

# **LCDproc User's Guide**

## **The Ultimate Guide to LCDproc 0.4.3**

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## **LCDproc User's Guide: The Ultimate Guide to LCDproc 0.4.3**

by Rene Wagner, Guillaume Fillion, and William W. Ferrell

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This document is a guide to LCDproc written for users. It covers LCDproc 0.4.3 ONLY. Some things may be valid for 0.5 as well, but a lot has changed since 0.4.1 and a lot will change for 0.5.

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# Chapter 1. Introduction

## About this Document

This document was meant as a tutorial for LCDproc users. It tries to introduce you into the world of LCDproc giving you an overview of the project. After reading this document you will be able to set up your own LCDproc'ed system.

**Note:** Please note that this document is still "under construction". We hope to finish it until the final release of LCDproc, which will probably take place in May or June 2002. If you run into any trouble feel free to write to the LCDproc mailing list. See <http://lcdproc.omnipotent.net/mail.php3> for details on how to subscribe to the list.

Therefore you might want to have a look at <http://lcdproc.sourceforge.net/docs/>, to get the latest version of this document (, unless you want to generate it yourself from the docbook files in the CVS).

This document was written for LCDproc 0.4.3. At the time of writing there had already been the "LCDproc User's Guide" written by William W. Ferrel in 1999. His version covered an early version of LCDproc and therefore concentrated on Matrix Orbital displays.

William's document was "recycled" for the description of the Matrix Orbital display driver and for other parts of this document.

In several other places e-mails and other documents have been included in this document. The authors of those are listed below every such document.

## What is LCDproc?

LCDproc is a client/server suite including drivers for all kinds of nifty LCD displays. The server 'LCDd' makes it possible to display text and other data on an LCD display. As well LCDd can handle certain input devices.

Support for devices is added by drivers. We distinguish between output and input drivers. LCDd currently supports only one single output driver, which may at the same time handle input. Nevertheless several input (only) drivers are supported.

Currently there are drivers for several serial devices: Matrix Orbital, Crystal Fontz, Bayrad, LB216, LCDM001 (kernelconcepts.de), Wirz-SLI and PIC-an-LCD; and some devices connected to the LPT port: HD44780, STV5730, T6963, SED1520 and SED1330. There are input (only) drivers for LIRC and joysticks.

Clients can connect to LCDd through common sockets.

Various clients are available. The "main" client `lcdproc`, which is shipped with the LCDproc distribution, can display things like CPU load, system load, memory usage, uptime, and a lot more.

## The LCDproc Server - LCDd

LCDd is one of those well known \*NIX daemons. BUT it's not just \*one\* daemon. It's the one that is supposed to drive your LCD ;)

LCDd can either be run from the command line or automatically by the init scripts shipped with the distribution.

As other daemons, LCDd has to be configured. In this respect a lot has changed since LCDproc 0.4.1. While LCDd retrieved all its configuration settings from the command line in 0.4.1, it now has a configuration file, which is normally `/etc/LCDd.conf`.

## The LCDproc "Main" Client - `lcdproc`

While `LCDd` only offer the functionality of displaying text on a display, `lcdproc` actually retrieves data worth displaying.

`lcdproc` gets its information from the `/proc` filesystem.

`lcdproc` can connect to an LCDproc server either on the local system or on a remote system as long as it is reachable. It extracts the same statistics regardless of where it sends this information. The statistics it gathers include CPU utilization, memory utilization, disk utilization, network utilization, system uptime, time, and date, and so on. It displays this information in assorted ways, and can be tailored to taste.

## Other LCDproc Clients

As it is rather simple to write an LCDproc client, you can find various clients on the Internet.

Unfortunately we cannot provide a list of LCDproc clients (yet). So, have fun searching [google](#)<sup>3</sup> or [freshmeat](#)<sup>4</sup>. Simply type 'lcdproc' for the keyword.

## Notes

1. <http://lcdproc.omnipotent.net/mail.php3>
2. <http://lcdproc.sourceforge.net/docs/>
3. <http://www.google.com>
4. <http://freshmeat.net>

## Chapter 2. How to Obtain LCDproc

### Versioning

At the time of writing there were four versions of LCDproc floating around on the Internet.

#### LCDproc 0.4.1

LCDproc 0.4.1 was the last "stable" release of LCDproc. It still uses the old command line configuration.

#### Warning

There are known security problems with LCDproc 0.4.1. A remote exploit is possible. An attacker can make use of some buffer-overflows in the client communication code of LCDd, in order to get root access to your system. Therefore running LCDproc 0.4.1 is NOT RECOMMENDED!

#### LCDproc 0.4.2

LCDproc 0.4.2 was meant to be the next stable release of LCDproc. As 0.4.1 it uses the old command line configuration.

**Note:** The known issues about 0.4.1 had been fixed. Unfortunately the guy who had the last pending patches on his box kind of "vanished" from the LCDproc mailing list. Of course you can get 0.4.2 from CVS. BUT its current state is unknown.

#### LCDproc 0.4.3

LCDproc 0.4.3 is the current stable release of LCDproc. It no longer uses the old command line configuration, but introduces the configuration file `/etc/LCDd.conf`. As well the driver API has slightly changed, which should not make older drivers incompatible, but might cause some trouble. As well the way LCDd reports messages (including error messages) has changed.

**Note:** Even though LCDproc 0.4.3 is the most stable version we can offer, it is still not perfect.

#### LCDproc 0.4.4

LCDproc 0.4.4 will be the next stable release of LCDproc.

**Note:** The 0.4.x branch will only be slightly updated. E.g. we plan better support of lcdproc (the client) for \*BSD. Yet, the active development will move to 0.5 now.

As 0.5 will not be stable in the near future, we may also work on porting drivers from 0.4.1 to 0.4.4 on demand. We do not have all the hardware LCDd supports. So, we only work on drivers that can be tested by YOU.

As well, the development and inclusion of new drivers is possible.

### LCDproc 0.5

LCDproc 0.5 is the development version of LCDproc. Everything is possible ;) Drivers can already be loaded at runtime. We will also work on client supplied menus and other nifty stuff.

#### Warning

From time to time LCDproc 0.5 might not even compile due to drastic changes. You have been warned!

Furthermore older drivers will NOT work with LCDproc 0.5 AT ALL! Feel free to port a driver that has not been ported to 0.5 yet ;)

## Download Last Day's CVS Version of LCDproc as a Tarball

There are nightly distributions of the CVS branches of LCDproc. You can download them from <http://lcdproc.sourceforge.net/nightly/>

To extract the files run either

```
$ tar xvfz lcdproc-CVS-*.tar.gz
```

or

```
$ bunzip2 -c lcdproc-CVS-*.tar.bz2 | tar xv
```

## Download The Latest Version of LCDproc from CVS

Of course you can download the latest stuff from CVS via anonymous login.

Create a "cvs" directory somewhere on your machine (not really necessary but useful):

```
$ mkdir ~/cvs  
$ cd ~/cvs
```

Login to CVS:

```
$ cvs -d:pserver:anonymous@cvs.lcdproc.sourceforge.net:/cvsroot/lcdproc login
```

(Hit enter when prompted for a password.)

Get the files from CVS:

```
$ cvs -d:pserver:anonymous@cvs.lcdproc.sourceforge.net:/cvsroot/lcdproc checkout -r stable
```

Once you've done that and want to update the downloaded files to the latest stuff you can use the "update" command of CVS (Make sure you have logged in to CVS first.):

```
$ cvs -d:pserver:anonymous@cvs.lcdproc.sourceforge.net:/cvsroot/lcdproc update -r stable
```

Now that you have downloaded the files you can prepare them for compiling, but first you should (you don't have to) copy them to another place on your machine:

```
$ mkdir ~/lcdproc-cvs
```

```
$ cp -f -R ~/cvs/lcdproc ~/lcdproc-cvs/`date +%Y%m%d`  
$ cd ~/lcdproc-cvs/`date +%Y%m%d`
```

## apt-get

Debian GNU/Linux users can get the debian package of LCDproc, which is in the unstable and testing distributions.

