embedded adventures

Device: PLT-2001

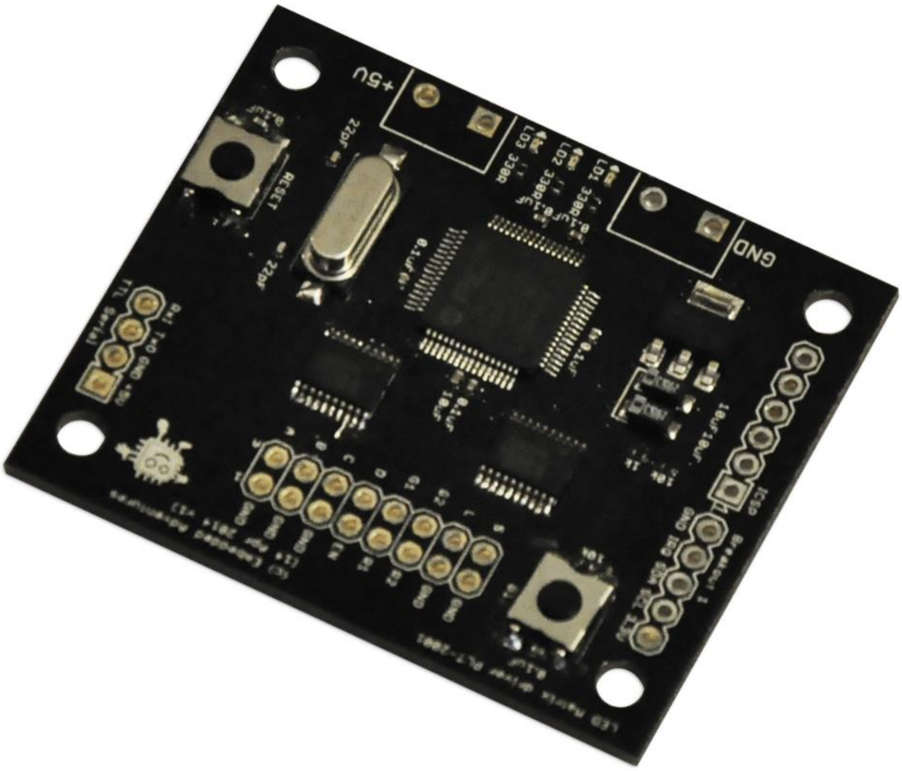
This document Version: 1

For hardware Version: 1

For firmware Version: 5.00

Date: 9 May 2014

Description: LED Matrix Display Driver board



Contents

Introduction

The PLT-2001v1 is a driver board designed to drive dynamically-scanned LED matrix displays (LED display panels) such as the LDP-3208S, LDP-8008, LDP-6416 and LDP-6432 from Embedded Adventures. Other panels that have similar pin-outs will work as well. Other panels that have different pin-outs but work the same way, will work with a little jumper wiring.

You don't need to know anything about the microcontroller on board to use the driver board however – it takes simple commands over the TTL serial port to enable rich graphical displays on common LED matrix display panels. Of course, if you want to, you can completely hack the firmware to change it in any way you like, but this is not necessary for normal operation.

Features

The PLT-2001 is designed to make it easy to interface to LED matrix displays. These displays require constant updating which consumes microcontroller CPU. This driver board allows graphical and text functions to be displayed through simple serial commands.

Hackability

The PLT-2001 is 100% hackable.

At Embedded Adventures, we believe you have the most fun when you have the most control over your hardware. For the PLT-2001 we provide a datasheet, complete schematic and complete source code. After that, it's all up to you. We'd love to hear about the projects you're using it for – send us information and photos to myproject@embeddedadventures.com

Construction

The PLT-2001v1 can be back-pack connected to LDP-8008 displays by soldering an 8x2 0.1" female connector on the underside of the board (so the pins are soldered on top). The holes on the PLT-2001v1 are designed to match the holes on the LDP-8008.

It can also be back-pack connected to LDP-6416 or LDP-6432, or alternatively a male connector inserted into the top of the board (and soldered on the back of the boards) and an IDC cable can be used to connect to the display.

