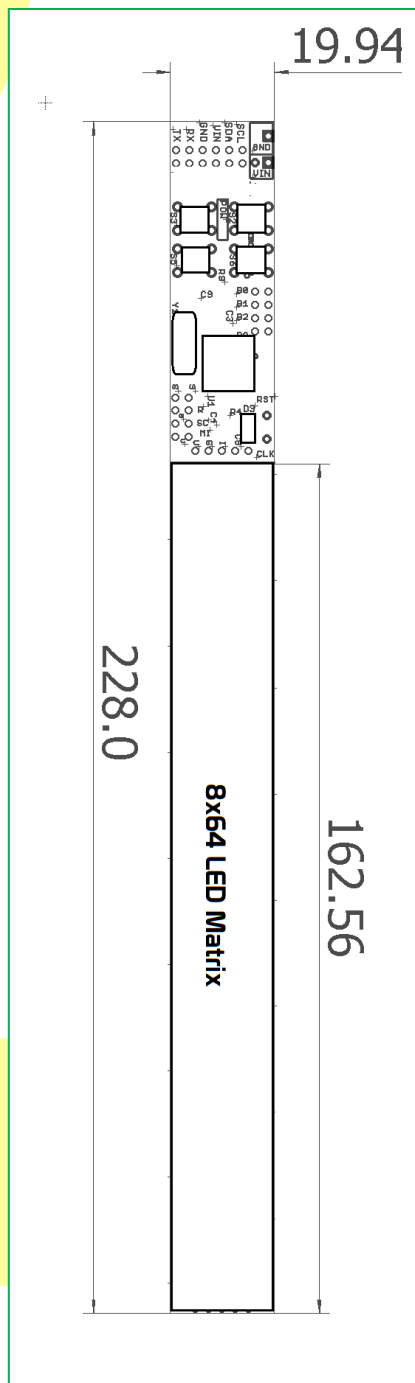
void loop() {
  // put your main code here, to run repeatedly:
  delay(10000);
  mySerial.print(F("LC+CLEAR\r")); // Clear the display.
  delay(1000); // Put a delay between commands.
  mySerial.print(F("LC+FONT=FONT1\r")); // Thin font.
  delay(1000);
  mySerial.print(F("LC+PRINT=01234567\r"));
  delay(1000);
  mySerial.print(F("LC+SCROLL=RIGHT\r")); // Enable scrolling.

  delay(10000);
  mySerial.print(F("LC+CLEAR\r")); // Clear the display.
  delay(1000);
  mySerial.print(F("LC+SCROLL=STOP\r")); // Disable scrolling.
  delay(1000);
  mySerial.print(F("LC+FONT=FONT2\r")); // Thick font.
  delay(1000);
  mySerial.print(F("LC+PRINT=ABCDEFGH\r"));
}

```

APPENDIX : PCB MECHANICAL DRAWING

Note: All dimensions are in mm



ORDERING INFORMATION

Ordering Code	Description	Revision
LC-062ES	Mini LED Matrix Display	v.1.0.0

TECHNICAL SPECIFICATIONS

Parameter	Minimum Value	Typical Value	Maximum Value
Supply Voltage		5 V	
Current Draw		~100-300 mA	2000 mA
Length	226	228 mm	230
Width	19.5	19.94 mm	20.5

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