Provided apt-get is configured properly. You should be able to install the package running:

```
$ su  
Password: top secret  
# apt-get install lcdproc
```

## Notes

1. <http://lcdproc.sourceforge.net/nightly/>



## Chapter 3. Installation

### Build LCDproc

Now that you have downloaded the LCDproc distribution you can start building it.

**Note:** If you have installed the debian package with apt-get (or another debian tool), you can skip this this chapter.

If you're building this version from CVS, you'll need autoconf, automake, aclocal & autoheader installed.

If you have autoconf and friends, run:

```
$ sh autogen.sh
```

This produces the configure script and supporting files. It has allready been run if you using the tarball distribution.

Once the above command has run, the rest is pretty standard:

```
$ ./configure --help
```

Read about the options, figure out what to use.

```
$ ./configure --prefix=/usr/local --enable-drivers=ncurses,cfontz
```

Be sure to replace /usr/local with the prefixdir you want (e.g. /usr for RedHat) and ncurses,cfontz with comma-separated list of drivers you want.

```
$ make
```

Congratulations: You have just compiled your version of LCDproc ;)

### Install LCDproc Directly From The Sources

If you want to install LCDproc more or less permanently you can run:

```
$ su
Password: top secret
# make install
```

**Note:** make install is absolutely OPTIONAL You can also run LCDproc directly from the source directory. See below for details.

### Generate And Install Packages of LCDproc

As an alternative (which is actually better ;) to installing directly from the sources you can generate packages using the packaging tool EPM.

First of all you may need to download EPM from <http://www.easysw.com/epm/> and install it according to the instructions that are included in its source distribution.

Debian users (who do not want to download the official debs via apt-get) can of course use the debian package of epm:

```
# apt-get install epm
```

**Note:** There are of course other and maybe better ways to generate packages for your system. The reason for us to choose EPM was that it provide the developers with a tool that makes it possible to write one list file for all platforms defining what the resulting package is meant to look like. This way we do not have to learn all the package managing tools of the different platforms that are supported by LCDproc.

To generate an LCDproc package follow these instructions:

**Tip:** It is of certain importance that you have run `./configure` with the correct pathname settings for your system. Otherwise the resulting package will install the files in the wrong directories.

```
$ epm -v -f native LCDproc
```

**Note:** Generating an RPM package as a non-root user will fail, RPM wants to generate the files from the tree under `/usr/src/RPM`, which you do not have write access to as a non-root user. If you want to generate the package as a non-root user anyway, you may want to follow these instructions.

A workaround for the described problem is creating a file named `~/.rpmmacros` which contains:

```
%_topdir ~/rpm
```

**Important:** `~/rpm` must contain the same tree usually found under `/usr/src/RPM`

Unfortunately `epm` does not read `~/.rpmmacros` and of course returns warnings. Don't worry! That's OK ;)

In order to actually install the generated package follow the instructions in your system's manual.

## Notes

1. <http://www.easysw.com/epm/>

## Chapter 4. LCDproc Configuration

### Configure LCDd

As mentioned in the introduction LCDd, the LCDproc server, now (with version 0.4.3 of LCDproc) has its own configuration file, which is normally `/etc/LCDd.conf`.

**Note:** If you have not installed LCDproc from the sources the configuration file might have a different location. You should find it when making your system's package manager list all the files in the LCDproc package.

The format of the `/etc/LCDd.conf` is ini-file-like.

It is divided into sections that start at markers that look like `[section]`. Comments are all line-based comments, and are lines that start with `'#'` or `';'`.

The server has a 'central' section named `[server]`. Further each driver has a section which defines how the driver acts. Those sections start with `[drivername]`.

The drivers are activated by specifying them in a `driver=` line in the server section, like:

#### Example 4-1. `LCDd.conf`: Specify which driver to use

```
Driver=curses
```

This tells LCDd to use the curses driver. The first driver specified here that is capable of output functionality will be used as 'the' output driver. All extra drivers can only serve as input. The default driver to use is curses.

#### Warning

If LCDd is started automatically by an init-script using the curses driver will lock `/dev/tty1`! So, be careful about what you are doing here.

The drivers can read their own options from the config file, but most of them don't do this yet. They expect 'command-line'-format parameters that were previously placed on the command line. These parameters can be given to the driver in the following way:

#### Example 4-2. `LCDd.conf`: Compatibility mode for drivers written for 0.4.1

```
Arguments="place arguments here"
```

The arguments between the quotes are passed to the driver. As said before these are the same arguments that would have been passed to the driver using the old command line format of

**LCDd -d driver "driverargs"**

**Note:** The `-d` option still works, but does not allow `driverargs` any more.

If `-d` is specified on the command line, the `Driver=` options in the config file are ignored.

### **LCDd.conf: The [server] Section**

The [server] section of the `LCDd.conf` contains the settings for the LCDproc server `LCDd`.

**Driver=**

Tells the server which driver(s) to use. See above for details

**Note:** The default setting is `Driver=none` which makes the server exit right after the start. This is necessary to avoid trouble with package installations.

**Bind=**

Tells the server to bind to the given interface. Default to `Bind=127.0.0.1` which is actually the safest variant.

**Port=**

Tells the server to listen to this specified port; defaults to 13666.

**ReportLevel=**

Sets the reporting level; defaults to 2 (warnings and errors only).

**ReportToSyslog=**

Should we report to syslog instead of stderr ? Defaults to no.

**WaitTime=**

Sets the default time in seconds to display a screen.

**User=**

User to run as. `LCDd` will drop its root privileges, if any, and run as this user instead. Defaults to `User=nobody`.

**Note:** If you want to use the server menu, to shutdown or reboot your system, you will have to set this to root. Otherwise `LCDd` does not have the privileges to run commands like `init 6`.

**ServerScreen=**

Enables the server screen even when other screens are active. Defaults to no.

**Foreground=**

The server will stay in the foreground if set to true. Otherwise the server will fork to background and report to syslog. Defaults to yes.

### **LCDd.conf: The [input] Section**

The [input] section enables you to set some general ("global") options related to the way `LCDd` handles input "events".

Table 4-1. The Standard LCDd Input Keys

Keyname	Function	
	Normal context	Menu context
PauseKey	Pause/Continue	Enter/select
BackKey	Back (Go to previous screen)	Up/Left
ForwardKey	Forward (Go to next screen)	Down/Right
MainMenuKey	Open main menu	Exit/Cancel

**Note:** The way input keys are handled will change completely in LCDproc 0.5.

#### LCDd.conf: [input] Section: The Free\*Key Options

The Free\*Key Options are interesting for those users whose keypad (or other input source) has got only four (or less) keys. In this case LCDd would normally use all those keys to enable you to control the server menu and the other server functions (like switching to the next screen). If these keys are used by a client to do anything but noticing that the user has e.g. entered the menu or switched to another screen, this will probably cause trouble, as one keypress has several effects at the same time.

The Free\*Key options enable you to influence this behaviour.

FreePauseKey=

If set to yes, this prevents LCDd from handling the PauseKey itself. Then a client can request the key 'A' and handle it.

FreeBackKey=

If set to yes, this prevents LCDd from handling the BackKey itself. Then a client can request the key 'B' and handle it.

FreeForwardKey=

If set to yes, this prevents LCDd from handling the ForwardKey itself. Then a client can request the key 'C' and handle it.

FreeMainMenuKey=

If set to yes, this prevents LCDd from handling the MainMenuKey itself. Then a client can request the key 'D' and handle it.

**Tip:** Even if you "free" the above keys, you can still use the menu provided you set FreeMainMenuKey to no.

#### LCDd.conf: The Drivers Section

As mentioned earlier, each driver has its own section in the LCDd.conf.

The settings are more or less self-explanatory. So, read through the section of your driver and change everything necessary.

## The LCDproc Init Scripts

The LCDproc distribution contains init scripts for RedHat- and Debian-based GNU/Linux distributions. You can find them in the `docs/` directory of the LCDproc sources.

**Note:** The init scripts are generated using autoconf. So, again it is important that you have run `./configure` with the correct options for your system.

Refer to your system's manual on how to install the scripts.

### init-LCDd

The file `scripts/init-LCDd.*` is the init script for the LCDproc server LCDd. It does not require modification.