For power, the PLT-2001 requires 5V and ground connections. Solder the terminal connectors on the board for easy screw connections, or simply power it through the 5V pin on the serial header.

Connections

The PLT-2001 has five connection ports. The breakout ports will be used for future expansion. The ICSP port is used for reprogramming the driver board using a PicKit3 or similar, but is not required for normal use.

TTL SERIAL	TTL level serial port
ICSP	Programming port for PIC, RB6, RB7 connections
Breakout 1	I2C port, for future expansion
LEDPANEL	16 pin connection to LED display panel

Power

The PLT-2001 provides a terminal block for power input for connection to your LED matrix display(s). The PLT-2001 is designed to run at 5v. Note that running large quantities of LEDs can result in a voltage drop across the supply, which may affect the reliability of the microcontroller. See the datasheet for your LED matrix display.

Setup

The PLT-2001 comes with universal firmware to support just aboard any board or configuration of boards. You can make super large displays by chaining LED panels together with the PLT-2001!

The key is the configpanel command.

configpanel width height paneltype bitsperpixel

Set width to the total number of pixels in the x direction

Set height to the total number of pixels in the y direction

Set paneltype according to this table:

LDP-6432 (2 active rows, dual colour, 2/32 scan LED panel) – 0

LDP-6416 (1 active row, dual colour, 1/16 scan LED panel) – 1

LDP-8008 / LDP-6408 (1 active row, dual colour, 1/8 scan LED panel) – 2

LDP-3208S – (1 active row, single colour, 1/8 scan LED panel) - 4

LDP-3216S – (1 active row, single colour, 1/16 scan LED panel) - 5

Set bitsperpixel to 2 for red/green panels, or 1 for single colour

So to configure an LDP-6432 panel, you would issue:

configpanel 64 32 0 2

You can use the title command to confirm that it worked okay.

If you are finding the display light but is very dim, try and alternate enable pin setting:

enableactive 1

or

enableactive 0

The power of this command is a little hidden. You can create massive displays with this board – for example, take 12 LDP-6432 panels, with 3 rows of 4 panels, and then configure them with:

configpanel 256 96 0 2

Or grab yourself 20 LDP-8008 displays make one super long display using:

configpanel 1600 8 0 2

You can see immediately how easy it is to get the driver board to handle whatever you throw at it.

The firmware is updateable, but we hope this will only be required for new features, rather than for swapping firmware for different types of LED panels as was required for the PLT-1001 driver board.

Operation

The driver board is controlled by the TTL Serial port. Connect a device to TxO and RxI – keeping in mind that you will need to connect transmit on your device to RxI on the PLT-2001, and receive on your device to TxO on the PLT-2001.

Set your serial port to 115,200bps and then you're ready to issue some commands.

Commands

The driver is double buffered. There is a "draw" buffer, which is what these commands act on, and a "display" buffer which unsurprisingly is what is actually used to drive the display.

This means that you can set up exactly what you need on the screen using multiple commands and then transfer the entire completed picture to the actual display in one hit for very smooth updates.

The driver board comes with a collection of graphical and text commands. Each command starts with a text word and ends with <ENTER> (ASCII character 13 – which is \r if you are using a microcontroller to send commands).

Once you have sent all commands you need, send a **paint** command. Effectively the paint command copies the draw buffer to the display buffer.

The exceptions to this are the **scroll** command, which doesn't require **paint**, since it updates the buffer automatically as the text moves across the display, and the **title** command.

Parameters to the commands can be separated by commas or spaces.

Most LED matrix displays, at least the ones from Embedded Adventures, have one or two pixel colours available – a single colour, or red and green, giving you black (colour 0), red (colour 1), green (colour 2), yellow/orange (colour 3).

clear

clear

Clear the display (all black pixels)

pixel

pixel colour x y

Set the pixel at position x, y to the specified colour. On LED matrix displays, x = 0 on the left most column, and y = 0 on the top row.

line

line colour x1 y1 x2 y2

Draws a line between x1, y1 and x2, y2 in the specified colour.

