

Serial LCD Display – Firmware Version 1.0

The MAILTRONICS serial LCD backpack simplifies the use of LCD with microcontroller systems (e.g. PICAXE) to visually output user instructions or readings, without the need for a computer. It also allows low pin count microcontrollers that are unable to directly drive an LCD to do so.

The serial LCD is very especially useful when working, for example with analogue sensors, as the analogue reading can easily be displayed on the LCD module. They are extremely helpful when debugging code also as comments can be sent to the LCD throughout the program to give you an indication of what is happening.

All LCD commands are transmitted serially via a single microcontroller pin using the **serout** command.

e.g. to print the text 'Hello' the command is simply:

serout 7,N2400,("Hello")

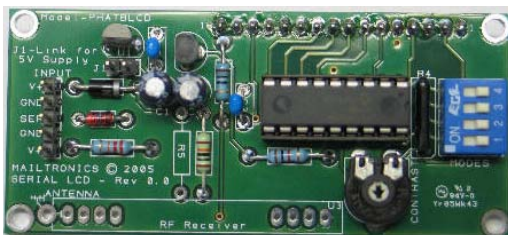
The serial LCD backpack can be configured in a number of ways to enable it to be run from a regulated 5VDC supply or an unregulated 8-24VDC supply. There are 8 options for baud rates including 300, 1200, 2400 and 4800 baud in either a True or Inverted state.

Two resistors allow the data line to be held either HI to +5V or to GND or left floating. An onboard potentiometer allows the contrast of the LCD to be adjusted. The kit is supplied with a range of plug headers and sockets to allow for a range of connection options.

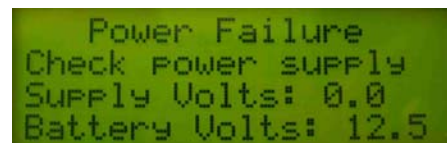
The backpack is not limited to driving a 16 x 2 LCD display. It can be purchased in a kit without an LCD display and drive up to a 40 x 4 LCD display.

LCD Backpack Features:

1. 16x2 LCD Alphanumeric Display – Backlit option available
2. Simple serial (1 wire) connection to microcontroller (300, 1200, 2400 and 4800baud ,N,8,1.
3. Selectable Baud Rate - 300, 1200, 2400 and 4800 ,N,8,1.
4. Selectable Polarity – True or Inverted
5. Small footprint – Same size as 16 x 2 LCD Display.
6. Easy to assemble through hole components and silk screened, solder masked PCB.
7. Plug in pre-programmed processor can be upgraded with future versions of firmware.
8. 5V DC or 8-24VDC Operation with on board Voltage Regulator.



Top view of an assembled Serial LCD Backpack



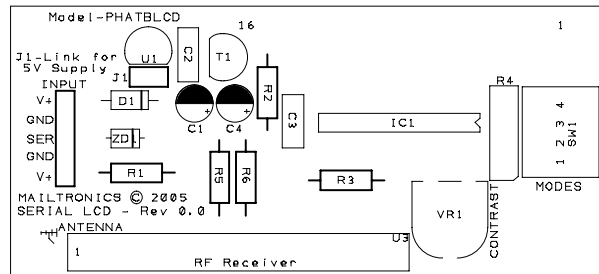
20 x 4 LCD Display in one of our manufacturing products driven by the Serial LCD Backpack

Backpack Kit Assembly

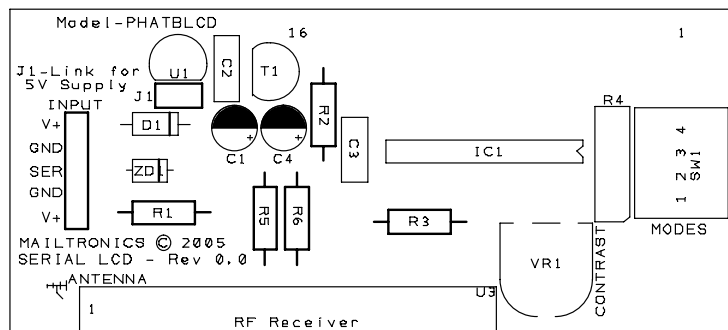
Before you start assembling your kit there are a couple of important things you must do. **FIRST** read through these instructions entirely **before you start construction** then follow the sequence below to ensure your kit is a success.