### init-lcdproc

The file `scripts/init-lcdproc.*` is the init script for the LCDproc "main" client `lcdproc`. As `lcdproc` itself does not (yet) have a configuration file you may want to modify the options the init script passes to `lcdproc`.

**Note:** You can retrieve a listing of all options of `lcdproc` running `lcdproc --help`.

The `lcdproc` init script retrieves the options it will pass to `lcdproc` from the file `/etc/lcdproc.conf` (`scripts/lcdproc.conf` in the sources distribution).

### Example 4-3. `lcdproc.conf`: Modify the option passed to `lcdproc`

```
# /etc/lcdproc.conf
#
# Configuration file of the main LCDproc client "lcdproc"
# NOTE: The configuration file of LCDd is /etc/LCDd.conf

# Set SCREENS to the screens you want lcdproc to send to LCDd
# lcdproc --help will give you a list of the screens available

SCREENS="C X"
```

In this example `lcdproc` will only send information on the CPU usage [C] and system load [X] to the server.

## Chapter 5. LCDproc Drivers

This chapter contains the documentation of each LCDproc driver, which may include the installation process of the hardware as well as the configuration of LCDd.

### The HD44780 Driver

There are several ways of wiring up the HD44780 devices. Your choice will probably be governed largely by your ability to wire up each one and/or a desire to use the device with other programs.

The LCDproc HD44780 driver supports the following connections on a parallel port:

- 4-bit
- 8-bit (winamp style)
- extended 8-bit (LCD + LED bargraph)
- serial LPT

And supports a PIC-an-LCD connected to a serial port.

The driver also lets you use multiple displays as a single virtual display. For example, a 4, 2 and 1 line display can be used to form a 7 line display. The number of displays is limited by the individual HD44780 driver.

### Connections

#### Common connections for all connectiontypes

No matter what connectiontype you choose, you will always need some connections. They are explained here.

#### *Power*

All variants use the same method of obtaining power. i.e., for each LCD:

**Table 5-1. HD44780: Power Connections**

LCD	pin	signal
1	GND	(connect to any of pins 18 - 25 of you parallel port)
2	+5V	
3	Vadj	(contrast)

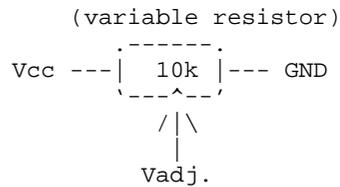
#### **Warning**

Always double check your power connection, your display will probably NOT survive a reversely connected supply !

There are several ways to get 5V:

- Connect to a 5V line intended for disk drives (the red wire is 5V, black is GND).
- Get it from a joystick port (pin 1 and 9 are 5V, 4, 5 and 12 are GND). It seems that some soundcards can use these lines for communication, so if you want to use this first check whether it really gives a 'clean' 5V.

- If you don't have a backlight, you can sometimes get the needed mA's from the LPT port itself. Connect a few diodes from the data pins to a capacitor and you have the 5V. If it's strong enough is another question...
- Get it from the keyboard connector. I do not recommend to use this with a backlight, as the keyboard connector is often protected with a fuse of 100mA or 200mA.



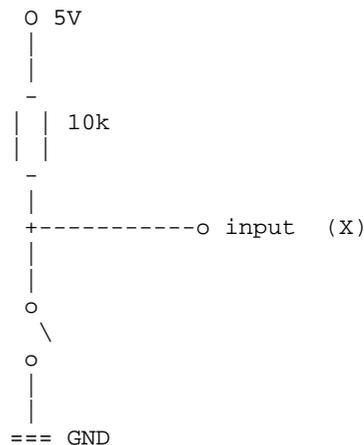
**Figure 5-1. HD44780: Connecting the contrast adjusting pin (Vadj.)**

### Keypad

You can connect a keypad with all connection types. The maximum supported number of keys differs per type. There are several ways to connect the keys to the input pins.

### Direct Keys

If you connect a key like sketched below, then you can only connect one key per input pin. It is a simple solution if you need only few keys.



**Figure 5-2. HD44780: Direct Keys**

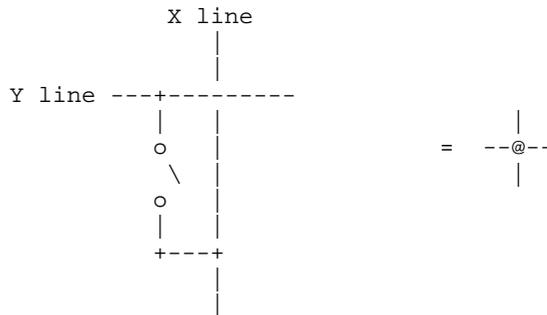
By default, the following keystrokes are generated by the different keys:

**Table 5-2. HD44780: Default Keystrokes**

X0	A
X1	B
X2	C
X3	D

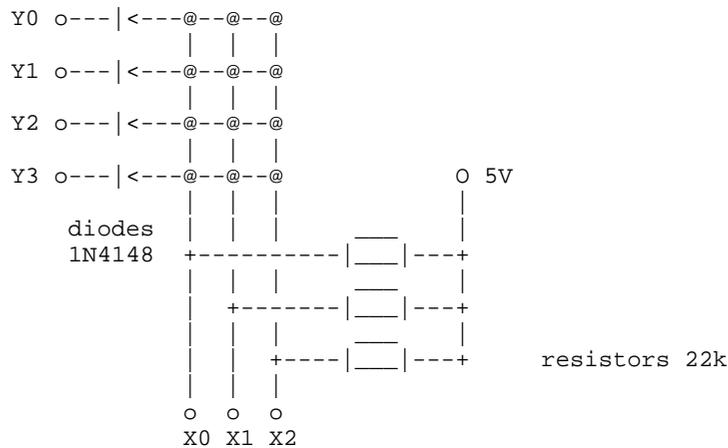
**Matrix Keys**

Using a matrix, we can connect much more keys. To simplify the drawing here, we replace all switches with an @ symbol:



**Figure 5-3. HD44780: Single Matrix Key**

We connect the matrix of keys like this:



**Figure 5-4. HD44780: Complete Key Matrix**

As you can see, you need 1 resistor per X line, and 1 diode per Y line. Lcdproc will presume that you have a keypad with a layout like a telephone connected, with X and Y lines connected as show. To be more precise, it assumes this:

	X0	X1	X2	X3
Y0	1	2	3	A
Y1	4	5	6	B
Y2	7	8	9	C
Y3	*	0	#	D

**Figure 5-5. HD44780: Keypad Layout**

If you only need 10 keys, leave the rest away. However, the lcdproc menu is controlled by the keystrokes A to D. You should modify and recompile the driver to get an other keypad layout.

You can buy arrays of keys that are connected like this in the electronics shop. They usually call it a matrix keypad. To hook it to lcdproc, you would only need to add the resistors and diodes.

If you want to use just one return line, for example with the serialLpt wiring, it looks (completely drawn) like this:

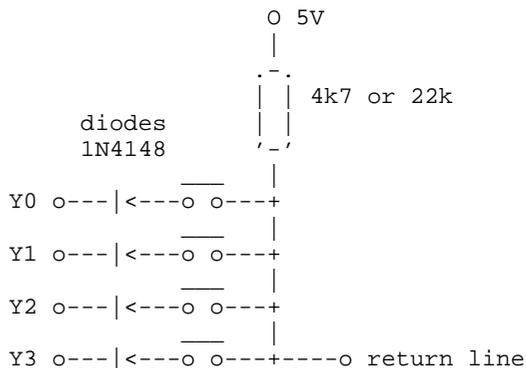
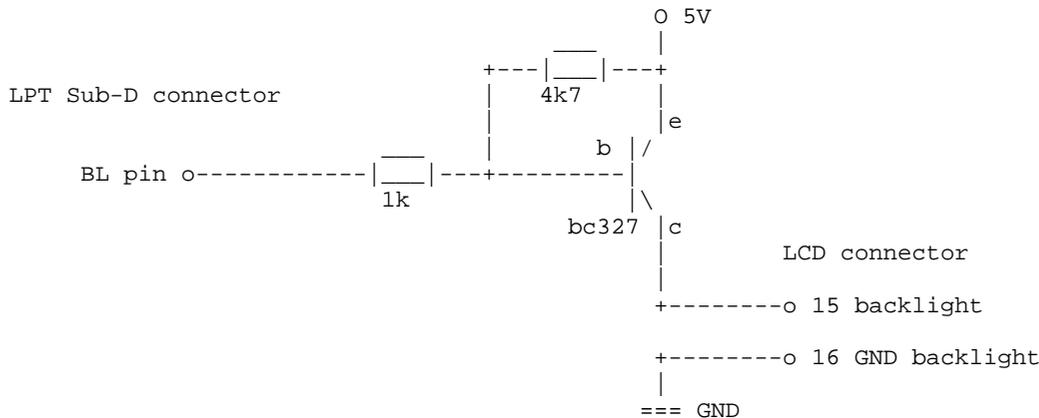


Figure 5-6. HD44780: One Return Line

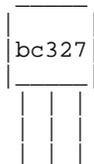
**Tip:** If the driver generates keypresses without that you actually press a key, it might be that the unconnected input lines are picking up electromagnetic waves from the air. In that case connect the unconnected input lines (pin 10, 11, 12, 13 and 15 of the LPT) to VCC = 5V.

