SILICON CRAFT

SC2004—20x4 Characters Serial LCD Module

Revision 2.0 User's Manual

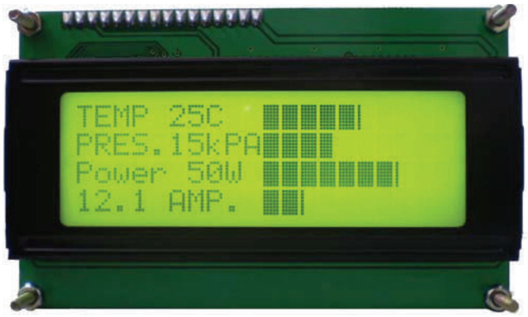


Figure 1: SC2004YG

SC2004 is an intelligence LCD module design to ease project development that requires a LCD display.

Its RS232 interface board receives and interpret serial data and output the data to the LCD display accordingly.

SC2004 works with any host controller with serial UART port.

Display option available

1.	SC2004YG	Dark Characters on Yellow Green LED backlight
2.	SC2004B	White Characters on Blue LED backlight
3.	SC2004W	Dark Characters on White LED backlight

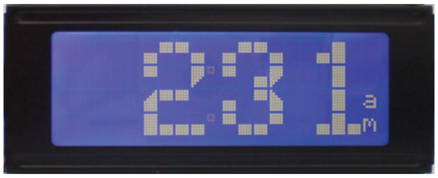


Figure 2: SC2004B

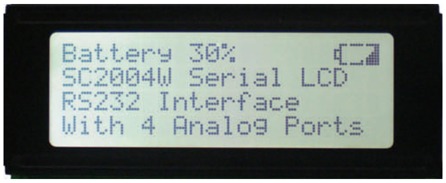


Figure 3: SC2004W

Available Accessories

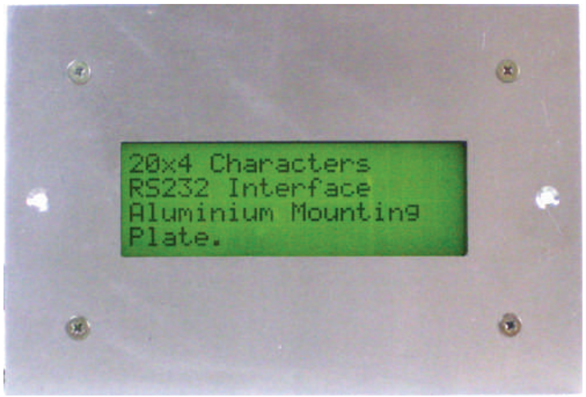


Figure 4: Aluminum Panel Mounting Kit

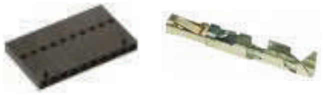


Figure 5: Mating connector for P3 with crimps

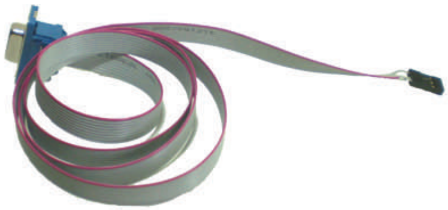


Figure 6: DB9 RS232 Cable

SC2004 Features

- RS232 or serial TTL interface
- Controllable LED backlight brightness
- 85 Bytes UART receive buffer eliminates delay requirement between commands
- Bar graph drawing commands
- 20 messages storage for easy retrieval, each 20 characters wide.
- 3 digital outputs for LED etc.
- 3 active low inputs for tact switches etc.
- 4 analog inputs port
- 8 user's defined characters
- Programmable baud rate 9600/19200 bps
- Wide input power supply 9-12VDC

