

# LCD Micro Serial Interface Module +

## Technical Data

### Features

- **Micro size (47 x 26mm) to piggy-back on the LCD module and form a compact solution.**
- **Simple RS232 serial transfer of characters to LCD from PC, BASIC Stamp, OOPic & other microcontroller modules.**
- **Serial selectable Backlight\* brightness, No. of lines and serial baud rate (1200-19200bps).**
- **LCD contrast variable with on-board control.**
- **Low power operation from 5Volt regulated supply or 8-15V supply using on-board regulation.**
- **Supports 16x2, 20x2, 40x2 & 20x4 LCD modules.**
- **No learning curve to get characters on the LCD.**

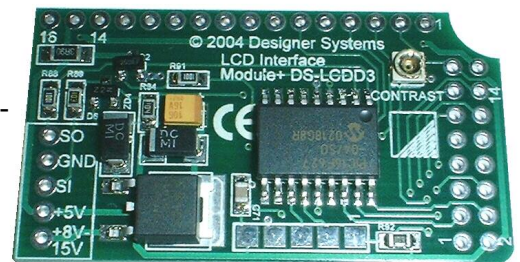
### Description

The DS-LCDD3 micro module provide a simple means of connecting any device capable of standard RS232 serial communication to a standard Liquid Crystal Display (LCD) module of 16 x 2, 20 x 2, 40 x 2 or 20 x 4 character/lines.

The DS-LCDD3 provides complete control of character placement, customisation and cursor movement to ensure that your application is up-and-running in a fraction of the time necessary to implement the standard LCD control protocol.

The DS-LCDD3 also features on-board supply regulation for both LCD supply and backlight, and also includes fully 'jumperless' setup of internal features over the serial link. These include 15 levels of backlight brightness, serial baud rate (9600 baud default) and number of display lines. The module simple piggy-backs on the LCD module to form a compact solution.

### DS-LCDD3



The module is controlled by a Microchip PIC FLASH microcontroller which can be re-programmed from the standard LCD routines with client specific code to form any HID type application e.g. Serial terminal, door entry etc.

### Applications

Simple HID applications within robotics, programming, user feedback, industrial control and monitoring. Visual feedback in both amateur and professional applications.

### Selection Guide

Description	Part Number
LCD Interface Module with serial control	DS-LCDD3

\* Backlight only available on some LCD modules; see pricelist for details.

## Power requirements

The DS-LCDD3 & LCD module requires either an external 5Volt regulated supply or a 8-15Volt unregulated supply. This supply can be derived from a mains adaptor or a battery pack. Current consumption is approx. 3mA excluding backlight, or from 3-150mA including backlight (brightness dependant). The five (5) pin header, see table below, is used to connect to either supply by connecting between 5V & GND or 8-15V & GND. Note connections to prevent damage!

## LCD Contrast

The DS-LCDD3 has a 'CONTRAST' control which is provided to set the display contrast to the desired level.

## LCD Connections

The DS-LCDD3 features two LCD connections to support both Single-In-Line (SIL) and Dual-In-Line (DIL) LCD modules. Both connections are easily soldered to the required LCD module using a 16 pin SIL pin header, 16 pin (8+8) DIL pin header or alternatively a flexible wire connection. *Note that incorrect connection may damage the DS-LCDD or LCD module.*

## RS232 (serial) connection

The DS-LCDD3 supports RS232 serial communication and control. Connection to the module is through a five (5) pin header, pinned as follows:

Header pin	Connection Designation
1	SO (Serial output)
2	GND (Signal ground)
3	SI (Serial input)
4	+5V (Regulated Supply)
5	+8-15V (Unregulated supply)

There are two popular forms of RS232 interfacing, standard and inverted TTL, the latter not actually being defined under the RS232 specification but being popular with the microcontroller community as no interface IC is required. The DS-LCDD3 supports both formats and can therefore be used with most microcontroller modules such as the OOPic-R and BASIC Stamp and any modern PC fitted with a serial port.