### Backlight

A small extension allows you to switch the backlight of the display on and off. At the moment only the 4bit and winamp connection types support this. The extension uses one output pin, you cannot use that pin for other functions anymore. The wiring looks like this:



Note: 4k7 means 4,7 kohm.  
The BC327 transistor has the following connections:



c b e

**Figure 5-7. HD44780: Backlight Wiring**

<b>Caution</b>	
Sometimes the backlight connections are not on the 'main' connector, but on the side. If that is the case, there is usually NO RESISTOR present to limit the current through the LEDs. Therefore you should then add a resistor after the transistor of about 10 ohm (see display documentation).	

**Tip:** If you want the backlight to light a bit while it's switched 'off', you can add a resistor bypassing the transistor from e to c, with a value of, say 47ohm or 22ohm. (My 4x20 has an internal resistor of 6ohm, so with 47 ohm extra it lights at only 1/9th. I like this. Joris.)

**4-bit**

This is originally based on "lcdtext" (by Matthias Prinke).

**Table 5-3. HD44780: 4-bit Pinouts (1)**

<b>printer port</b>	<b>LCD</b>
D0 (2)	D4 (11)
D1 (3)	D5 (12)
D2 (4)	D6 (13)
D3 (5)	D7 (14)
D4 (6)	RS (4)
D5 (7)	RW (5) (LCD3 - 6) (optional - pull all LCD RW low)
D6 (8)	EN (6)
D7 (9)	EN2 (LCD2 - 6) (optional)

If you want to connect more than two displays to the parallel port then wire D5 (pin 7) to the enable line (pin 6) of the third LCD. Then for displays four to seven use:

**Table 5-4. HD44780: 4-bit Pinouts (2)**

<b>printer port</b>	<b>LCD</b>
STR (1)	EN4
LF (14)	EN5
INIT (16)	EN6
SEL (17)	EN7

The optional keypad can be connected as follows:

**Table 5-5. HD44780: 4-bit Keypad Pinouts**

printer port	LCD
D0 (2)	Y0
D1 (3)	Y1
D2 (4)	Y2
D3 (5)	Y3
D4 (6)	Y4
D5 (7)	Y5
nSTRB (1)	Y6
nLF (14)	Y7
INIT (16)	Y8
nSEL (17)	Y9
nACK (10)	X0
BUSY (11)	X1
PAPEREND (12)	X2
SELIN (13)	X3
nFAULT (15)	X4

The optional backlight wiring should be connected to D5, pin 7.

### 8-bit "Winamp"

This type of connection should work with winamp.

```

printer port  LCD
D0 (2)       D0 (7)
D1 (3)       D1 (8)
D2 (4)       D2 (9)
D3 (5)       D3 (10)
D4 (6)       D4 (11)
D5 (7)       D5 (12)
D6 (8)       D6 (13)
D7 (9)       D7 (14)
nSTRB (1)    EN (6)
nLF (14)     nRW (5) (EN3 6 - LCD 3) (optional)
INIT (16)    RS (4)
nSEL (17)    EN2 (6 - LCD 2) (optional)

```

**Figure 5-8. HD44780: "Winamp" wiring**

If you want the display to work with the Winamp plugin, wire nLF (pin 14) to nRW of your LCD. You can then use the plugin in bidirectional mode (which is much faster). With 3 connected LCDs this is not possible. Note from Benjamin: I haven't tried using winamp while having the third LCD connected to this line.

The optional keypad can be connected as follows:

```

printer port  keypad
D0 (2)       Y0
D1 (3)       Y1
D2 (4)       Y2

```

D3 (5)	Y3
D4 (6)	Y4
D5 (7)	Y5
D6 (8)	Y6
D7 (9)	Y7
nLF (14)	Y8
INIT (16)	Y9
nACK (10)	X0
BUSY (11)	X1
PAPEREND (12)	X2
SELIN (13)	X3
nFAULT (15)	X4

**Figure 5-9. HD44780: "Winamp" wiring - Keypad**

The optional backlight wiring should be connected to nSEL, pin 17.

### 8-bit "lcdtime"

This is originally based on "lcdtime" (by Benjamin Tse <blt@ComPorts.com>) and allows you to combine the LCD with a LED bargraph. The LCD is driven by LCDproc and the LEDs by another program such as portato. Further details can be obtained from:

<http://metalab.unc.edu/pub/linux/system/status/lcdtime-0.2.tar.gz> <http://metalab.unc.edu/pub/linux/0.2.tar.gz> <http://metalab.unc.edu/pub/linux/system/status/portato-1.2.tar.gz>

**Note:** Theoretically this wiring sends the data over twice as slow as the winamp or ext8bit wirings, because it only sends 4 bits at a time.

The LCD connections are:

printer port	LCD
D0 (2)	D0 (7)
D1 (3)	D1 (8)
D2 (4)	D2 (9)
D3 (5)	D3 (10)
D4 (6)	D4 (11)
D5 (7)	D5 (12)
D6 (8)	D6 (13)
D7 (9)	D7 (14)
nSEL (17)	-
nSTRB (1)	RS (4)
nLF (14)	RW (5) (LCD2 - 6) (optional - pull all LCD RW low)
INIT (16)	EN (6)

**Figure 5-10. HD44780: "lcdtime" wiring**

See the lcdtime tar-ball (above) for full details of the bargraph connections.

The optional keypad can be connected as follows:

printer port	keypad
D0 (2)	Y0
D1 (3)	Y1
D2 (4)	Y2
D3 (5)	Y3
D4 (6)	Y4
D5 (7)	Y5
D6 (8)	Y6
D7 (9)	Y7
nSTRB (1)	Y8
nSEL (17)	Y9
nACK (10)	X0
BUSY (11)	X1
PAPEREND (12)	X2
SELIN (13)	X3
nFAULT (15)	X4

Figure 5-11. HD44780: "lcdtime" wiring - keypad

The backlight wiring should be attached to nSEL, pin 17. Because the portato program (mentioned above) also uses this pin to control the bargraph, you cannot use the backlight control together with the bargraph.

### Serial LPT

This interface uses a handful of wires to interface to the HD44780. Suitable for high noise, long connections. Designed by Andrew McMeikan <andrewm@engineer.com>. The original wiring and driver can be found at:

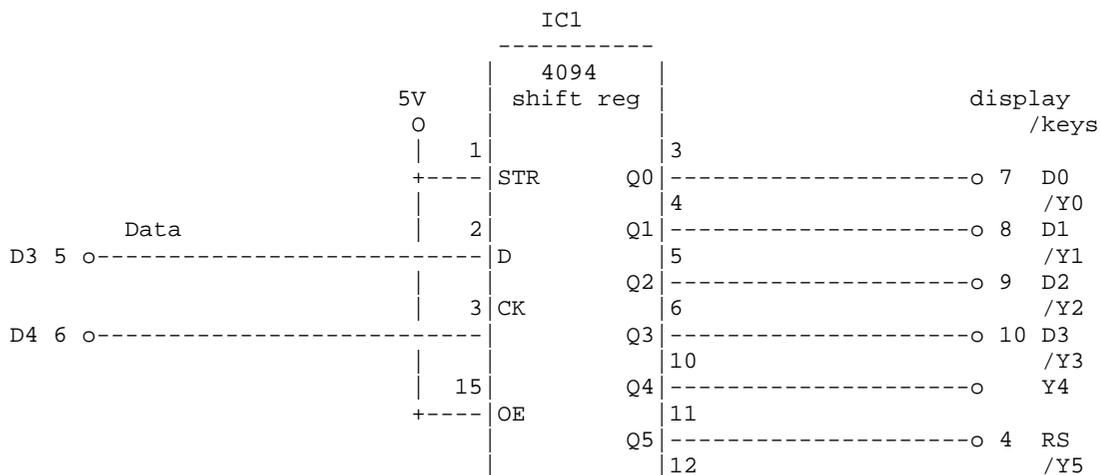
<http://members.xoom.com/andrewmuck>

I (Joris) have extended this driver and the wiring a bit. It now supports keys again (it had earlier supported keys, but some time did not).