Connecting SC2004

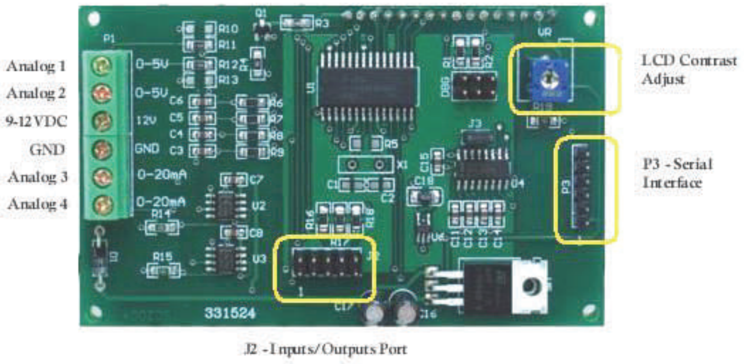


Figure 7: SC2004 Back View—connector location

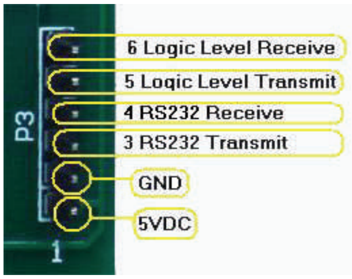


Figure 8: Serial Interface connector

Mate with Molex C-Grid Crimp Box 25.4mm pitch

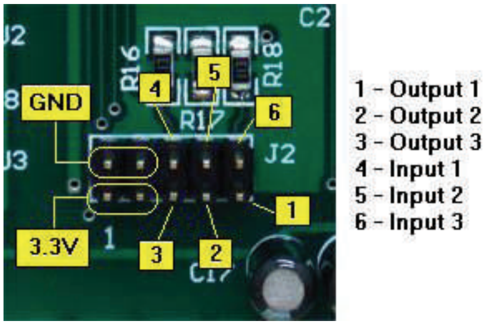


Figure 9: Inputs/Outputs Connector

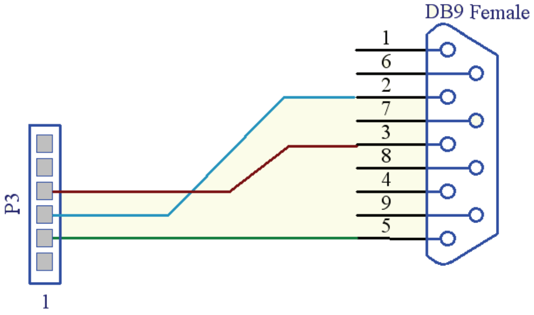


Figure 10: P3 to DB9 Connection

Communication

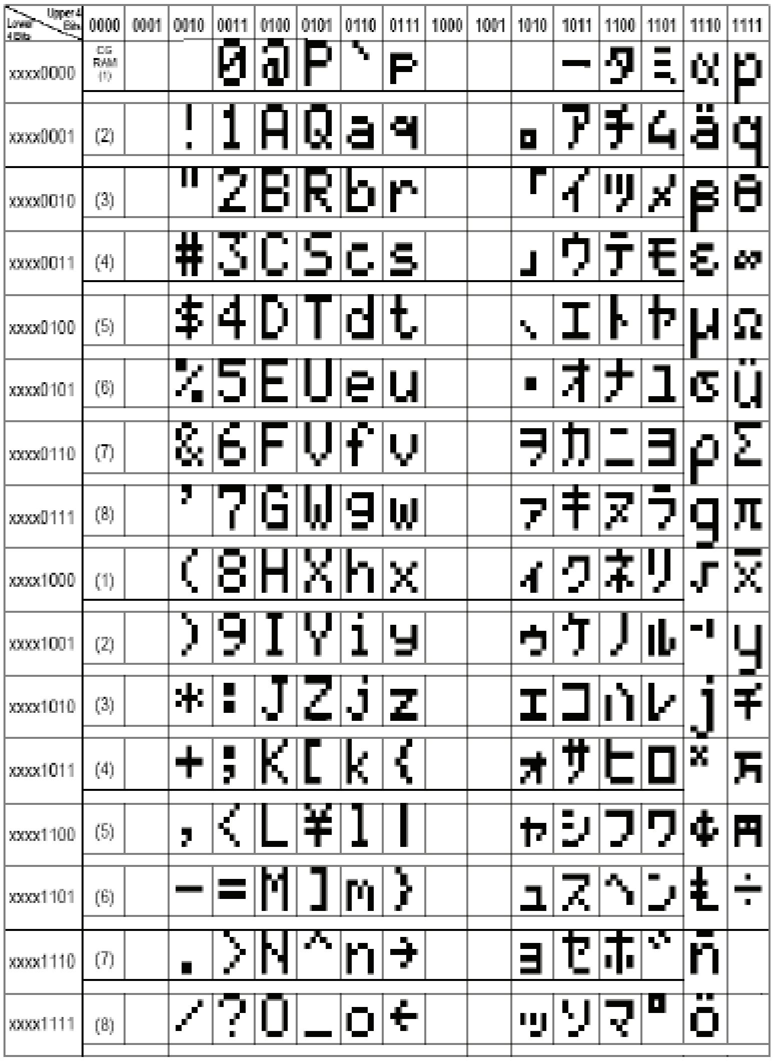
Communication with SC2004 is through its UART serial port either RS232 or TTL interface.

