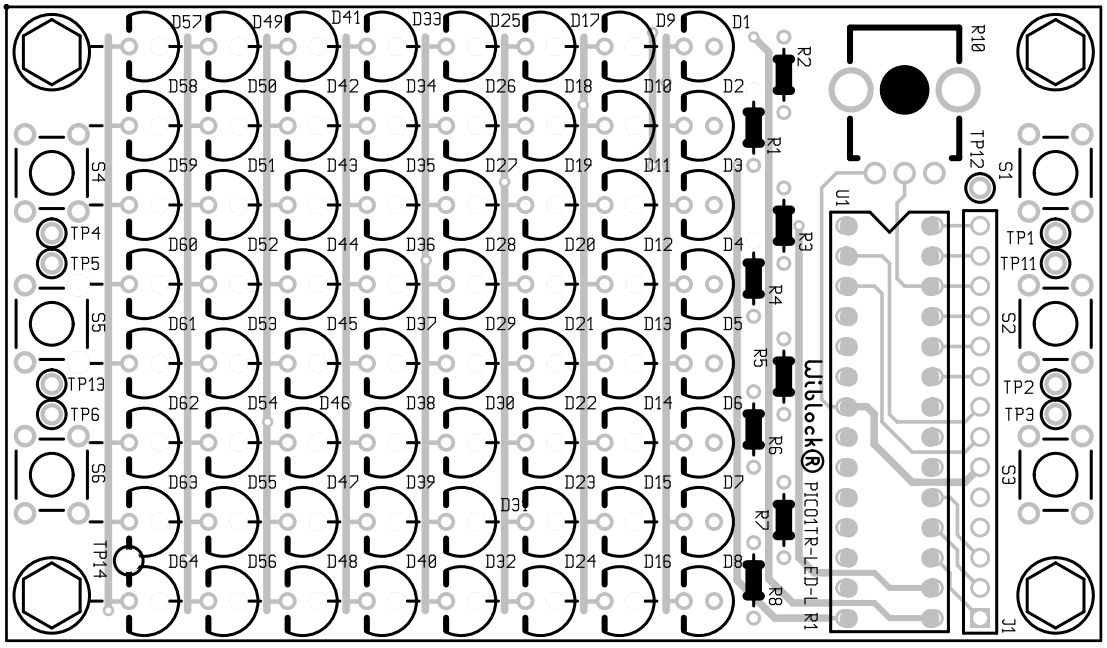

Description

The PICO1TR-LED-L is an 8x8 LED matrix that is designed to interface with a PICO1TR. The board size is 2.1” x 3.625” with a the 2.1” x 1” area to mount a PICO1TR. The PICO1TR is included in the kit.

Features

- 8x8 matrix of 5mm LEDs – requires only nine I/O lines.
- 2.1” x 3.625”
- Mounting area for PICO1TR. *The PICO1TR is included in the kit.*
- Positions for six 6mm pushbuttons (Panasonic PAE04M or equivalent).
- Position for a potentiometer (Panasonic EVU-F2AF30B54 or equivalent).
- 100mil Header connector for the unused I/O lines – RX and TX (PD0, PD1), digital I/O lines (PB3, PB4, PB5) and analog I/O lines (PC0, PC1, PC2, PC3, PC4, PC5).

1 Assembly

Semiconductors are electrostatic-sensitive devices. Proper ESD handling precautions need to be taken to avoid damage.

The Bill of Materials (BOM) and Component List are in section 4. For full page assembly drawings see Figure 1 (top) and Figure 2 (bottom).

1.1 Overview

The PICO1TR-LED-L contains all the parts to make a PICO1TR and an LED matrix. The board is v-scored so that the PICO1TR and the LED matrix sections can be separated. Separation is performed by firmly gripping each half of the board and bending it. This is easier to perform prior to assembly. The board may also contain a border which is v-scored. While holding the board grip the border with needle-nose pliers and flex the border.

The instructions for assembling the PICO1TR portion of the PCB are in the PICO1TR datasheet at wiblocks.

The LED matrix assembly consists a PCB and 64 LEDs. All of the LEDs are the same. There are positions for ballast resistors for operation at voltages other than 3.3V. For 3.3V operation each ballast resistor should be replaced with a jumper wire. The PCB contains positions for eight optional components — six pushbutton switches, a potentiometer and an I/O connector.

1.2 Which Side is Up?

A number of the components can be placed on either side. The assembly options are –

LEDs These can be placed on either side. You need to observed the proper polarity.

Ballast Resistors These can be placed on either side and are not polarized. The prefered location for these is the side with the LEDs.

PICO1TR This has to be mounted on the top side.

Pushbutton Switches These can mount on either side.