Further I have extended the driver and the wiring to be able to run using 2 instead of 3 output pins. That's even one less pin ! :)

Of course the use of fewer lines than the other wirings can not stay without drawbacks. In this case the simplicity of the long feeding wires is compensated by some intelligence in the decoding of the data. If you have no experience with the soldering iron, I do not recommend to build this wiring.

OK, so here is the wiring. First of the 'simple' 3 wires version. IC1 is the shift register, a 4094. Do not forget to connect the 5V to pin 16 and GND to pin 8 of the IC.



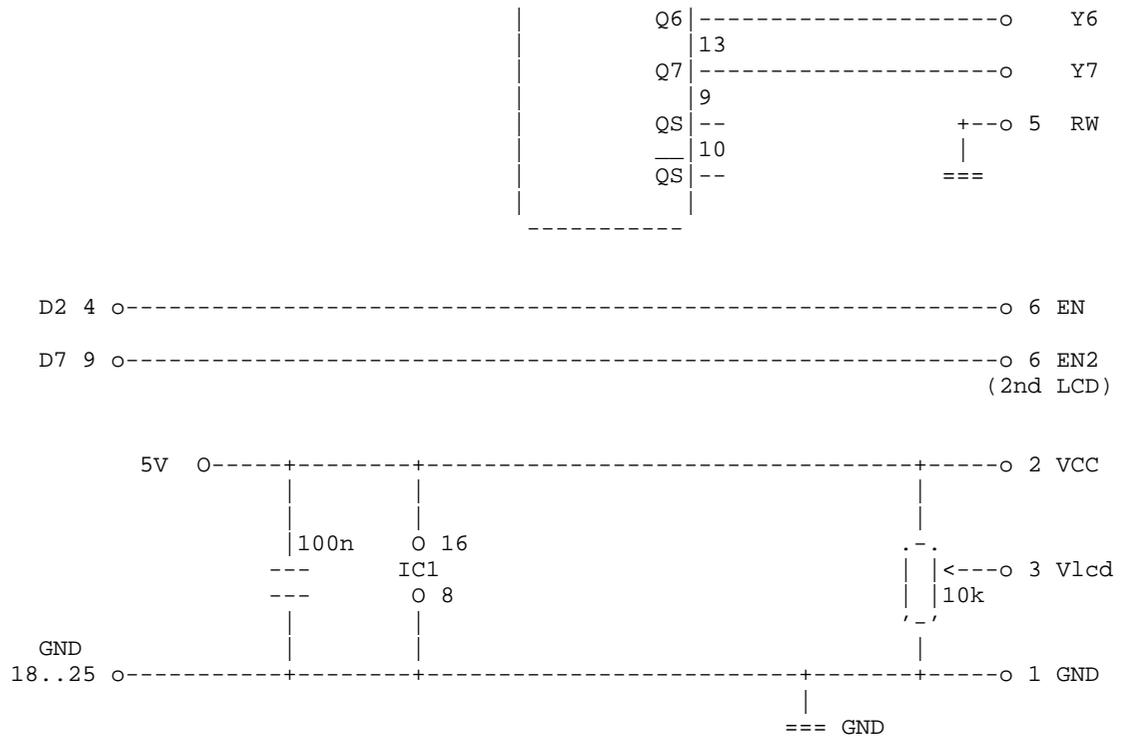
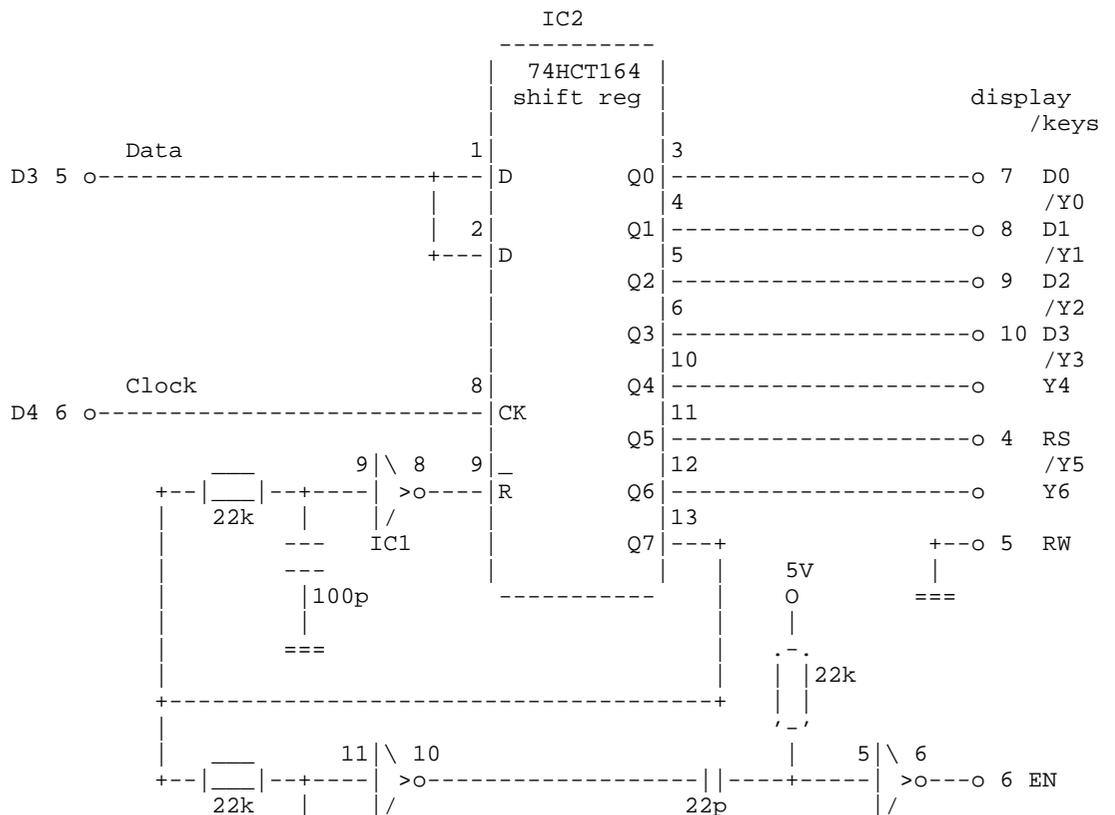


Figure 5-12. HD44780: Serial LPT wiring ('simple')

The second possible wiring is with 2 output lines. This one is a bit more complex. If you do not understand the schematic, do not build it.