8 data bits, no parity , 1 stop bit (8,N,1)

Baud rate is programmable to 9600* bps or 19200 bps. * Factory default

Displaying texts

SC2004 displays whatever characters it receives from the serial port, starting from the top left corner. Supported internal characters is listed in Figure 11.



Upper 4 Bits / Lower 4 Bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)			0	@	P	`	p				ー	タ	ミ	α	p
xxxx0001	(2)		!	1	A	Q	a	q			。	ア	チ	ム	ä	q
xxxx0010	(3)		"	2	B	R	b	r			「	イ	ツ	メ	β	θ
xxxx0011	(4)		#	3	C	S	c	s			」	ウ	テ	モ	ε	∞
xxxx0100	(5)		$	4	D	T	d	t			、	エ	ト	ヤ	μ	Ω
xxxx0101	(6)		%	5	E	U	e	u			・	オ	ナ	ユ	σ	ü
xxxx0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
xxxx0111	(8)		'	7	G	W	g	w			ァ	キ	ヌ	ラ	g	π
xxxx1000	(1)		(	8	H	X	h	x			ィ	ク	ネ	リ	√	x̄
xxxx1001	(2)		)	9	I	Y	i	y			ゥ	ケ	ノ	ル	⁻¹	y
xxxx1010	(3)		*	:	J	Z	j	z			ェ	コ	ハ	レ	j	千
xxxx1011	(4)		+	;	K	[	k	{			ォ	サ	ヒ	ロ	ˣ	万
xxxx1100	(5)		,	<	L	¥	l	|			ャ	シ	フ	ワ	¢	円
xxxx1101	(6)		-	=	M	]	m	}			ュ	ス	ヘ	ン	£	÷
xxxx1110	(7)		.	>	N	^	n	→			ョ	セ	ホ	゛	ñ	
xxxx1111	(8)		/	?	O	_	o	←			ッ	ソ	マ	゜	ö	

Figure 11: Character Set

Displaying non-ASCII characters

You can display non-ASCII such as ÷ by sending Hex code OxFD

Hex code OxFE is reserved for command code which will be covered later.

Control Characters

OxO8	Backspace	Move cursor one position left and delete the character
OxOB	Cursor Home	Send cursor to top left corner , LCD screen unchanged.
OxOC	Next Line	Move cursor to the beginning of the next line.
OxOD	Clear Screen	Clear LCD screen and send cursor home.
OxOE	Cursor Left	Move cursor one position to the left.
OxOF	Cursor Right	Move cursor one position to the right.

Text Display Example

To display

```
LCD Demonstration
4 ÷ 2 = 2
```

Send : "LCD Demonstration" , OxOC, Ox34,Ox20 , OxFD, 0x20 , 0x32, 0x3D,0x32

Total : 25 Bytes

User's Defined Characters

Apart from the character set listed in Figure 11, 8 memory spaces are reserved for user's defined characters.

Each custom character is 5 x 8 pixels matrix represented by 8 bytes of data.

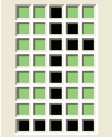


Figure 12: Example of a Custom Character

Custom character above is represented by

0x04, 0x06, 0x07, 0x04, 0x04, 0x04, 0x04, 0x1F

Custom characters can be defined by sending command

0xFE , 0x64, [8 Bytes x 8 Bytes Custom Characters Bitmap]

Before these custom characters can be displayed, it must be loaded to the LCD memory.

This is done by command 0xFE,0x08.

Send 0x00 through 0x07 to display custom character 0 to 7 respectively.

Note : Graph drawing command shares the same bitmap memory with custom characters on the LCD. Thus, both cannot be used simultaneously.