Potentiometer This has to be mounted on the bottom side.

I/O Connector This has to be mounted on the bottom side.

The assembly instructions assume that all of the supplied components are mounted on the top and none of the optional components are installed.

1.3 Top Side Components

These instructions assume all parts, including the PICO1TR, are mounted on the top side.

1.3.1 LEDs

There are 64 LEDs labeled D1-D64. Line the cathode marking on D1 with the cathode marking on the silkscreen. For each LED apply pressure to the top of the LED while you solder one lead. Repeat for each LED. After all LEDs have one terminal soldered flip the board and make any minor adjustments that are required to align the LEDs. Flip the board back and solder each of the unsoldered leads.

1.4 Resistors

There are positions for eight resistors labeled R1-R8. These resistors are ballast resistor and limit the current for each row of LEDs. For 3.3V operation a resistor is not required so a jumper wire should be inserted in each resistor position. If you are operating at 5V a 47Ω, 1/8W resistor is recommended. See subsection 3.1 for information about calculating ballast resistor values.

1.5 PICO1TR

After the LEDs and resistors are soldered the PICO1TR-LED-L can be tested by placing a programmed PICO1TR into the U1 position. If you do not have a PICO1TR that is programmed with an LED annimation download the demo animation from wiblocks.

With the programmed PICO1TR plugged into the PICO1TR-LED-L apply power. The animation should be displayed. You may need to tilt the the PICO1TR and apply pressure to get all of the pins to connect.

After both boards are working solder the PICO1TR into the PICO1TR-LED-L.

2 IO Connectors

J1 Pinout

J1 Pin	Atmega328P	Arduino
1	PB3	11
2	PB4	12
3	PB5	13
4	GND	
5	GND	
6	VCC	
7	TXD	1
8	TXD	0
9	PC0	A0
10	PC1	A1
11	PC2	A2
12	PC3	A3
13	PC4	A4
14	PC5	A5

Table 1: J1 I/O Header

3 Electrical Hints

3.1 Ballast Resistors

Since the ATmega328P output pins directly drive the LEDs the maximum currents of the ATmega328P pins, ports and total supply current needs to be considered when deterimming the size of the ballast resistors and when writing the software. (Atmel, 2009a)

Maximum Source/Sink Current

Pins are not guaranteed to sink or source more than the listed test condition in the Atmel specification which is 20mA for a V_{CC} of 5V and 10mA for a V_{CC} of 3V.

Maximum I_{OL}

- I_{OL} should not exceed 40mA.
- The sum of I_{OL} for ports C0-C5, ADC7, AD6 should not exceeed 100mA.
- The sum of I_{OL} for ports B0-B5, D5-D7, XTAL1, XTAL2 should not exceeed 100mA.
- The sum of I_{OL} for ports D0-D4, /RESET should not exceeed 100mA.

Maximum I_{OH}

- The absolute maximum I_{OH} is 40mA.
- The sum of I_{OH} for ports C0-C5, D0-D4, ADC7, /RESET should not exceeed 150mA.
- The sum of I_{OH} for ports B0-B5, D5-D7, ADC6, XTAL1, XTAL2 should not exceeed 150mA.

Maximum I_{CC}

The absolute maximum I_{CC} is 200mA.

3.1.1 Calculation

For LED currents greater than 2mA the software must multiplex columns or provide a large enough ballast resistor to limit the current to the maximum guaranteed level. A ballast resistor is not required when using the LEDs in the kit and $V_{CC} = 3.3$V and the columns are multiplexed.

If the regulator is adjusted to a V_{CC} of 5V the maximum guaranteed output current is 20mA. At 20mA $V_{OL} = 0.9$V and $V_{OH} = 4.2$V. The LED in the kit has a $V_{f(max)}$ of 2.4V at an I_f of 20mA. The value of the ballast resistor for a 5V system is given by the equation –

$$R_B = \frac{V_{OH} - V_F - V_{OL}}{I_F} = \frac{4.2\text{V} - 2.4\text{V} - 0.9\text{V}}{20\text{mA}} = 45\Omega$$

3.2 Pushbutton Switches

There are two groups of three pushbuttons. For each group there is a ground connection, switch common input and three outputs. Testpoints are provided for each of these connections.

Connect the switch common testpoint to the ground testpoint. Connect the switch output testpoint to any of the unused pins on the J1 header strip.

Pin	Group	Description
TP12	Top	Ground
TP11		S1, S2, S3 Common Input
TP1		S1 Output
TP2		S2 Output
TP3		S3 Output
TP13	Bottom	Ground
TP14		S4, S5, S6 Common Input
TP4		S4 Output
TP5		S5 Output
TP6		S6 Output

Table 2: Pushbutton Connections

3.3 Potentiometer

The potentiometer (R10) wiper is wired to PC3 (Arduino pin 17). The ends of R10 are wired to V_{CC} and GND.

