This is the Revision A version of the LCD32 RoboBrick. The status of this project is work in progress.

LCD32 Module (Revision C)

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This document is also available in PDF format.

1. Introduction

The LCD32 module can display a total 4 lines of 16 characters each, of which only 2 lines are visible at a time. The characters are displayed using a 5×7 dot matrix. There is a mechancal switch labeled LINES on the LCD32 module that switches between displaying lines 1−2 and lines 3−4. The LCD32 module is based upon the inexpensive Lumex® LCM−S01602DTR/M 2×16 liquid crystal display (LCD) module available from both Digikey® and Mouser The LCD32 module has a small trim potentiometer that allows you adjust the display contrast.

Most of the newer RoboBRiX modules have a 4−pin port labeled DEBUG. For modules that support the RoboBRiX debug protocol (some older firmware releases some do not drive the debug port), an LCD32 can be attached to the DEBUG port and display up to 32 hexadecimal bytes arranged as 4 lines of 8 bytes each. These bytes present the user with the internal state of each module. While it takes some effort to keep track of which byte is which, it is still way better than most modules which do not provide any view of the internal module state.

There is a second mechanical switch on the LCD32 module labeled MODE that switches the LCD module between DEBUG mode and REGULAR mode. In debug mode, characters inserted at the end of one line automatically show up on next line; this is called automatic line wrapping. Conversely, in regular mode, there is no automatic line wrapping and all characters output after the 16th character, will overwrite the 16th character.

The LCD32 module is meant to be used in conjunction with the LCD32Holder (Rev. A) board which carries the actual LCM−201602DTR/M and plugs onto the top of the LCD32 module.

2. Programming

Command	**Send/ Receive**	**Byte Value**								**Discussion**
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
Back Space	Send	0	0	0	0	1	0	0	0	Move cursor to the left.
Line Feed	Send	0	0	0	0	1	0	1	0	Advance currsor to beginning of next line; clear the next line
Form Feed	Send	0	0	0	0	1	1	0	0	Clear entire display and place cursor at home