Cursor Control

Cursor is the indicator of the current position on the LCD where the character is to be displayed. By default, the cursor is hidden. To turn it on send command

0xFE,0x01 for underline type cursor or 0xFE,0x02 for block blinking type of cursor

To hide it , send command 0xFE,0x03

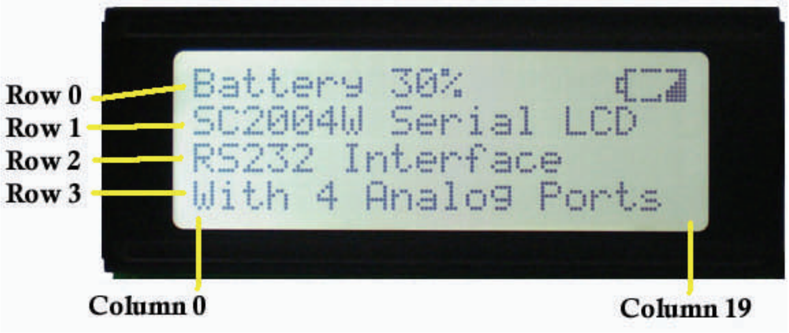


Figure 13: Row and Column Positioning

Cursor can be moved to any position on the screen by command

0xFE,0x32,[row number],[column number]

Example: to move cursor to row 2, column 10

0xFE,0x32,0x02,0x0A

Delete row

Texts on any row can be cleared by command 0xFE,0x2D,[row number]

Cursor is moved to the beginning of the selected row after execution of this command

Delete column

Texts on any row can be cleared by command 0xFE,0x2E,[column number]

Cursor is moved to the next column at row 3 after execution of this command

LED Backlight Control

The backlight is turn on by command 0xFE,0x06 and turn off by command 0xFE,0x07

Brightness is control with command 0xFE,0x28, [Brightness level]

Where brightness level = 50 min, 250 max

Backlight is turn on when the module is powered up.

Backlight auto-off feature

This feature turn off the backlight after x amount of seconds of inactivity on the serial port.

To enable this feature send command 0xFE,0x29, x

Where x is 1 to 255.

To disable auto-off feature, send command 0xFE,0x29,0x00 Auto-off is disabled by default.

Texts Messages Storage

20 memory locations is reserved for storage of commonly used messages. Each is 20 characters wide.

Messages can be programmed by user with the command

0xFE, [memory location address] , [20 bytes texts including spaces]

Where memory location address is 0xC8 (200 Decimal) for location 1 and 0xDB (219 Decimal) respectively.

Messages is retrieved and displayed with command

0xFE,0x34,[row number where text to be displayed] , [memory location address 0 to 19]

Controlling the digital outputs

3 digital outputs are accessible via connector J2. Each is capable of sinking or sourcing 20mA current max.

Output	OUT3	OUT2	OUT1
0	Low	Low	Low
1	Low	Low	High
2	Low	High	Low
3	Low	High	High
4	High	Low	Low
5	High	Low	High
6	High	High	Low
7	High	High	High

0xFE, 0x2F, [Output]

High voltage level is 3.3V , Low voltage level is 0V

Figure 14 : Digital Output Table

Bar Graph

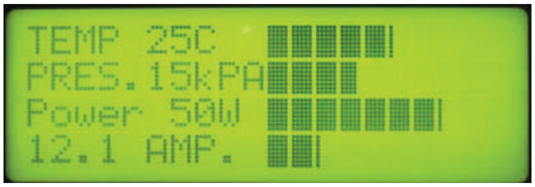


Figure 15: Horizontal Bar Graph

Graph can be drawn from left to right or right to left. The starting point of the graph is the current cursor position.

Initialize horizontal graph command (0xFE,0x04) must be issued before this command can be used.

In the example in Figure 15, the starting point of the graph is at column 10.

To draw the graph at row 0, first set the cursor to row 0, column 10. Then issue the draw left to right graph command

0xFE , 0x2B , [length of the graph, in this case 26)

The maximum length of the graph depends on the starting position of the graph. In the example above, maximum length is 50.

If a new graph is drawn over the existing graph, the existing graph will not be automatically override. This is OK if the new graph length is greater than the existing one. However, if the new graph is shorter in length, the graph must be erase first before a new graph is drawn.

This is done with command 0xFE,0x30, [length to be erased]

Ensure that cursor position is set to the beginning of the graph first.