rect

rect colour x y width height

Draws a rectangle with left, bottom corner x,y that is width wide and height high. Keep in mind that x and y specifies the bottom left corner of the rectangle, so to fill a 64x32 display, issue: rect 1 0 31 64 32

circle

circle colour x_centre y_centre radius

Draws a circle centred at x_centre, y_centre in the specified radius and colour.

circlef

circlef colour x_centre y_centre radius

Draws a filled circle centred at x_centre, y_centre in the specified radius and colour.

circle2

circle2 colour x_centre y_centre radius

Draws a "squared" circle, centred at x_centre, y_centre – like an ordinary circle but with an extra pixel inserted at the top and sides so that the circle completely fills a square space.

font

font font_num

Sets the current font to font_num. With the PLT-2001 we have plenty of room for lots of awesome fonts. We look forward to adding more over time – so do send in your suggestions!

As of this version of the firmware, the following fonts are available:

Font ID	Description
1	5 pixel high narrow
2	5 pixel high normal
3	7 pixel high normal
4	8 pixel high fixed pitch
5	8 pixel high normal
6	10 pixel high narrow
7	10 pixel high normal
8	10 pixel high double
9	12 pixel high double
10	16 pixel high double
11	16 pixel high triple
12	24 pixel high triple
13	Bignum font
14	32 pixel high Tahoma*
15	Reserved
16	32 pixel high Segoe
17	10 pixel high Arial
18	5x7 fixed

Bignum font – great for clocks and temperature displays. This font only has 0-9, :, C, F and the degree symbol (use the ‵ character for degree).

* Font 14 contains extended ASCII characters

text

text colour x y "text"

Displays text in the current font where the bottom left corner of the text is positioned at x,y, in the current font.

textv

textv colour x y "text"

Displays text in the current font where the bottom left corner of the text is positioned at x,y – and the text is printed vertically from that point.

This enables you to make different shaped displays – eg put three LDP-6432 displays together vertically, rotate the physical displays 90 degrees, and you have yourself a 96x64 pixel display which you can print text horizontally on using the textv command.

scroll

scroll colour x y width "text"

Displays text that scrolls through the rectangle made by x,y to width and the font height. The driver will send **<done>** when the scroll is complete. You can interrupt an existing scroll by simply issuing another **scroll** command. Scroll can handle strings of up to 170 characters.

scrollspeed

The default speed that scrolling moves at is a stately 150ms between changes. To alter this, pass the set the new speed using **scrollspeed**. This can even be done while scrolling.

scrollloop n

If you would like the scrolling text to loop around – as in, start displaying again after the scroll has complete, set n to 1, otherwise 0. You can even change it while it's scrolling – loop for a while, and then set to 0 so that it finishes scrolling after the current loop. When continuously looping, the "<done>" response is not printed, until n is set to 0.

paint

paint

Copies the draw buffer to the display buffer so previous commands are actually displayed.

title

The **title** command is a great way of testing your display. Using whatever resolution is available, it will draw a boarder around the outside, and show you the version of the firmware among other things. This enables you to see which display is which and see which way around the displays are orientated – the text will always be in the top-most or left-most display.

enableactive

The Enable line on LED matrix displays can be a different polarity on different displays. All the displays you use in one daisy chain must be the same type.

For a display that is active low, issue the command:

```
enableactive 0
```

For a display that is active high, issue the command:

```
enableactive 1
```

It won't harm your display either way, but if you're getting nothing displayed at all, or it is quite feint, try the opposite polarity.

Tips and tricks

I'm sending commands but nothing is displayed!

Check the power connections. Be careful when hooking up the board since reversing the connections will damage LED matrix displays.

Make sure you send a paint command after you send commands. Try the **title** command. It's a great first step to see that everything is working.

Check that your panel has the same pin-out as the PLT-2001 – it's called "HUB08", a semi-standard for LED panels.

And if your display is either blank or you can see pixels only faintly, then you probably need to try the **enableactive** command to set the ENable line correctly.

I'm sending commands and there's crazy stuff being displayed!

Actually this used to be a problem with the PLT-1001 if you sent it random commands that drew outside of the boundary of the current panel. With the PLT-2001, you can happily draw outside the screen and it will simply clip your command.

Red displays okay but green is very faint and orange/yellow is more red than orange/yellow.