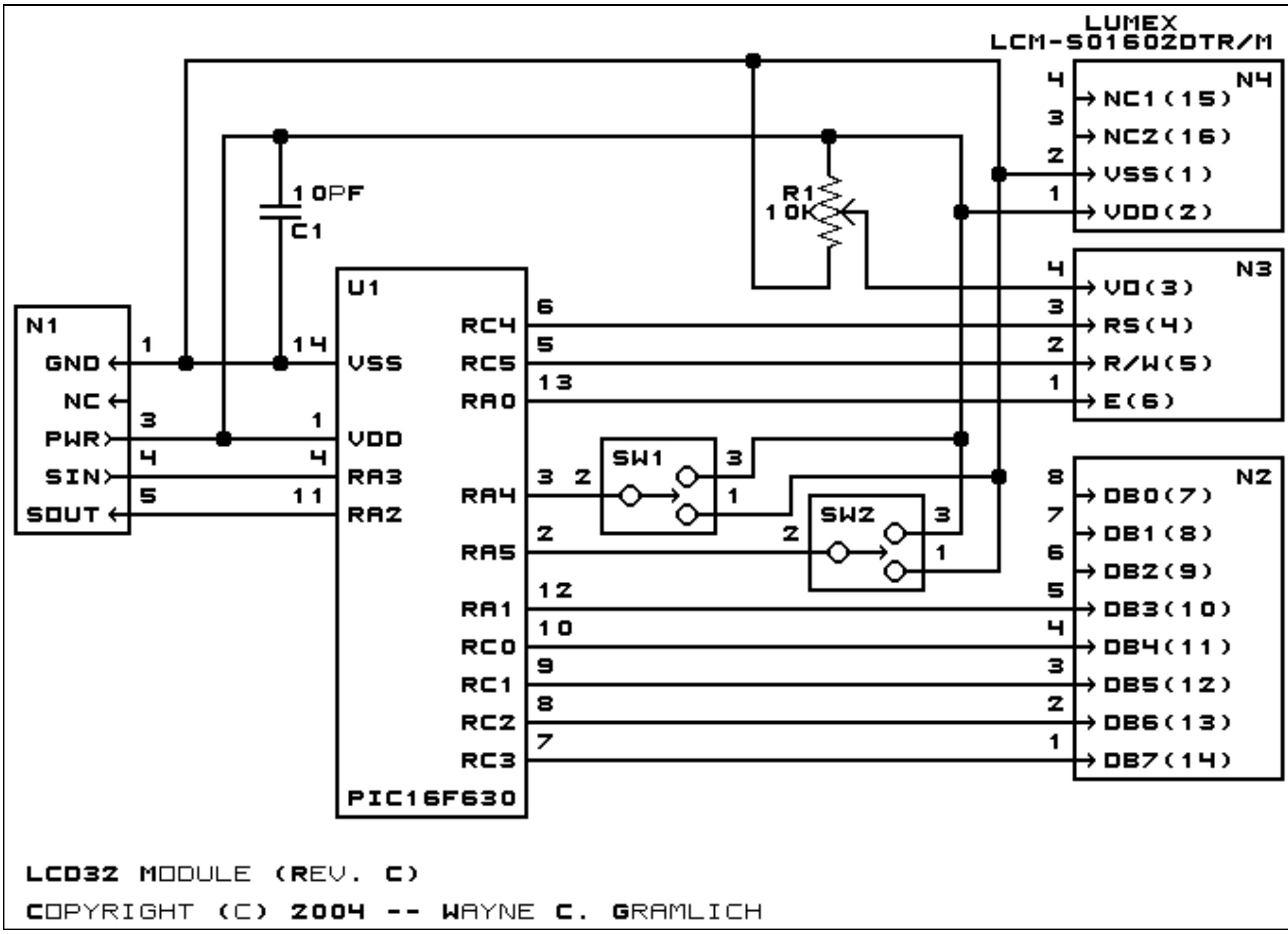
Carriage Return	Send	0	0	0	0	1	1	0	1	Return cursor to beginning of line
Character 32 to 63	Send	0	0	1	x	x	x	x	x	Enter the character on the display and advance cursor.
Character 64 to 127	Send	0	1	x	x	x	x	x	x	Enter the character on the display and advance cursor.
Line Set	Send	1	0	0	0	0	0	*l*	*l*	Move cursor to line *ll*
Line Clear	Send	1	0	0	0	0	1	*l*	*l*	Move cursor to line *ll* and clear it
Cursor Mode Set	Send	1	0	0	0	1	0	*v*	*b*	Cursor mode is set (*v*=1 visible cursor) (*b*=1 blinking cursor)
Cursor Mode Read	Send	1	0	0	0	1	1	0	0	Read cursor mode (*v*=1 visible cursor) (*b*=1 blinking cursor)
	Receive	0	0	0	0	0	0	*v*	*b*	
Character Read	Send	1	0	0	0	1	1	0	1	Read the current character *ccc cccc*; advance cursor
	Receive	0	*c*	*c*	*c*	*c*	*c*	*c*	*c*	
Line Read	Send	1	0	0	0	1	1	1	0	Read the current line *ll*
	Receive	0	0	0	0	0	0	*l*	*l*	
Position Read	Send	1	0	0	0	1	1	1	1	Read the current character position *pppp*
	Receive	0	0	0	0	*p*	*p*	*p*	*p*	
Position Set	Send	1	0	0	1	*p*	*p*	*p*	*p*	Move cursor to character position *pppp*
Position Set	Send	1	0	1	0	*p*	*p*	*p*	*p*	Move cursor to character position *pppp*; clear to end of line
Shared Commands	Send	1	1	1	1	1	*c*	*c*	*c*	Execute shared command *ccc*.

3. Hardware

The hardware consists of a circuit schematic and a printed circuit board.

3.1 Circuit Schematic

The schematic for the LCD32 RoboBrick is shown below:



The parts list kept in a separate file −− lcd32.ptl.

3.2 Printed Circuit Board

The printed circuit board files are listed below:

lcd32_back.png
: The solder side layer.

lcd32_front.png
: The component side layer.

lcd32_artwork.png
: The artwork layer.

lcd32.gbl
: The RS−272X "Gerber" back (solder side) layer.

lcd32.gtl
: The RS−272X "Gerber" top (component side) layer.

lcd32.gal
: The RS−272X "Gerber" artwork layer.

lcd32.drl
: The "Excellon" NC drill file.

lcd32.tol
: The "Excellon" tool rack file.