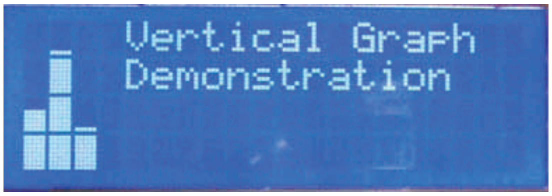


Figure 16: Vertical Bar Graph

Vertical bar graph can be drawn in any column with row 3 as bottom of the graph. Maximum height is 32

Before the vertical graph command can be used, initialize vertical graph command must be issued (0xFE, 0x05)

Vertical graph is draw by command

0xFE,0x33, [column number], [height]

Unlike horizontal graph, drawing a new graph over the existing one will automatically erase the existing graph first.

Note : Custom Characters, Horizontal graph , Vertical Graph and Big Numbers shares the same characters set. Thus, only one of them can be used at any one time.

Switches Inputs

3 input pins for switches are available through J2 connector. These inputs are internally pulled up for easy interface with tact switches etc.

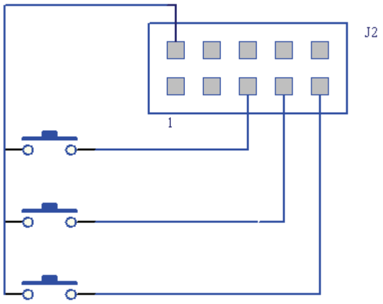
SC2004 will transmit 3 bytes code each time the switch is pressed and released. The switches inputs are scanned every 250ms

0xF9 , [Code 1], [Code 2]

Code 1	Code 2	Input depressed
0x01	0xFE	Input 1
0x02	0xFD	Input 2
0x04	0xFB	Input 3

Figure 17 :

Connection to switches on J2



Analog Ports

Analog 1 & 2 measure voltage of 0 to 10V, while Analog 3 & 4 measure current of 0 to 20mA

Read Analog 1

Command: 0xFE, 0x0B

Response: 0xFA, [ADC Value MSB], [ADC Value LSB]

Read Analog 2

Command: 0xFE, 0x0C

Response: 0xFB, [ADC Value MSB], [ADC Value LSB]

Read Analog 3

Command: 0xFE, 0x0D

Response: 0xFC, [ADC Value MSB], [ADC Value LSB]

Read Analog 4

Command: 0xFE, 0x0E

Response: 0xFD, [ADC Value MSB], [ADC Value LSB]

ADC Value = 1024 for measured voltage level of 10V and current level of 20mA

Saving the user's settings onto non-volatile Flash Memory

User's setting :

- Backlight brightness level
- Custom Characters
- Texts Messages
- Backlight Auto off
- Baud rate

Can be made permanent so that its retains the user's setting even after the module is powered down.

To do this , send the save settings command after you have entered all your settings.

0xFE, 0x20

When settings is saved, the module response with 0xFE, 0x20,0x20 indicating successful save operation.

Changing the Baud Rate

9600 bps	command	0xFE, 0x1E
19200 bps	command	0xFE, 0x1F

Send save settings command. Baud rate will only be changed on the next power up cycle.

SC2004App Software

This software runs on Windows PC designed to test and configure SC2004.

Available for free from www.siliconcraft.net/download.htm

You can use it to create the custom characters, define the stored texts messages and test all the functionality of SC2004.

Hexadecimal code of all command sent to the LCD will be displayed along with all the responded code from the LCD.

Figure 17: Communication Monitor from SC2004App Software

Big Numbers

SC2004 is capable of drawing 4 big numbers each spanning 4 rows by 4 columns.

Initialize big numbers command must be issued before this command can be used. 0xFE , 0x08

Draw big numbers command is 0xFE, 0x63 , [4 digits ASCII numbers].

Supported numbers are 0 to 9 and space (0x20)

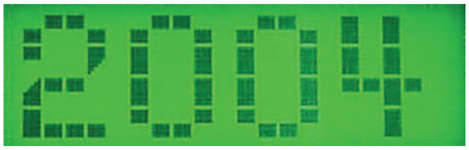


Figure 18 : Big Numbers

To draw numbers " 2004 " on the screen. First clear the LCD. Initialized big number. [0xFE,0x08].