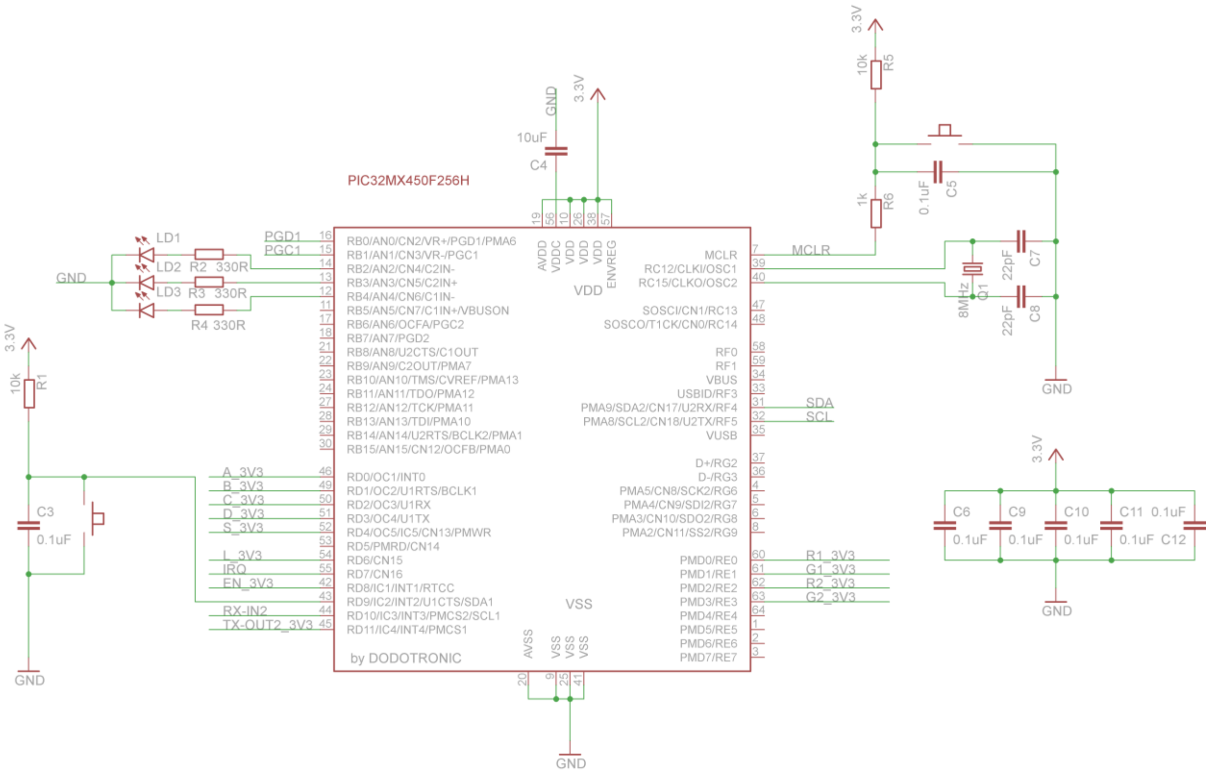
You probably haven't powered the displays with their 5V and GND connections and your display is leaching current from the serial connection.

Other panels

If your LED panel has a different pin-out to the standard set, it is a simple matter of connecting the correct pins to the LED Panel connection on the PLT-2001. In this case, you may find it easier to use a male connector on the top of the board so female jumpers can be used.