4. Software

The LCD32 software is available as one of:

lcd32.ucl
    The µCL source file.
lcd32.asm
    The resulting human readable PIC assembly file.
lcd32.lst
    The resulting human readable PIC listing file.
lcd32.hex
    The resulting Intel® Hex file.

5. Issues

Any fabrication issues that come up are listed here.

A. Appendix A: Parts List

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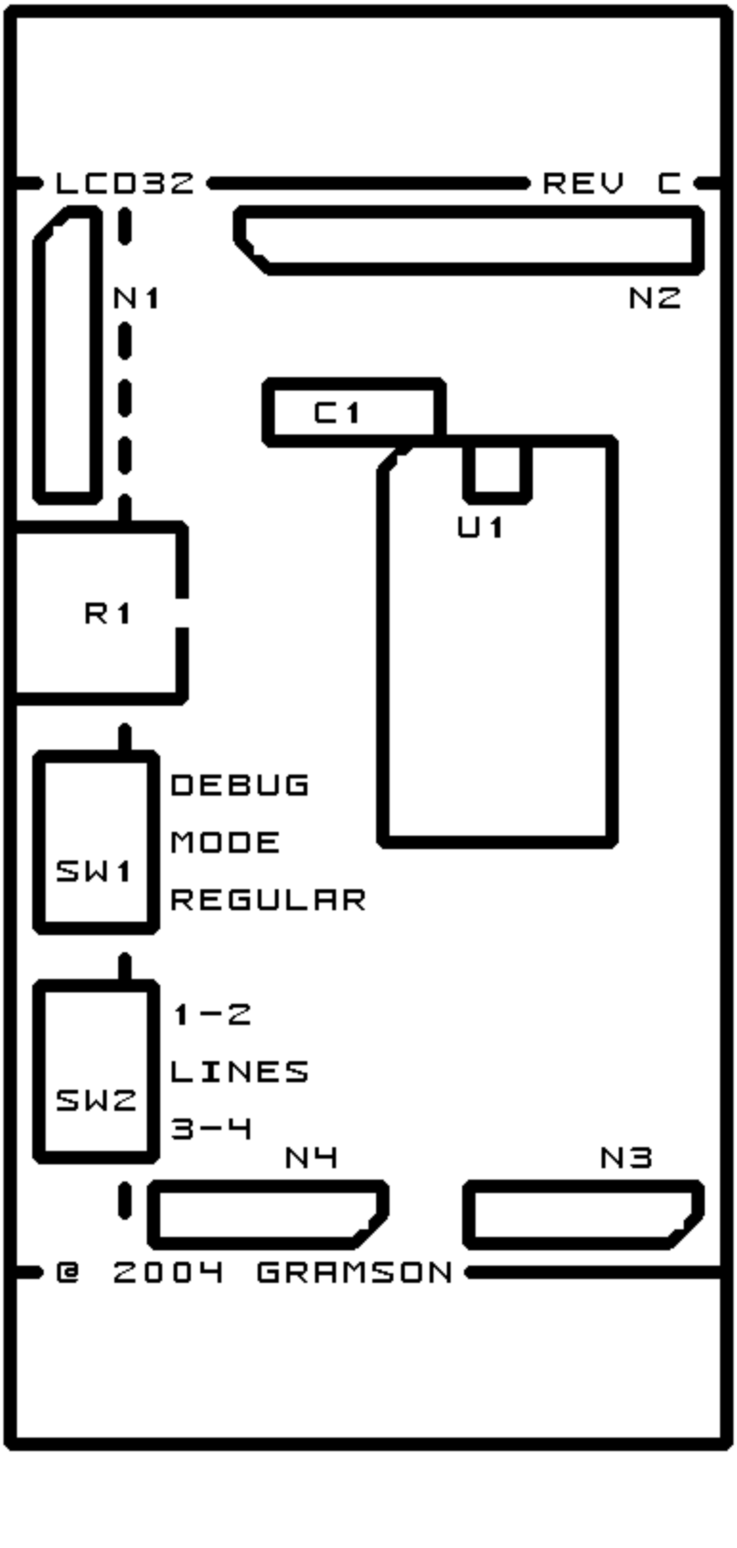
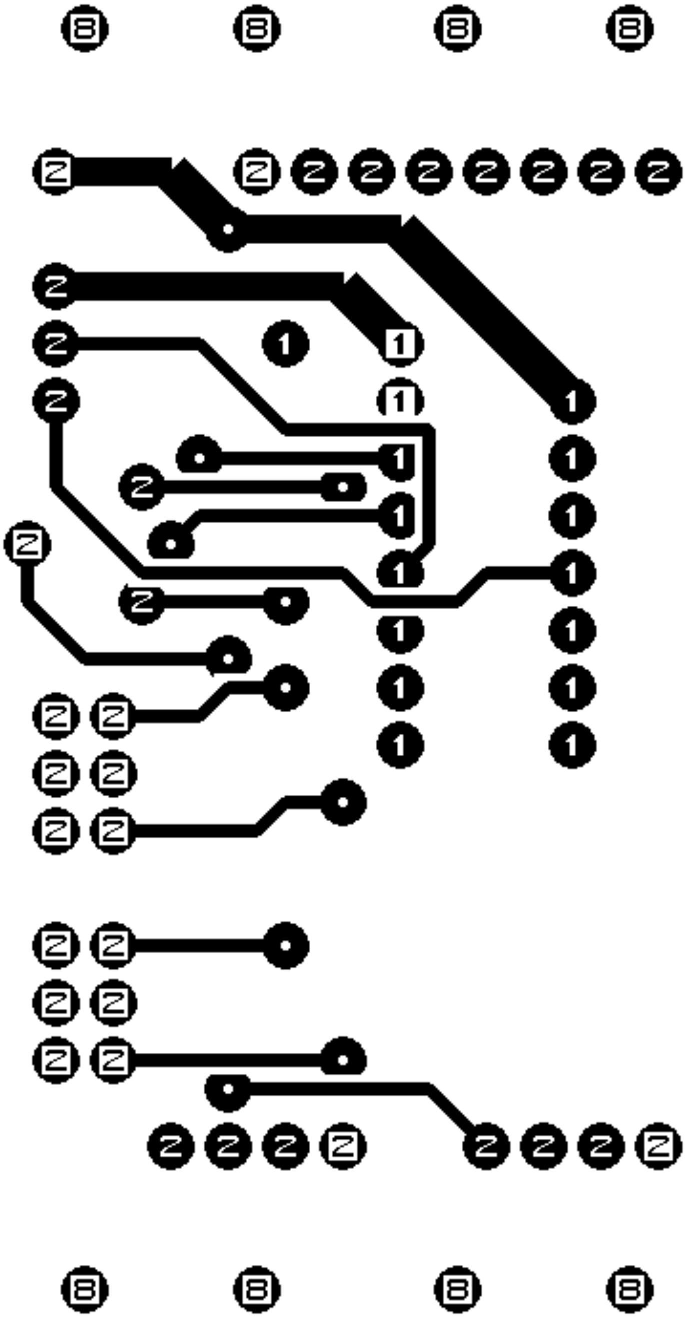
# Parts list for LCD32 Module (Rev. C)
#
C1: Capacitor10pF − 10 pF Ceramic Capacitor [Jameco: 15333]
N1: Header1x5.Slave − 1x5 Male Header [5/40 Jameco: 160881]
N2: Header1x8.LCD32 − 1x8 Male Header [8/40 Jameco: 160881]
N3: Header1x4.LCD32 − 1x4 Male Header [4/40 Jameco: 160881]
N4: Header1x4.LCD32 − 1x4 Male Header [4/40 Jameco: 160881]
R1: ResistorTrimPot10K − 10K Ohm Trim Pot [Digikey: D4AA14−ND]
SW1−2: SwitchSmallDPDT − Small DPDT Switch [Jameco: 161816]
U1: PIC16F630.LCD32 − Microchip PIC16F630 [Digikey: PIC16F630−I/P−ND]
```

B. Appendix B: Artwork Layer



C. Appendix C: Back (Solder Side) Layer



D. Appendix D: Front (Component Side) Layer