Send 0xFE,0x63 , 0x32 , 0x30, 0x30 , 0x34

Electrical Specification

Power Supply:	9 to 12VDC	Communication Interface :	RS232 / TTL
Current consumption :	25mA (Backlight Off)	Maximum input voltage at TTL input :	5.5V
	Backlight Off	Output High Voltage Level :	3.3V
SC2004YG	Max 300mA , Min 150mA	Maximum sink/source current at output pin :	20mA
SC2004B/W	Max 50mA , Min 30mA		
Operating Temperature :	0°C to 50°C		
Storage Temperature:	-10°C to 60°C		

LCD Data:

Viewing Direction:	6 o'clock
Character size:	2.95 x 4.75 mm

SC2004 Commands Summany

Command	Code (Hexadecimal)	Code (Decimal)
Cursor Home	0x0B	11
Move cursor to the beginning of the next row	0x0C	12
Clear LCD	0x0D	13
Cursor On (Underline)	0xFE , 0x01	254, 1
Cursor On (Blinking)	0xFE, 0x02	254, 2
Cursor Off	0xFE, 0x03	254, 3
Initialize horizontal graph	0xFE, 0x04	254, 4
Initialize vertical graph	0xFE, 0x05	254 , 5
Backlight On	0xFE, 0x06	254, 6
Backlight Off	0xFE, 0x07	254, 7
Initialize Custom Characters	0xFE, 0x08	254, 8
Initialize Big Numbers	0xFE, 0x09	254, 9
Read Analog 1 Value	0xFE, 0x0A	254, 10
Read Analog 2 Value	0xFE, 0x0B	254, 11
Read Analog 3 Value	0xFE, 0x0C	254, 12
Read Analog 4 Value	0xFE, 0x0D	254, 13
Set baud rate to 9600 bps	0xFE, 0x1E	254, 30
Set baud rate to 19200 bps	0xFE, 0x1F	254, 31
Save settings	0xFE, 0x20	254, 32
Set Backlight Brightness	0xFE, 0x28 , [Level]	254, 40 , [Level]
Set Backlight auto off interval	0xFE, 0x29 , [interval in seconds]	254, 41 , [Interval in seconds]
Draw horizontal graph (left to right)	0xFE, 0x2B , [length]	254, 43, [length]
Draw horizontal graph (right to left)	0xFE, 0x2C , [length]	254, 44 , [length]
Clear selected row	0xFE, 0x2D, [row number]	254, 45, [row number]
Clear selected column	0xFE, 0x2E, [column number]	254, 46, [column number]
Set outputs	0xFE, 0x2F, [output value]	254, 47, [output value]
Erase horizontal graph (left to right)	0xFE, 0x30, [length to erase]	254, 48, [length to erase]
Erase horizontal graph (right to left)	0xFE, 0x31, [length to erase]	254, 49, [length to erase]
Set cursor position	0xFE, 0x32, [row number], [column number]	254, 50, [row number] , [column number]

SC2004 Commands Summany (Continue)

Command	Code (Hexadecimal)	Code (Decimal)
Draw Vertical Graph	0xFE, 0x33, [column number] , [height]	254, 51, [column number] , [height]
Print stored texts on selected row	0xFE, 0x34, [row number] , [memory location]	254, 52 , [row number] , [memory location]
Print big numbers	0xFE, 0x63, [4 bytes ASCII numbers]	254, 99, [4 bytes ASCII numbers]
Define Custom Characters	0xFE, 0x64, [64 Bytes Bitmap Data]	254, 100, [64 Bytes ASCII Bitmap Data]
Defines texts messages	0xFE, [memory location] , [20 Bytes text message]	254, [memory location] , [20 bytes text message]