## Connection examples:

To connect a PC fitted with a standard DB9 serial port pin 3 on the DB9 connector should connect to 'SI', pin 5 to 'GND' and pin 2 to 'SO'.

Additional connections may be required to allow serial communication to take place on the PC, these being wire links from 1 to 4 & 6 and 7 to 8 on the DB9 connector.

To connect a PC fitted with a standard DB25 serial port pin 2 on the DB25 connector should connect to 'SI', pin 7 to 'GND' and pin 3 to 'SO'.

Additional connections may be required to allow serial communication to take place on the PC, these being wire links from 20 to 6 & 8 and 4 to 5 on the DB25 connector.

*A readymade PC cable fitted with a DB9 connector is available (P.n. DS-L232CAB2) that will also power the LCD module from the PC serial interface (with backlight disabled).*

## RS232 (serial) commands

Characters for display on the LCD module are sent to the DS-LCDD3 in the form of ASCII codes of value 32<sub>decimal</sub> (20<sub>hex</sub>) to 127<sub>decimal</sub> (7F<sub>hex</sub>). These characters are displayed as text on the LCD module at the current cursor position.

Text can be displayed very simply from a PC and many Microcontroller based controllers such as the OOPic (II), BS2, BASIC Stamp etc. by writing a serial out command with a string value.

### Examples:

#### Savage Innovations OOPic-R:

```
RS232.Baud = cv9600           '9600 baud
RS232.Mode = 0                'Async mode
RS232.Operate = cvTrue       'Enable
RS232.String = "Display Test" 'Send text
```

#### Parallax BASIC Stamp:

```
SEROUT 0, N9600, ("Display Test") '9600 baud
```

To allow the setup of backlight brightness, serial baud rate etc. the module supports a control command format. To place the DS-LCDD3 into control command mode 255<sub>decimal</sub> (FF<sub>hex</sub>) must be sent before the following instruction codes/values:

Command	Dec	Hex
Backlight - OFF	0	00
Backlight - Bright 1	1	01
Backlight - Bright 2	2	02
Backlight - Bright 3	3	03
Backlight - Bright 4	4	04
Backlight - Bright 5	5	05
Backlight - Bright 6	6	06
Backlight - Bright 7	7	07
Backlight - Bright 8	8	08
Backlight - Bright 9	9	09
Backlight - Bright 10	10	0A

Backlight - Bright 11	11	0B
Backlight - Bright 12	12	0C
Backlight - Bright 13	13	0D
Backlight - Bright 14	14	0E
Backlight - FULL ON	15	0F
BAUD rate - 1200baud	16	10
BAUD rate - 2400baud	17	11
BAUD rate - 4800baud	18	12
BAUD rate - 9600baud	19	13*
BAUD rate - 19200baud	20	14
LCD 1 line display	32	20
LCD 2 line display	33	21*

\* Factory defaults

Serial baud rate and LCD lines are stored within non-volatile memory to ensure recall upon the next power-up.

The other serial protocol requirements are:

```
8 Data bits
1 Stop Bit
No Parity
No handshaking (if configurable)
```

*Tip: If character errors appear on the LCD display when sending from a fast PC then set Stop bits to 2.*

The backlight brightness defaults to 'OFF' on every power-up.

To allow the control of cursor position, clear display and scroll etc. the LCD module also supports a command format. To place the DS-LCDD3 into command mode 254<sub>decimal</sub> (FE<sub>hex</sub>) must be sent before the following instruction codes:

Command	Dec	Hex
Home (abort scroll)	0	00
Clear display	1	01
Blank display (text not cleared)	8	08
Cursor OFF or restore after blanking	12	0C
Cursor ON & blinking	13	0D
Cursor ON & underline	14	0E
Move cursor left	16	10
Move cursor right	20	14
Scroll display left	24	18
Scroll display right	28	1C