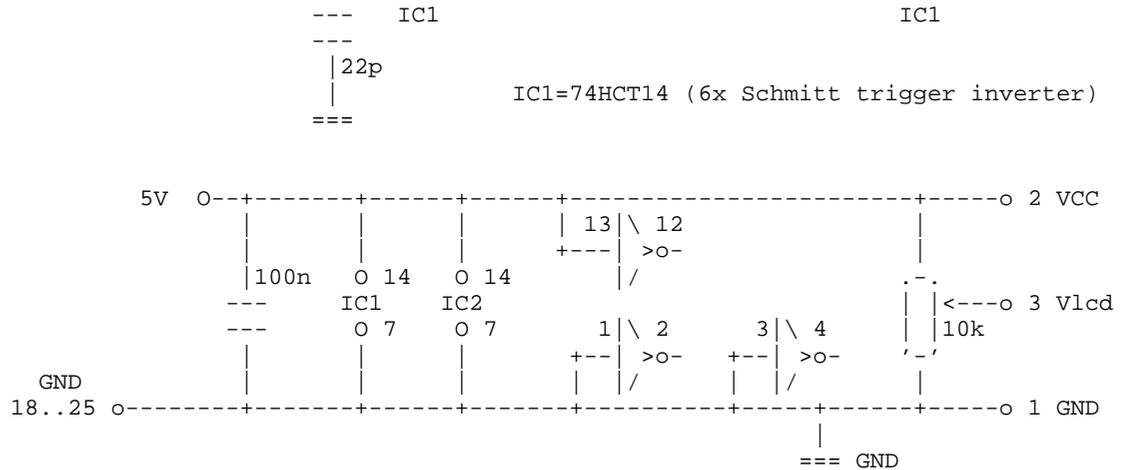


Figure 5-13. HD44780: Serial LPT wiring ('complex')

### Serial LPT Keypad

**Note:** To understand this part of the serialLpt documentation, you also need to read the keypad section in this document.

serialLpt wiring supports a keypad. The 3 wires version supports 8 keys, or if you use multiple return lines up to  $8 \times 5 = 40$  lines. The 2 wires version supports 7 keys, or with multiple return lines  $7 \times 5 = 35$  keys.

nACK (10)	X0
BUSY (11)	X1
PAPEREND (12)	X2
SELIN (13)	X3
nFAULT (15)	X4

Figure 5-14. HD44780: Serial LPT - Keypad return lines

On lines longer than, say a meter, you should buffer the return line(s). If you only have 1 return line, you can buffer it with two remaining buffers from the 74HCT14:

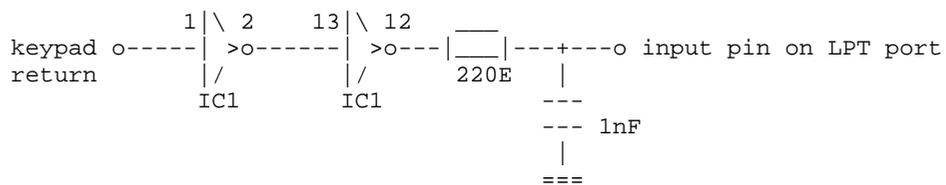


Figure 5-15. HD44780: Serial LPT - Keypad return lines buffered

### Serial LPT Backlight

Also a backlight is supported. You will also need a port from the 74HCT14 for that. The BL output below should be connected to the BL input in the backlight section

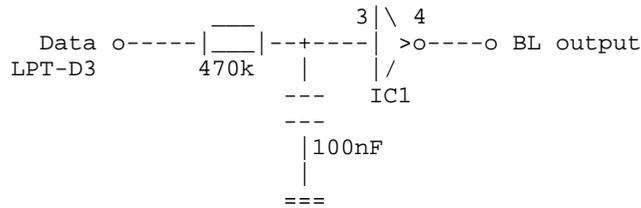


Figure 5-16. HD44780: Serial LPT - Backlight extra circuit

### PIC-an-LCD serial device "picanlcd"

The PIC-an-LCD module is also supported. It is not connected to the LPT port but to a serial port, which saves you from a lot of potential problems. To use it, specify the device to which you have connected the module in the config file with the `Device=` setting. The default is `/dev/lcd`. It does not support a keypad nor backlight switching.

### Compiling

Make sure that the HD44780 files are built when you run configure. This can be done by specifying `--enable-drivers=all` or by `--enable-drivers=hd44780`.

### Configuration

Since LCDproc 0.4.3 the HD44780 driver can be configured from the configfile.

The [HD44780] section is more or less self-explanatory. Yet, a list of the possible connection types has proved useful. The following table should make it clear, how the `ConnectionType` is to be set.

Table 5-6. HD44780: Connection Types

Wiring / Display Type	ConnectionType=
HD44780 4bit Wiring	4bit
HD44780 8bit Wiring ("lcdtime")	8bit
HD44780 Serial LPT Wiring	serialLpt
HD44780 8bit Wiring "winamp" Style	winamp
PIC-an-LCD serial device "picanlcd"	picanlcd

**Tip:** The above table might be outdated, when you read this. If you suspect this is the case, you might want to have a look at `server/drivers/hd44780-drivers.h` which contains the actual translation code.

### Running

Modify the `LCDd.conf` file before you run `LCDd`. In this config file are detailed instructions on how to configure the HD44780 driver.

Then as usual, start `LCDd` with the correct config file:

E.g. `LCDd -c ./LCDd.conf`

If you want to override the driver selection in `LCDd.conf` then use:

`LCDd -c ./LCDd.conf -d HD44780`

If you use this, the HD44780 driver will read the options from the config file anyway.

### Miscellania

This text has originally been taken from a message by Bill Farrow <bffarrow@arrow.bsee.swin.edu.au>.

Updated February 2000, Benjamin Tse <blt@ComPorts.com>

Updated October 2001, Joris Robijn <joris@robijn.net>

Converted to docbook March 2002, Rene Wagner <reenoo@gmx.de>

Updated April 2002, Rene Wagner <reenoo@gmx.de>

## Parallel Port Troubleshooting

Unfortunately attaching an LCD module to a parallel port is not trivial.

In most cases it requires soldering abilities and basic knowledge of electronics.

The following hints might be helpful:

### Check The Wiring

Wiring errors can easily be made. If you are unexperienced with the soldering iron better have someone solder it for you. Display modules are sensitive to electro static discharges, so touch an earthed surface (computer case, water pipes...) before you handle these.

### Power Source Unregulated / Noisy

Make sure your power supply delivers steady 5 Volts with- out noise or interruptions. The bare wall plug in trans- former is not suitable, though you can make it stabilized by adding an 7805 and a few capacitors. Some noise induced in the supply lines may be tricky to track, even if you have an oscilloscope.

### Ground Lift

The power supply wires and especially the GND wires should be a little thicker than the other wires. If GND is not thick enough (or not existent, see 1) the resistance of the wire may cause differing GND potentials in the circuit. This may lead to strange display behaviour. It may also be wise to solder a 100nF capacitor directly to the GND and VDD pins of the display.

### Latchup

Never let the supply voltage get much below the io signal voltage. It may lead to a latchup condition which will destroy the controller chip on the display.

## Contrast

If you don't see anything on your display it may be that your contrast voltage is set wrong. Turn your contrast potentiometer all the way to the end connected to GND. Contrast is highest then.

**Beware:** The module you got so ultra cheap may be an enhanced temperature model which needs a negative contrast voltage for sufficient contrast - see chapter 99 on how to make negative voltage.

## Parallel Port Voltage

Many modern mainboards and especially notebooks will not nearly output 5V for a logic H as the older parallel ports did, because the operating voltage of computers is lower than 5V these days. I have measured voltages between 2.5V and 4V for logic H, which is barely within specification of the HD44780. If you account RCL of your cable, this may not be enough and can cause unreliable operation.

## Enable Signal Rise Time

If you ever read the HD44780 datasheet you will notice that somewhere in the 'signal timing' table is written: 'Enable Signal Rise Time max. 20nS'. That means the Voltage on the HD44780 pin called 'Enable' has to rise from 0 Volts to 5 Volts within 20 Nanoseconds and the other way round. They should better print that in big fat red letters, because most HD44780s are really picky about the enable signal rise time.

That is a Problem: If you count together the bad driving characteristics of the parallel port combined with the capacitance of flat ribbon cable you may easily get an order of magnitude slower rise time. Therefore you should only use really short cable (shorter than 50cm) for connecting the display to the parallel port. It may also be useful to use pull-up resistors on the display module or a schmitt-trigger.

**Note:** The rise time of a digital output can (usually) not be altered by Software.

## EMI

The cable from the parallel port to the display may be sensible to electromagnetic interference and may emit electromagnetic radiation. If you place your cellphone near the cable, you may get unexpected display readings, on the other hand your house neighbour may not be able to listen to his/her favourite radio station any more - so better use shielded cable and put the display in a metallic case, perhaps a computer case.