Mechanical Dimension

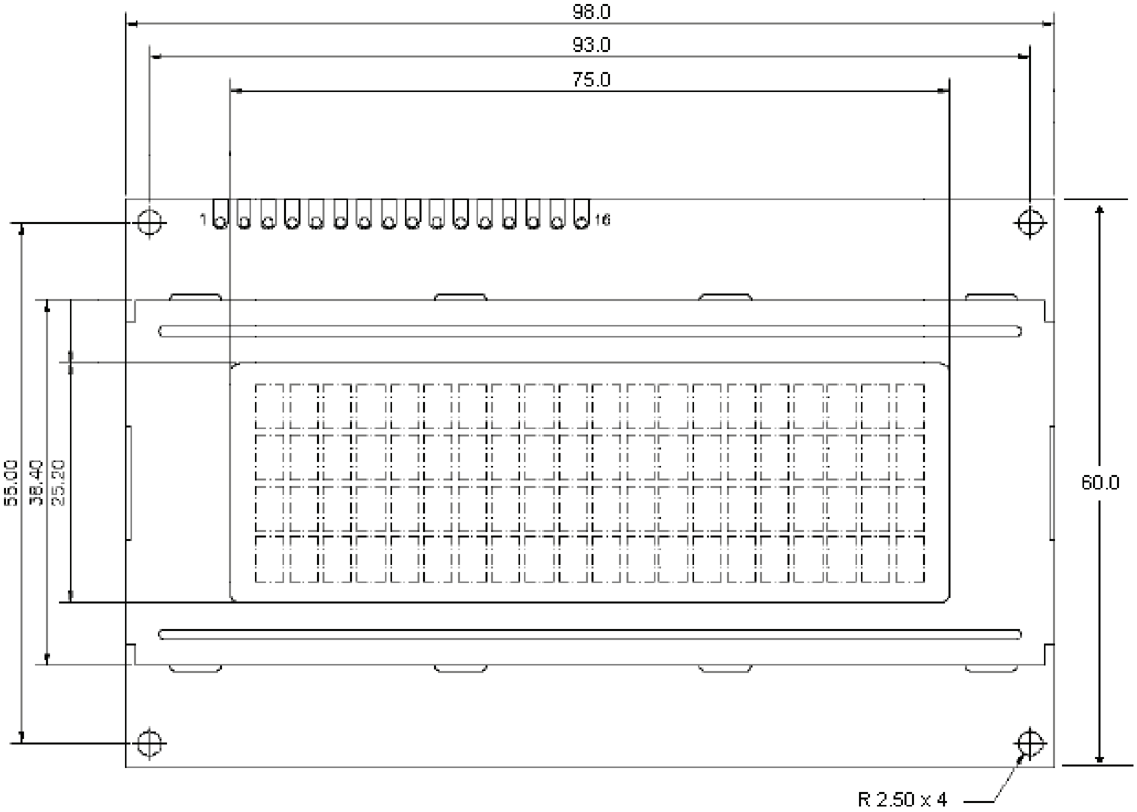


Figure: 19: Mechanical Dimension (units in mm)   Maximum height : 27 mm

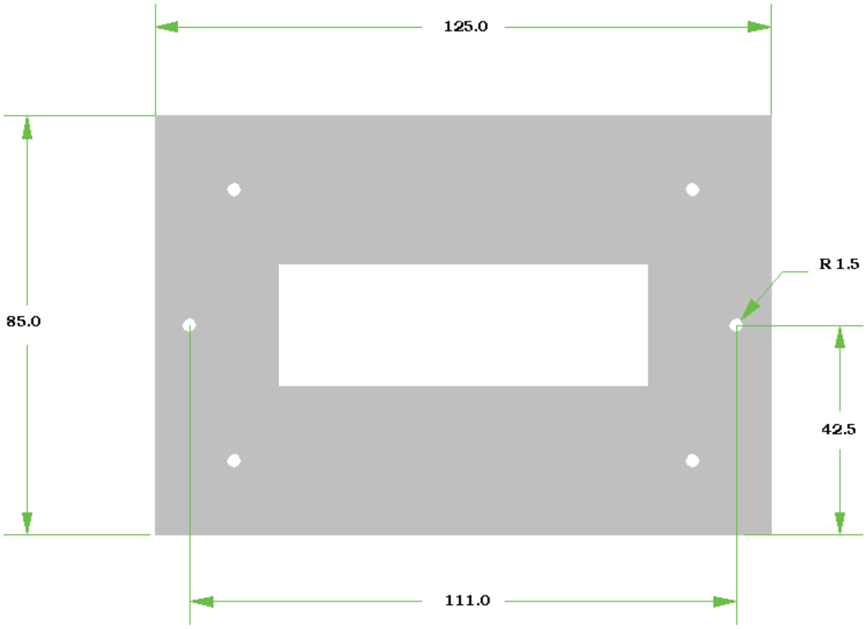


Figure 20 : Mounting Kit dimension (units in mm) Thickness : 1.5 mm