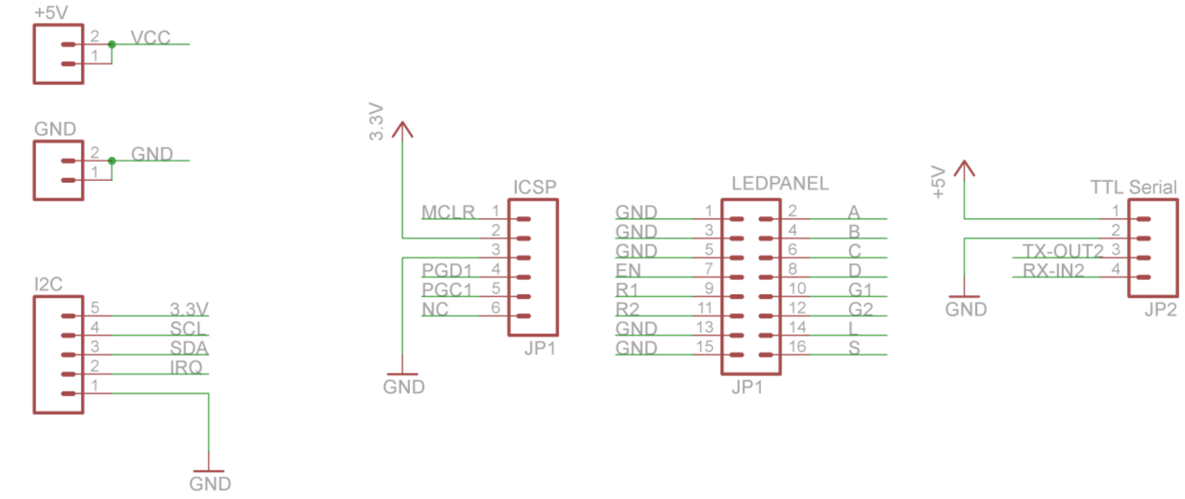
Schematic

General circuit



A fairly standard PIC32 microcontroller layout. Reset is provided via pulling MCLR to ground, and B1 pull RD9 to ground. B1 is used to trigger the bootloader. Hold it down while pressing the reset button.

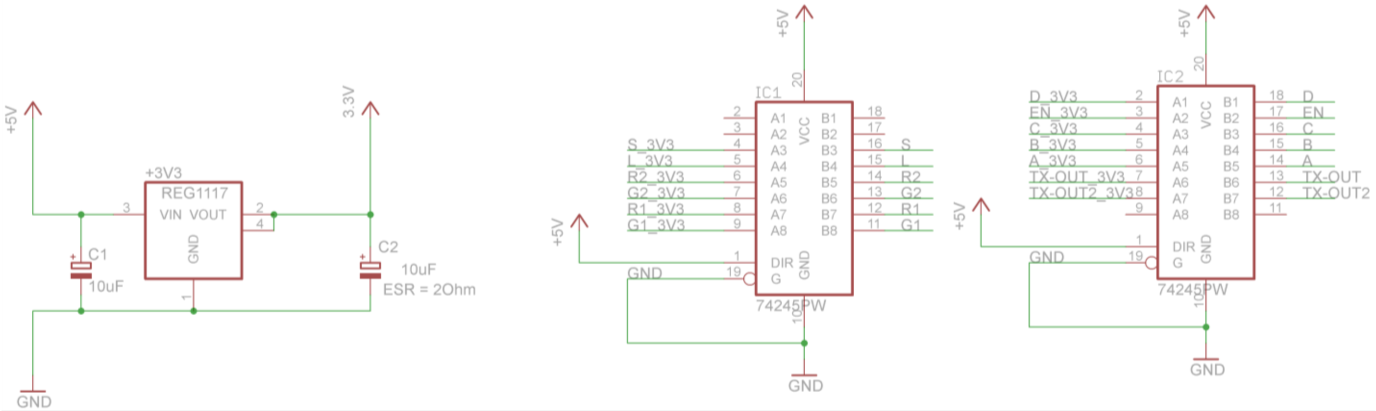
Connections



The LED panel connection follows the HUB08 standard connection for LED matrix display panels. ICSP allows for in circuit (non bootloader) programming normally only required for initial program