The following examples for the OOPic (II), BS2 and BASIC Stamp issues a clear display command and then reverts back to waiting for text input:

#### Savage Innovations OOPic-R:

```
RS232.Baud = cv9600           '9600 baud
RS232.Mode = 0                'Async mode
RS232.Operate = cvTrue       'Enable
RS232.Value = 254            '
RS232.Value = 1              'Clear display
```

#### Parallax BASIC Stamp:

```
SEROUT 0, N9600, (254,1)      '9600 baud
```

A further two commands allow special characters to be defined and characters to be displayed at particular locations without having to re-write the whole display.

Each character position on the LCD occupies a memory location with a specific address. These addresses allow one or more characters to be changed on the LCD without having to re-write the whole screen i.e. if you want to update just a temperature value on a display which reads 'Temperature = 25oC'.

To accomplish this the DD address of the character position is written after the command mode request e.g. to write the character 'A' to position 6 of line 1 on a 16 x 2 type display the following would be sent:

254<sub>decimal</sub>, 134<sub>decimal</sub>, 'A' ASCII

134 is calculated from the line start address 128\*, plus 6.

*Note: All character based LCD modules use a 40-character per line RAM storage area. This means that if 20 characters were written to a 16-character display then only the first 16 characters would be displayed, with the missing 4 being stored in RAM but not displayed. A scroll-left of the display would then be necessary to view the additional characters.*

*It should also be noted that once the end of the current line is reached the display does not automatically wrap-around to the next line, a new line start address must be written.*

*\* See Table 1.0 below for DD addresses for different LCD modules.*

The LCD contains a small amount of Character-Generator or CG RAM to allow the definition of special characters. Only 8 special characters are definable and displayed by writing a value of 0 to 7 into the display e.g. to display 'ohms Ω' the omega must be firstly defined as CG character 0 and be displayed by writing:

RS232.String = "ohms " + CHR\$(0)

To define the omega character in CG RAM eight values are required to make up the character shape. These values consist of the binary representation, or bit map, of the character as follows:

```

□ □ □ □ □ 0
□ ■ ■ ■ □ 14
■ □ □ □ ■ 17
■ □ □ □ ■ 17
■ □ □ □ ■ 17
□ ■ □ □ □ 10
■ ■ □ □ ■ 27
□ □ □ □ □ 0
  
```

After sending the command code 254<sub>decimal</sub>, the character address is then sent consisting of:

64<sub>decimal</sub> + (8<sub>decimal</sub> x CG character)

where CG character = character to define 0 to 7

for CG 0 address would be 64<sub>decimal</sub>.

The above bit map values are then sent in the order shown to define the character. Therefore the above character would be defined by sending:

254,64,0,14,17,17,17,10,27,0<sub>decimal</sub>

To then switch back to display RAM and print the character send 254<sub>decimal</sub>, DDRAM address i.e. 128<sub>decimal</sub> (for start of line 1) and 0<sub>decimal</sub> to display the character defined above.

## Testing

The DS-LCDD3 can be tested for operation by shorting the 'SI' input to '+5V' and applying power. The Part Number and firmware version are displayed on the LCD until power is removed, e.g.:

```

DS-LCDD3 (c) 2004
Version 1.00
  
```

*Note: Ensure that no other serial connection is made to prevent damage to external serial equipment such as the PC.*

Table 1.0

LCD Display addresses

16 characters x 2 lines:

Line 1	0	1	2	3	4	5	6	.....	15	.....	39
DD Address	128	129	130	131	132	133	134	.....	143	.....	167
											Hidden
Line 2	64	65	66	67	68	69	70	.....	79	.....	103
DD Address	192	193	194	195	196	197	198	.....	207	.....	231
											Hidden

20 characters x 2 lines:

Line 1	0	1	2	3	4	5	6	.....	19	.....	39
DD Address	128	129	130	131	132	133	134	.....	147	.....	167
											Hidden
Line 2	64	65	66	67	68	69	70	.....	83	.....	103
DD Address	192	193	194	195	196	197	198	.....	211	.....	231
											Hidden

40 characters x 2 lines:

Line 1	0	1	2	3	4	5	6	.....	39
DD Address	128	129	130	131	132	133	134	.....	167
Line 2	64	65	66	67	68	69	70	.....	103
DD Address	192	193	194	195	196	197	198	.....	231

20 characters x 4 lines:

Line 1	0	1	2	3	4	5	6	.....	19
DD Address	128	129	130	131	132	133	134	.....	147
Line 2	64	65	66	67	68	69	70	.....	83
DD Address	192	193	194	195	196	197	198	.....	211
Line 3	20	21	22	23	24	25	26	.....	39
DD Address	148	149	150	151	152	153	154	.....	167
Line 4	84	85	86	87	88	89	90	.....	103
DD Address	212	213	214	215	216	217	218	.....	231

Note : RED boxed values denote line start addresses

### Electrical Characteristics (T<sub>A</sub> = 25°C Typical)

Parameter	Minimum	Maximum	Units	Notes
Supply Voltage (5V)	4.5	5.5	V	
Supply Voltage (8-15V)	8	15	V	
Supply Current	3	5	mA	1
RS232 TX data output level	0	VCC-0.8	V	
RS232 RX data input level	-15	+15	V	

### Absolute Maximum Ratings

Parameter	Minimum	Maximum	Units
Supply Voltage (5V)	-0.5	+6	V
Supply Voltage (8-15V)	-0.5	16V	V
Operating Temperature	0	50	°C

### Environmental

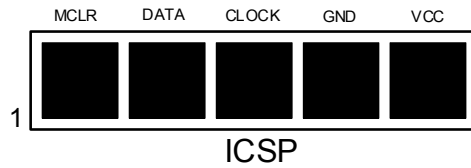
Parameter	Minimum	Maximum	Units
Operating Temperature	-5	70	°C
Storage Temperature	-10	80	°C
Humidity	0	80	%
Immunity & emissions	EMC compliance to 89/336/EEC		

#### Notes:

1. Value given does not include backlight current.

## Programmable features:

The DS-LCDD3 module features a Microchip FLASH based PIC<sup>®</sup> microcontroller that can be re-programmed with a suitable lead (P.n. DS-ICSP18) which plugs directly into the ICD2<sup>®</sup> development programmer and mates with five square pads on the PCB:



This allows the customer (or Designer Systems) to write his or her own application code to produce Display based systems without the need to design additional hardware.

Applications could include Security entry systems, Robotic programming systems, Diagnostic display and programming in industrial control systems etc.

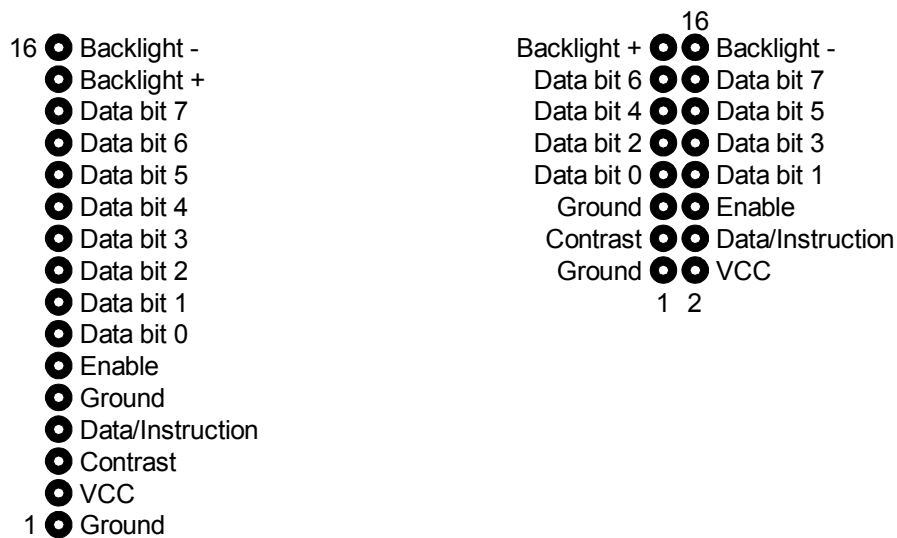
The following table lists the IO pin structure for the DS-LCDD2 to allow custom applications to be developed:

IO Description	IO Port / Line	IO Direction
LCD data bus input 0	Port B / RB0	Output
LCD data bus input 1	Port B / RB1	Output
LCD data bus input 2	Port B / RB2	Output
LCD data bus input 3	Port A / RA6	Output
LCD data bus input 4	Port B / RB4	Output
LCD data bus input 5	Port B / RB5	Output
LCD data bus input 6	Port B / RB6	Output
LCD data bus input 7	Port B / RB7	Output
LCD enable line (H=Enabled)	Port A / RA0	Output
LCD register select (L=Instruction, H= Data)	Port A / RA1	Output
RS232 serial input	Port A / RA3	Input
RS232 serial output	Port A / RA2	Output
Backlight control	Port B / RB3	Output

The above IO lines may also be re-assigned in program code to allow the DS-LCDD3 to be used in other applications that do not require an LCD or keypad.

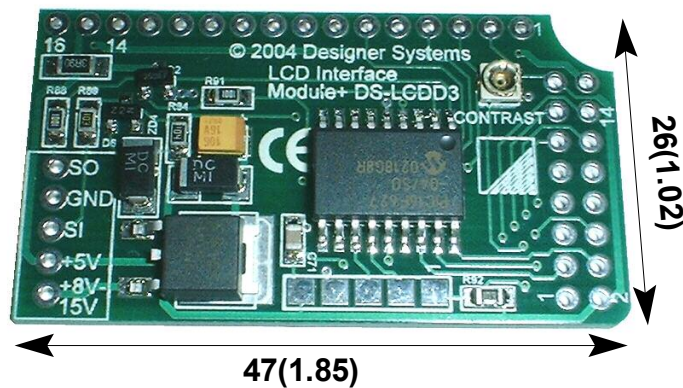
## LCD connections:

The DS-LCDD3 features two types of LCD connector, SIL (Single In Line) and DIL (Dual In Line), these being pinned as follows:



# Mechanical Specifications – Units millimetres (inches)

Design subject to change without notice.



## WEEE Consumer Notice

This product is subject to Directive 2002/96/EC of the European Parliament and the Council of the European Union on Waste of Electrical and Electronic Equipment (WEEE) and, in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal/public waste. Please utilise your local WEEE collection facilities in the disposition and otherwise observe all applicable requirements. For further information on the requirements regarding the disposition of this product in other languages please visit [www.designersystems.co.uk](http://www.designersystems.co.uk)



## RoHS Compliance

This product complies with Directive 2002/95/EC of the European Parliament and the Council of the European Union on the Restriction of Hazardous Substances (RoHS) which prohibits the use of various heavy metals (lead, mercury, cadmium, and hexavalent chromium), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

### Declaration of Conformity

**Apparatus name / model number** DS-LCDD3

**Conformity via** Generic Standard EN50081-1

Generic Standard EN50082-1

**Conformity criteria** For use only within commercial, residential and light industrial applications

**We certify that the apparatus identified above conforms to the requirements of Council Directive 89/336/EEC & 73/23/EEC**

**Signed.**

**Date** 1/4/04

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**Manufacturer** Designer Systems, 15 Andrew Place, Truro, Cornwall

TR1 3HZ, United Kingdom

**Description of apparatus** LCD panel interface peripheral

Having made this declaration the CE mark is affixed to this product, its packaging, manual or warranty.

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