## One or Two Black Lines

If you see one or two black lines on the display it means nothing more than that the display is powered and contrast voltage is present. If one or two black lines appear the controller has not been reset properly by the on chip power on reset generator. No need to worry - it will be reset by the LCDd software. But if the black line will not disappear although the wiring is working, the controller on the display may be defective.

### Software Too Fast

If you have a super GHz computer it may happen that the signal timing generated by LCDd is too fast. Adjust DELAYMULT in the source file to a bigger value. Parallel port wirings usually don't permit to read back the busy flag of the controller chip, so timing must be adjust so that the controller never is busy.

### LED Backlight

Check whether you need a resistor for your LED Backlight and which value it should have. If you forget the required resistor the backlighting LEDs might become hot and draw excessive current.

### HD44780 Compatible

The original HD44780 controller that we advertise to support has become the industry standard for alphanumeric character displays. The original HD44780 is out of production. It has many successors from many manufactures, which sometimes won't tell you that their chips are 'compatible'.

To name a few: KS 0066, KS 0070, KS 0076, LC 7985, NT 3881, SED 1278, ST 7066 ...

### Miscellania

This text has originally been taken from a message<sup>5</sup> by Robin Adams <robin@adams-online.de>

Converted to docbook and slightly modified May 2002, Rene Wagner <reenoo@gmx.de>

## The Matrix Orbital Driver (MtxOrb)

This section covers the installation process for the Matrix Orbital LCD module intended for use with LCDproc.

We will examine the installation process of the hardware in small steps, as it is vitally important to pay close attention to detail during hardware installation to avoid damaging equipment.

### Matrix Orbital LCD Modules

LCDproc was born out of original tinkering by William Ferrell with one of these LCD modules. Their ease of installation and use (as well as the amazing amount of patience demonstrated by the folks at Matrix Orbital whilst William figured things out) meant one less thing to worry about during the early stages of LCDproc's life.

These 20x4 alphanumeric modules are connected via standard DB-9 cabling and connectors. They draw either 5V or 12V, depending on the module purchased, and are attached with a standard floppy cable connector (with a slightly modified wire configuration).

Once connected, using them is a breeze. They can operate at any number of different baud rates and serial configurations, but normally they run at 19,200 baud, 8-N-1, making them quite quick. Sending ASCII to the module will make it simply display that text at its current cursor position. The module has a built-in BIOS that recognizes commands (sent by transmitting a single-byte "marker" signifying that a command is on the way, followed by the single-byte command character itself along with any parameters, if needed) allowing the programmer to clear the screen, position the cursor anywhere, define custom characters (up to 8 at a time), draw bar graphs and large numbers, change the LCD's contrast, and so on.

The BIOS included also implements line-wrapping (i.e. writing past the twentieth character on the first row will automatically move the cursor to the first character on the second row), and screen scrolling (i.e. writing past the twentieth character on the fourth row causes the whole screen to scroll up one row, clearing the fourth line and positioning the cursor at the first character on that line).

These modules are fast. Using the auto-line-wrap feature and disabling the auto-scrolling feature, the screen can be updated thirty times per second if \*every\* character on the screen is changed. If updating less than the whole screen, the LCD can update faster than can be seen by the human eye. This, of course, more than meets LCDproc's needs.

## Matrix Orbital Hardware Installation

Regardless of what specific type of hardware you intend to use with LCDproc, installation is usually straightforward, and requires only a few steps. Regardless, you must use caution while working inside your computer system or with any hardware attachments.

### Warning

Installing new hardware inside a computer system can be dangerous to both system components and the installer. Use caution whenever adding a component to the inside of your system, altering a power cable, or physically mounting a device inside a computer system.

When installing hardware inside a computer, make sure it's turned off and that its power is disconnected. This is especially important when making changes to power cables (as some LCD modules require).

## Matrix Orbital LCD/VFD Module Installation

The LCD and VFD modules from Matrix Orbital are relatively straightforward to install. With a small, regular (flat-head) screwdriver, a spare floppy drive power cable, and a bit of luck, installation will take less than an hour.

These installation instructions assume that you are installing the module into a PC or PC-style system (one with AT- or ATX-compliant power cabling) and that you have some idea of where you intend to permanently mount the module. For mounting ideas and tips, refer to the section "Mounting" below.

**Before you start:** Your Matrix Orbital LCD or VFD module should be clearly marked with an indication of the module's power requirements. It should be either a 5 volt or 12 volt unit. You should have this information available before proceeding.

### Power Cable Modification

The first step in installing the module is making the necessary modifications to a floppy drive power cable in order to provide power to the module. The modifications must be made based on the module's power requirements -- either 5V or 12V -- depending on which module you purchased.

A standard floppy drive power cable has a smaller connection than a "normal" PC power connector. However, like a "normal" power connector, it has four wires: one yellow, one red, and two black. The red wire provides +5V power, and is "hot" or live when the system is powered up. The yellow wire provides +12V power, and is also hot when the system is powered up. Both black wires are ground. [TODO: INCLUDE A FIGURE HERE SHOWING A "STANDARD" FLOPPY CONNECTOR]

One of the hot wires and one of the black wires will not be needed for your module's power connection; they will be completely removed when the power cable modification is complete.

### Warning

Do NOT make this modification to a power cable attached to a running system! Electrocutation resulting in personal injury and/or damage to the system can result.

Using a regular screwdriver, press down the small metal locking flap of one of the two black wires on the small end of the cable, and pull the black wire from the connector. Using a pair of needle-nose pliers, squeeze the other end of the same black wire, and pull it out of the large end of the cable. This black wire can be set aside; it will not be used for the module's power connection. Either wire can be safely removed; you may safely remove either wire. [TODO: INCLUDE A FIGURE HERE SHOWING THIS PROCESS]

Next, using the same procedure, remove the unneeded hot wire. If your module is 5V, you do not need the yellow (+12V) wire. Conversely, if your module is 12V, you do not need the red (+5V) wire. The removed wire can be set aside; it will not be used for the module's power connection. [TODO: INCLUDE A FIGURE HERE]

The floppy power connector should now have only two wires attached to it. Leave the larger end alone from now on; these connections are correct (the larger end connects to your system's power mains). Move the two remaining wires to the outside connectors on the small end of the cable. Orientation does not particularly matter here; the connector will fit on the module's receptacle in either orientation. [TODO: A FIGURE HERE]

You should now have a properly modified power connector. When physically attaching this connector to the module, the black (ground) lead should be connected to the pin labelled GND, while the colored (+5V / +12V) lead should be connected to the pin labelled +5V / +12V.

Test the power connection before connecting the data line or mounting the module. Connect the module to the power connector, and the connector to your system's power mains. Turn the system on.

### Caution

If the module does not immediately display its initial BIOS screen and light up its backlight (or light up the screen if a VFD module is being used), *immediately* power down the system, disconnect the module and connector, and double-check the modification before trying again. Do NOT leave the system on if the module does not immediately respond; module or system damage could result.

When the LCD powers up and displays its initial BIOS screen, you've gotten the power connection wired properly and can now properly mount the module and make its final connections. Matrix Orbital Corporation sells a PC bay insert mount for the 20x4 and 20x2 modules (LCDproc, however, only supports the 20x4 at present). The inserts provide an easy means of mounting the LCD modules inside a PC using one (for the 20x2) or two (for the 20x4) 5 1/4" bays.

**Note:** Describing how to physically mount the module in a PC case is beyond the scope of this document; LCDproc's website contains more detailed mounting information and examples.

### Serial Connection

The LCD module uses a standard DB9 serial connector. You can attach the module to your system using a direct cable to the motherboard, or by removing one of your system's serial ports from the back of the case, then connecting it to a standard serial cable to the module.

While connecting the serial cable to the module, be sure to configure the module's serial interface settings. Typically, setting the module to its fastest setting (19,200 baud, 8-N-1) is recommended. The speed settings can be configured from the config file `/etc/LCDDd.conf`. If not specified in the config file, the Matrix Orbital module driver in LCDproc default to use these settings.