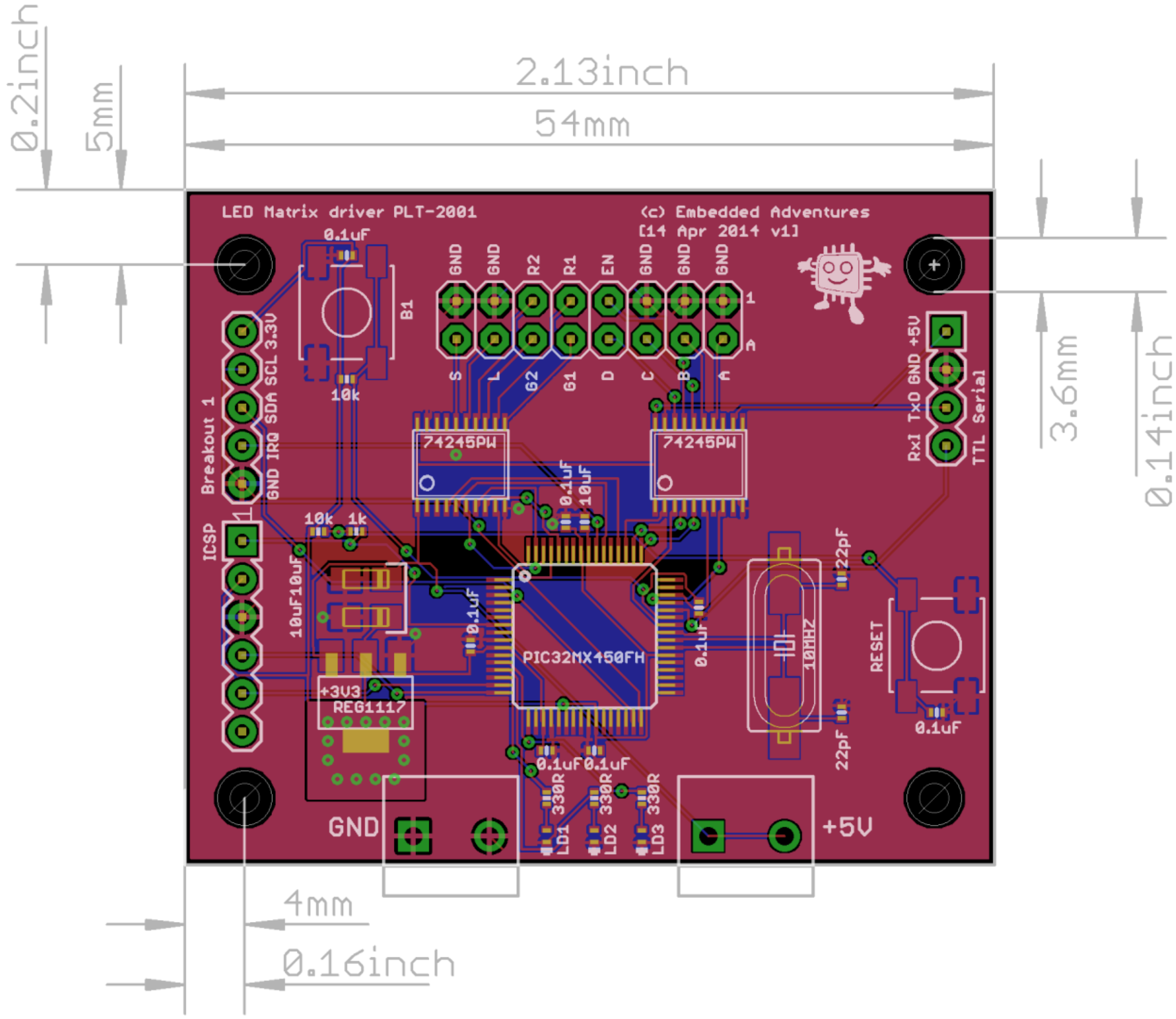
The TTL Serial connection is the main method of connecting to the driver board in this firmware revision. In the future we will add support for the I2C port as well.

Power



Since the microcontroller runs at 3.3V, we must convert the 5V the board runs at via a regulator. While most LED panels contain buffers and will probably run just fine being controlled at 3.3V, we use buffers to maintain 5V outputs and prevent load on the microcontroller. This also gives us a proper 5V TTL serial connection (the microcontroller will happily accept 5V input, and the 74HC245 gives us 5V output.

PCB



What next?

We really hope you enjoy using this display driver and come up with some fantastic projects. Please tell us about it – email us at myproject@embeddedadventures.com. And don't forget that we'll be making updates to the firmware so that you can interface with real time clock modules and more!

Versions

Version	Date	Comments
Version 1.0	11 May 2014	Initial version for board v1