1. First you need to check the components against the parts list below to ensure you have all the components required. If all components are present then move on to step two. If you are missing any components then you will need to contact us for replacements.

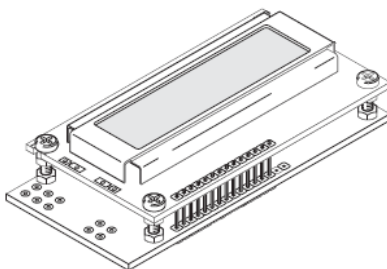
IC1	IC Socket and Microcontroller
R1	22K ohm resistor
R2	10 ohm resistor
R3	1K ohm resistor
R4	10K ohm 4 way SIL resistor
R5	100K ohm resistor
R6	100K ohm resistor
C1	10uF electrolytic capacitor
C2	0.1uF mono capacitor
C3	0.1uF mono capacitor
C4	10uF electrolytic capacitor
D1	1N4007 power diode
ZD1	5.1V Zener diode
T1	BC547 Transistor
UI	LM78L05 Voltage Regulator
SW1	4 Way DIP Switch
CONN1	16way Pin Header
J1	2 Way Pin Header and Jumper
VR1	50K Potentiometer
INPUT	5 Way SIL Pin Header, Molex Type Header, 5 Way SIL Socket



2. You now need to examine both sides of PCB (printed circuit board) to ensure there are no shorted or broken tracks. If the PCB looks OK you may proceed to step 3. If you find any shorted tracks try to remove the short with a small scraper. If there are broken tracks you can repair them by soldering a small piece of wire across the break or contact us for a replacement PCB. The PCB supplied is checked when kit is packed so it will be very unlikely you will find a problem.
3. Lets start making the kit. Mount the components as shown on the Layout diagram below. When mounting the components, bend the leads with a small pair of long nose pliers where required, place component leads through PCB and slightly bend the leads over to hold the components in place. This prevents the components falling out when you turn the PCB over to solder.



4. First mount and solder the resistors, these can be mounted hard against the PCB. The following options are available that determine which resistors to install.
Install resistor R1 and R4. Note that R4 is polarity sensitive. There is a small white dot on one end of R4. This dot goes closest to VR1 end of R4 PCB pads or where the corner is cut of the silk screen overlay of R4.
Option 1: For backlight control install resistors R3 and R2 – you may need to adjust the value of R2 if you are using an LCD not supplied with the kit. See LCD back lighting section.
Option 2: To hold receive line LOW install R6 and leave out R5
Option 3: To hold receive line HIGH install R5 and leave out R6
Option 4: Leave receive line floating. Leave out R5 and R6
5. Next mount the Zener (ZD1) and the IN4007 (DI) diodes, taking note of the polarity. Line the black or gray stripe end of the diode with the line on the component overlay on the PCB. Double check polarity before soldering in place.
6. Now mount the IC socket (IC1), line the notch on the end of the socket up with the notch on the component overlay on the PCB. Double check polarity before soldering in place.
7. Mount the 0.1uF mono capacitors (C2, C3), note these are non polarised so may be installed either way.
8. Next mount the electrolytic capacitors C1 and C4 taking note of the polarity. The long lead of the capacitor goes to the pad with the + next to it. The short lead (the one closest to the --- --- --- marking on the side of the capacitor can) goes in the hole surrounded by the white PCB overlay.
9. Now mount the LM75L05 (U1) voltage regulator. Ensure that it faces the direction as shown on the overlay with the flat side facing into the center of the PCB
10. If the Backlight control is to be used, next install the BC547 Transistor (Q1)
11. Mount the DIP Switch (SW1) making sure the numbers on the switches match up with the numbers on the overlay.
12. Next install the Potentiometer (VR1)
13. The last components to solder in are the connectors. These include the 2-pin header and jumper (J1), The 16 way header for connecting to the LCD and the power and data input connectors. First install the 2-pin jumper in J1.
14. You have a choice of connectors for the 5 way input connection. Select and install your desired configuration.
15. A 16-way pin header and socket is supplied to enable the LCD to be either plugged on to the backpack (removable) or soldered to the backpack with only the header.



