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

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.

```
<table>
<thead>
<tr>
<th>ASCII</th>
<th>0000</th>
<th>0001</th>
<th>0010</th>
<th>0011</th>
<th>0100</th>
<th>0101</th>
<th>0110</th>
<th>0111</th>
<th>1000</th>
<th>1001</th>
<th>1010</th>
<th>1011</th>
<th>1100</th>
<th>1101</th>
<th>1110</th>
<th>1111</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0001</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>1000</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1001</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>1010</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
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</tr>
<tr>
<td>1011</td>
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<td>0</td>
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</tr>
<tr>
<td>1100</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1101</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1110</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1111</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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, Ox20 , 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](image)

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

![Row and Column Positioning](image)

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.

<table>
<thead>
<tr>
<th>Output</th>
<th>OUT3</th>
<th>OUT2</th>
<th>OUT1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>5</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>6</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>7</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

oxFE, 0x2F, [Output]

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

Figure 14 : Digital Output Table
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.

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 inter-
face 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 ]

<table>
<thead>
<tr>
<th>Code 1</th>
<th>Code 2</th>
<th>Input depressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01</td>
<td>0xFE</td>
<td>Input 1</td>
</tr>
<tr>
<td>0x02</td>
<td>0xFD</td>
<td>Input 2</td>
</tr>
<tr>
<td>0x04</td>
<td>0xFB</td>
<td>Input 3</td>
</tr>
</tbody>
</table>

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: oxFE, ox0B

Response: oxFA, [ADC Value MSB], [ADC Value LSB]

Read Analog 2

Command: oxFE, ox0C

Response: oxFB, [ADC Value MSB], [ADC Value LSB]

Read Analog 3

Command: oxFE, ox0D

Response: oxFC, [ADC Value MSB], [ADC Value LSB]

Read Analog 4

Command: oxFE, ox0E

Response: oxFD, [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.

![Communication Data Monitor (HEX)](image)

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)

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

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

Figure 18: Big Numbers

Electrical Specification

Power Supply: 9 to 12VDC

Current consumption: 25mA (Backlight Off)

Backlight Off

Operating Temperature: 0°C to 50°C

Storage Temperature: -10°C to 60°C

Communication Interface: RS232 / TTL

Maximum input voltage at TTL input: 5.5V

Output High Voltage Level: 3.3V

SC2004YG Max 300mA, Min 150mA

SC2004B/W Max 50mA, Min 30mA

Maximum sink/source current at output pin: 20mA

LCD Data:

Viewing Direction: 6 o’clock

Character size: 2.95 x 4.75 mm
# SC2004 Commands Summary

<table>
<thead>
<tr>
<th>Command</th>
<th>Code ( Hexadecimal )</th>
<th>Code ( Decimal )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cursor Home</td>
<td>0x0B</td>
<td>11</td>
</tr>
<tr>
<td>Move cursor to the beginning</td>
<td>0x0C</td>
<td>12</td>
</tr>
<tr>
<td>Clear LCD</td>
<td>0x0D</td>
<td>13</td>
</tr>
<tr>
<td>Cursor On ( Underline )</td>
<td>0xFE, 0x01</td>
<td>254, 1</td>
</tr>
<tr>
<td>Cursor On ( Blinking )</td>
<td>0xFE, 0x02</td>
<td>254, 2</td>
</tr>
<tr>
<td>Cursor Off</td>
<td>0xFE, 0x03</td>
<td>254, 3</td>
</tr>
<tr>
<td>Initialize horizontal graph</td>
<td>0xFE, 0x04</td>
<td>254, 4</td>
</tr>
<tr>
<td>Initialize vertical graph</td>
<td>0xFE, 0x05</td>
<td>254, 5</td>
</tr>
<tr>
<td>Backlight On</td>
<td>0xFE, 0x06</td>
<td>254, 6</td>
</tr>
<tr>
<td>Backlight Off</td>
<td>0xFE, 0x07</td>
<td>254, 7</td>
</tr>
<tr>
<td>Initialize Custom Characters</td>
<td>0xFE, 0x08</td>
<td>254, 8</td>
</tr>
<tr>
<td>Initialize Big Numbers</td>
<td>0xFE, 0x09</td>
<td>254, 9</td>
</tr>
<tr>
<td>Read Analog 1 Value</td>
<td>0xFE, 0x0A</td>
<td>254, 10</td>
</tr>
<tr>
<td>Read Analog 2 Value</td>
<td>0xFE, 0x0B</td>
<td>254, 11</td>
</tr>
<tr>
<td>Read Analog 3 Value</td>
<td>0xFE, 0x0C</td>
<td>254, 12</td>
</tr>
<tr>
<td>Read Analog 4 Value</td>
<td>0xFE, 0x0D</td>
<td>254, 13</td>
</tr>
<tr>
<td>Set baud rate to 9600 bps</td>
<td>0xFE, 0x1E</td>
<td>254, 30</td>
</tr>
<tr>
<td>Set baud rate to 19200 bps</td>
<td>0xFE, 0x1F</td>
<td>254, 31</td>
</tr>
<tr>
<td>Save settings</td>
<td>0xFE, 0x20</td>
<td>254, 32</td>
</tr>
<tr>
<td>Set Backlight Brightness</td>
<td>0xFE, 0x28, [ Level ]</td>
<td>254, 40, [ Level ]</td>
</tr>
<tr>
<td>Set Backlight auto off interval</td>
<td>0xFE, 0x29, [ interval in seconds ]</td>
<td>254, 41, [ Interval in seconds ]</td>
</tr>
<tr>
<td>Draw horizontal graph ( left to right )</td>
<td>0xFE, 0x2B, [ length ]</td>
<td>254, 43, [ length ]</td>
</tr>
<tr>
<td>Draw horizontal graph ( right to left )</td>
<td>0xFE, 0x2C, [ length ]</td>
<td>254, 44, [length ]</td>
</tr>
<tr>
<td>Clear selected row</td>
<td>0xFE, 0x2D, [ row number ]</td>
<td>254, 45, [ row number ]</td>
</tr>
<tr>
<td>Clear selected column</td>
<td>0xFE, 0x2E, [ column number ]</td>
<td>254, 46, [ column number ]</td>
</tr>
<tr>
<td>Set outputs</td>
<td>0xFE, 0x2F, [ output value ]</td>
<td>254, 47, [ output value ]</td>
</tr>
<tr>
<td>Erase horizontal graph ( left to right )</td>
<td>0xFE, 0x30, [ length to erase ]</td>
<td>254, 48, [ length to erase ]</td>
</tr>
<tr>
<td>Erase horizontal graph ( right to left )</td>
<td>0xFE, 0x31, [ length to erase ]</td>
<td>254, 49, [ length to erase ]</td>
</tr>
<tr>
<td>Set cursor position</td>
<td>0xFE, 0x32, [ row number ], [ column number ]</td>
<td>254, 50, [ row number ], [ column number ]</td>
</tr>
</tbody>
</table>
SC2004 Commands Summary (Continue)

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

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