### Copyright

This section was originally part of the `lcdproc.sgml` file by William W. Ferrell <[wwf@splatwerks.org](mailto:wwf@splatwerks.org)> Slightly modified in order to include it in this document March 2002, Rene Wagner <[reenoo@gmx.de](mailto:reenoo@gmx.de)>

## The lircin Driver

The lircin driver enables you to use any IR remote control that works with LIRC to control the LCDproc server (LCDDd) and/or clients that can handle input.

Of course you need a working LIRC setup. Refer to <http://www.lirc.org> for more information on LIRC itself.

### Checking Your LIRC Setup

Basically all you need is a running `lircd`. And of course you have to start `lircd` as root.

Also, make sure that the permission of `/dev/lircd` are correct.

### Build LCDDd with the lircin Driver

You need to add lircin to the `--enable-drivers=...` list.

Then simply run `make`.

### Configure LCDDd to Use the lircin Driver

First of all you need to activate the driver by adding a `Driver=lircin` line to your `LCDDd.conf`

#### Example 5-1. LCDDd.conf: Activate the lircin driver

```
Driver=mtxorb  
Driver=lircin
```

This activates the `mtxorb` driver as the output driver and the `lirc` driver as the input driver.

Then you have to modify the `[lircin]` section of your `LCDDd.conf`.

### **LCDD.conf: The [lircin] Section**

The [lircin] section of the LCDD.conf contains the settings for the lircin LCDproc driver.

`lircrc=`

Normally all LIRC clients scan the file `~/.lircrc`. However, you might want to have a separate file to configure the LCDproc lircin driver only.

This option enables you to specify the file you want the lircin driver to scan.

`prog=`

All LIRC keys are assigned to a program using the `prog=...` option in the `~/.lircrc` (or the file you have specified with `lircrc=...`).

The `prog=...` line must be the same as in your `~/.lircrc` (or the file you have specified with `lircrc=...`).

### **Modify Your `~/.lircrc`**

As mentioned above you can either modify the `~/.lircrc` or use a separate file for the lircin LCDproc driver (See above for details).

No matter which file you use, you have to add at least the following lines to the file:

#### **Example 5-2. `~/.lircrc`: Specify the keys for the lircin driver**

```
begin
    prog = lcmd
    button = 2
    config = A
end

begin
    prog = lcmd
    button = 4
    config = B
end

begin
    prog = lcmd
    button = 6
    config = C
end

begin
    prog = lcmd
    button = 8
    config = D
end
```

Which buttons you specify here depends on your RC and your LIRC configuration. Anyways, `config=A/B/C/D` is necessary to control the server menu of LCDd. Of course you can define other keys. Those keys will not be handled by the server but sent to a client. Refer to the documentation of the client you want to use, to find out which keys are necessary for that client.

## Notes

1. <http://metalab.unc.edu/pub/linux/system/status/lcdtime-0.2.tar.gz>
2. <http://metalab.unc.edu/pub/linux/system/status/meter-0.2.tar.gz>
3. <http://metalab.unc.edu/pub/linux/system/status/portato-1.2.tar.gz>
4. <http://members.xoom.com/andrewmuck>
5. <http://lists.omnipotent.net/pipermail/lcdproc/2002-May/005832.html>
6. <http://www.lirc.org>



## Chapter 6. Running LCDproc

### Running LCDd

If you have installed the init-scripts you can simply start, stop and restart LCDd with the init-script.

#### Running LCDd from the command line

There are several reasons for running LCDd from the command line

- You don't want to install LCDd but run it from the source directory.
- You want to do some debugging.
- You want to get the output directly on stderr.
- ...

**Note:** If you run LCDd as a "normal" user, it will not change to the user specified in the config file. For parallel port devices you will need root privileges anyway ;)

The simplest command that will run LCDd is the following. It is useful for running LCDd from the source directory, e.g. after building.

```
$ server/LCDD -c LCDD.conf
```

#### The Command Line Options of LCDd

Running LCDd -h gives you an overview of the currently available command line options, including a list of the compiled in drivers.

##### Example 6-1. LCDd -h

```
LCDD Server Daemon (part of lcdproc), 0.4.3dev
Copyright (c) 1999 Scott Scriven, William Ferrell, and misc contributors
This program is freely redistributable under the terms of the GNU Public License
Usage: LCDD [ -hfiws ] [ -c <config> ] [ -d <driver> ] [ -a <addr> ] \
 [ -p <port> ] [ -u <user> ] [ -w <time> ] [ -r <level> ]
```

Available options are:

```
-h Display this help screen
-c <config> Use a configuration file other than /etc/LCDD.conf
-d <driver> Add a driver to use (output only to first)
-f Run in the foreground
-i Disable showing of the main LCDproc server screen
-w <waittime> Time to pause at each screen (in seconds)
-a <addr> Network (IP) address to bind to
-p <port> Network port to listen for connections on
-u <user> User to run as
-s Output messages to syslog
-r <level> Report level (default=2)
```

Currently available drivers:

```
lcdm001, LCDM001, MtxOrb, MatrixOrbital, CFontz, CrystalFontz, LB216, text,
curses, ncurses, BayRAD, glk, glc
```

## Running lcdproc

You will probably more often run **lcdproc** from the command line than you will run LCDd.

### The Command Line Options of lcdproc

Running **lcdproc -h** gives you an overview of the currently available command line options.

#### Example 6-2. lcdproc -h

```
LCDproc, 0.4.3dev
Usage: lcdproc [-s server] [-p port] [modelist]
Options in []'s are optional.
modelist is "mode [mode mode ...]"
Mode letters:  [C]pu [G]raph [T]ime [M]emory [X]load [D]isk [B]attery
               proc_[S]izes [O]ld_time big_cloc[K] [U]ptime CPU_SM[P]
               [A]bout

Use "man lcdproc" for more info.
Example:
lcdproc -s my.lcdproc.server.com C M X -p 13666
```

**Note:** You will not be able to connect to a remote server, unless it listens to the correct interface and port! See `LCDd.conf`: The `[server]` Section for details on the server setup.

## Chapter 7. Contact Us

### Errata

Of course LCDproc is not perfect (yet). We do our very best to improve it, but in some cases we are very much restricted in our efforts.

The main reason for that is the fact that we do NOT have all the hardware people have written drivers for. Unfortunately some developers have kind of vanished and don't react to mails from the mailing list any more.

So, as far as drivers are concerned we rely on YOU as testers. We have developed elaborate "coding in the dark" skills over the time. E.g. the CFontz driver has been updated and ported to 0.4.3 without the developers having the hardware.

### The LCDproc Mailing List

We are a bit lazy about the bug-tracking and whatever stuff on SourceForge. So, please contact us directly through the mailing list.

For details on how to subscribe to the list see <http://lcdproc.omnipotent.net/mail.php3>.

We like people to subscribe to the list with their real names. Of course we cannot and do not want to force you to do so. Anyway, we need to know your name, if you want to contribute code to LCDproc (legal issues of copyrights).

### Reporting Bugs

Possibly you will find a bug in the LCDproc distribution. Before reporting this to the mailing list, please respect the following:

- Your system should be more or less up to date. This does not mean that you have to update from GNU/Linux kernel 2.0.x to 2.2.x or from 2.2.x to 2.4.x. But we would like to make sure that your problem is not related to a known bug in the kernel or maybe your compiler.
- Especially LCDd might need certain privileges to execute a command. Make sure LCDd HAS the rights to do so.
- When experiencing problems with LCDd, make sure that your hardware is OK. E.g. you should make sure that the wiring for your (in this case most likely parallel) device is correct.
- Make sure that you use the correct speed settings for your device. Incorrect speed settings (baud rate) are most likely to produce garbage scrolling on your display. Refer to the specifications of your device. If your device needs a speed setting that is not supported by LCDd send us a mail.
- Make sure that you have modified the configuration file according to your needs and that LCDd actually uses the configuration file. I.e. you might have to run LCDd with the -c option

Anyway, no question is too stupid to ask ;) Feel free to ask whatever you want. Unfortunately replying to mails takes time as well (a damn lot of time). So, if you want LCDproc to develop faster, please try to solve a problem yourself first.

BUT if you have actually FOUND A BUG we will be quite happy if you let us know. We NEED YOU as testers and appreciate any feedback.

**Notes**

1. <http://lcdproc.omnipotent.net/mail.php3>

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Version 1.1, March 2000

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