16. Now you can install the microcontroller IC1. Simply press it into the IC Socket making sure the notch on the IC lines up with the sockets mark.
17. The next step is to select a baud rate, connect a power supply and see if the kit works.

Double check the connection of the power supply as incorrect polarity may damage the device.

If you are using a 5V power supply the fit jumper J1 over the 2 pins. If a higher voltage is to be used then remove the jumper.

CAUTION!!!

If a voltage higher than 5VDC is supplied to the PCB while the jumper J1 is in place the microcontroller and LCD display may be destroyed.

IT'S ALIVE

To set the baud rate and inverted or true data type use the dipswitches and the table below:

DATA MODE	DIPSW1	DIPSW2	DIPSW3	DIPSW4
300 – True	OFF	OFF	OFF	OFF
1200 – True	ON	OFF	OFF	OFF
2400 – True	OFF	ON	OFF	OFF
4800 – True	ON	ON	OFF	OFF
300 – Inverted	OFF	OFF	ON	OFF
1200 – Inverted	ON	OFF	ON	OFF
2400 – Inverted	OFF	ON	ON	OFF
4800 – Inverted	ON	ON	ON	OFF

Once you have set the baud rate you can apply power to the LCD display and it should display the baud rate setting for 2 seconds then go blank. If nothing is displayed try adjusting the contrast potentiometer until you see the dots on the display darkening. Watch the display while re powering it and it should display the baud rate setting. If you still have not got any message on the display then remove power and double check all component polarities and solder joints. Also check if there is actually power getting to the display. There should be 5VDC present across pins 5 and 14 of the microcontroller.

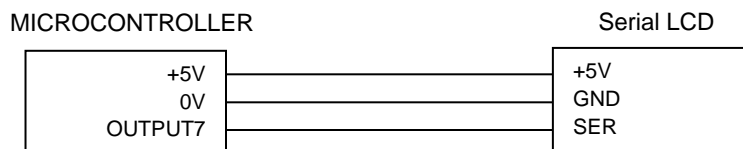
Once you have the LCD up and running you can disable the startup message by switching on DIPSW4.

LCD Backlight (LCD)

When a backlight is fitted the LCD connections allow a controlled output to switch the back lighting on and off via serial data. Note that you must also have soldered the 'A' and 'K' connections on the LCD and added a resistor to position R2 on the PCB to use this feature. See LCD datasheet for suitable resistor values for the LCD backlight. You also should have added Q1 and R3 to the PCB your

Connecting the LCD to a Microcontroller

The following diagram shows how to connect the Serial LCD module to the PICAXE system. In this documentation we will use Output 7 of the Microcontroller



Output 7 is used to send serial data signals to the LCD

Basic Test program

```

init: pause 500 ' wait for display to initialise
main: serout 7,N2400,(254,128) ' move to start of first line
      serout 7,N2400,("Hello!123") ' output text
end
  
```

Note the use of N2400 (not T2400) within PICAXE programs. Note the Serial LCD does not buffer bytes received, and so a small delay between bytes (to update the display) is required on non-PICAXE systems. This delay is applied automatically by the PICAXE system.

If the characters do not all appear as expected, the wrong baud rate and polarity may not be selected.

Displaying Messages

The LCD can display characters, messages and the time, and can also accept certain control commands (e.g. clear display or move cursor to new position). Note that the serial LCD module takes approx half a second to initialise and so any data sent during this period will be lost. It is advisable to put a 'pause 500' command at the start of any program to ensure no data is lost when the system is powered up.

Characters

Characters are normal symbols that can be displayed on the LCD screen. See Appendix 1 for a table of the common ASCII characters. The numbers 253 and 254 are used to indicate a write memory or control command sequence follows.

8-128 ASCII Characters (see Appendix 1)
129-252 Miscellaneous Characters (may vary dependant on LCD type)
254 Special Command – Command Character
255 Reserved for future use

Serial LCD

Note: The connections must be made **directly** to the microcontroller output pins (not via the darlington driver buffered outputs found on some starter pack project boards)

Characters can be output via two methods – either by using the ASCII number or the symbol enclosed in speech marks e.g. (65) and ("A") both output the same symbol.

Control Commands (254)

The number 254 prefixes all control commands. They are used to send commands to the Serial LCD Module (e.g. move to line 2, switch cursor off etc.).

The most common control commands are:

254,1 Clear Display (must be followed by a 'pause 30' command)
254,8 Hide Display
254,12 Restore Display
254,14 Turn on Cursor
254,16 Move Cursor Left
254,20 Move Cursor Right
254,128 Move to line 1, position 1
254, y Move to line 1, position x (where $y = 128 + x$)
254,192 Move to line 2, position 1
254, y Move to line 2, position x (where $y = 192 + x$)

Controlling Backlight

To turn backlight on send

254,254,1

Basic Program example

init: pause 500 ' wait for display to initialise

main: serout 7,N2400,(254,254,1) ' turn on backlight

end

To turn backlight off send

254,254,2

This is only V1.0 of the firmware which is the first release. It is very simple. We are looking for you to come back to us with ideas on how we can improve the firmware. Do you want to be able to store messages in display and recall them, put backlighting into different modes such as flashing or auto on with received data then off after a preset time etc etc. Give us your wish lists and we will see what we can do.

Some Standard LCD Character Patterns of LCDs

Upper(4bit) Lower(4bit)		LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HHLL	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

Some Standard LCD Character Patterns of LCDs

		Higher 4-bit (D4 to Character Code (Hexadecimal))																
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)	±		0	0	P	'	P	S	E	A	'	r	R	P	T	
	1	CG RAM (2)	=	!	1	A	0	a	A	0	*	i	'	J	+	Y	V	
	2	CG RAM (3)	"	"	2	B	R	b	r	e	f	6	'	°	°	S	8	2
	3	CG RAM (4)	#	#	3	C	S	c	s	A	0	0	'	P	7	e	4	
	4	CG RAM (5)	\$	\$	4	D	T	d	t	a	0	0	'	4	7	Z	0	
	5	CG RAM (6)	%	%	5	E	U	e	u	A	0	0	'	5	7	A	7	7
	6	CG RAM (7)	&	&	6	F	V	v	A	0	0	'	6	7	1	0	0	7
	7	CG RAM (8)	'	'	7	G	W	w	G	0	R	x	'	7	7	7	7	7
	8	CG RAM (1)	(	(	8	H	X	x	e	0	0	'	8	7	7	7	7	7
	9	CG RAM (2)	)	)	9	I	Y	y	e	0	0	'	9	7	7	7	7	7
	A	CG RAM (3)	*	*	A	J	Z	z	e	0	0	'	A	7	7	7	7	7
	B	CG RAM (4)	+	+	B	K	Z	z	e	0	0	'	B	7	7	7	7	7
	C	CG RAM (5)	=	=	C	L	Z	z	e	0	0	'	C	7	7	7	7	7
	D	CG RAM (6)	-	-	D	M	Z	z	e	0	0	'	D	7	7	7	7	7
	E	CG RAM (7)	.	.	E	N	Z	z	e	0	0	'	E	7	7	7	7	7
	F	CG RAM (8)	/	/	F	O	Z	z	e	0	0	'	F	7	7	7	7	7