3.4 Debug LED

The debug LED of the PICO1TR is connected to `PD7` which is also used by the PICO1TR-LED-L for LED column 7. Placing the PICO1TR jumper (`J3`) in the `NC` position will disconnect the debug LED. Since the debug LED only consumes a few mA it can be left connected.

References

Atmel. (2009a). 8-bit AVR Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash. 313-314. (Retrieved March 14, 2009, from http://www.atmel.com/dyn/resources/prod_documents/doc8025.pdf)

Atmel. (2009b). 8-bit AVR Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash. (Retrieved March 14, 2009, from http://www.atmel.com/dyn/resources/prod_documents/doc8025.pdf)

4 Assembly Documentation and Schematics

Table 3: Bill of Materials

Kit: PICO1TR-LED-L-KIT

Qty	Reference	Part Number	Description
64	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, D43, D44, D45, D46, D47, D48, D49, D50, D51, D52, D53, D54, D55, D56, D57, D58, D59, D60, D61, D62, D63, D64	Lite-On_LTL2H3KEK	
1		wiblock_PICO1TR-LED-L-PCB	

Table 4: Component List

Kit: PICO1TR-LED-L-KIT

Reference	Part Number	Description
D1	Lite-On_LTL2H3KEK	
D2	Lite-On_LTL2H3KEK	
D3	Lite-On_LTL2H3KEK	
D4	Lite-On_LTL2H3KEK	
D5	Lite-On_LTL2H3KEK	
D6	Lite-On_LTL2H3KEK	
D7	Lite-On_LTL2H3KEK	
D8	Lite-On_LTL2H3KEK	
D9	Lite-On_LTL2H3KEK	
D10	Lite-On_LTL2H3KEK	
D11	Lite-On_LTL2H3KEK	
D12	Lite-On_LTL2H3KEK	
D13	Lite-On_LTL2H3KEK	
D14	Lite-On_LTL2H3KEK	
D15	Lite-On_LTL2H3KEK	
D16	Lite-On_LTL2H3KEK	
D17	Lite-On_LTL2H3KEK	
D18	Lite-On_LTL2H3KEK	
D19	Lite-On_LTL2H3KEK	
D20	Lite-On_LTL2H3KEK	
D21	Lite-On_LTL2H3KEK	
D22	Lite-On_LTL2H3KEK	
D23	Lite-On_LTL2H3KEK	
D24	Lite-On_LTL2H3KEK	
D25	Lite-On_LTL2H3KEK	
D26	Lite-On_LTL2H3KEK	
D27	Lite-On_LTL2H3KEK	
D28	Lite-On_LTL2H3KEK	
D29	Lite-On_LTL2H3KEK	
D30	Lite-On_LTL2H3KEK	
D31	Lite-On_LTL2H3KEK	
D32	Lite-On_LTL2H3KEK	
D33	Lite-On_LTL2H3KEK	
D34	Lite-On_LTL2H3KEK	
D35	Lite-On_LTL2H3KEK	
D36	Lite-On_LTL2H3KEK	
D37	Lite-On_LTL2H3KEK	
D38	Lite-On_LTL2H3KEK	
D39	Lite-On_LTL2H3KEK	
D40	Lite-On_LTL2H3KEK	
D41	Lite-On_LTL2H3KEK	
D42	Lite-On_LTL2H3KEK	
D43	Lite-On_LTL2H3KEK	
D44	Lite-On_LTL2H3KEK	
D45	Lite-On_LTL2H3KEK	
D46	Lite-On_LTL2H3KEK	
D47	Lite-On_LTL2H3KEK	
D48	Lite-On_LTL2H3KEK	
D49	Lite-On_LTL2H3KEK	
D50	Lite-On_LTL2H3KEK	

Reference	Part Number	Description
D51	Lite-On_LTL2H3KEK	
D52	Lite-On_LTL2H3KEK	
D53	Lite-On_LTL2H3KEK	
D54	Lite-On_LTL2H3KEK	
D55	Lite-On_LTL2H3KEK	
D56	Lite-On_LTL2H3KEK	
D57	Lite-On_LTL2H3KEK	
D58	Lite-On_LTL2H3KEK	
D59	Lite-On_LTL2H3KEK	
D60	Lite-On_LTL2H3KEK	
D61	Lite-On_LTL2H3KEK	
D62	Lite-On_LTL2H3KEK	
D63	Lite-On_LTL2H3KEK	
D64	Lite-On_LTL2H3KEK	
	wiblock_PICO1TR-LED-L-PCB	

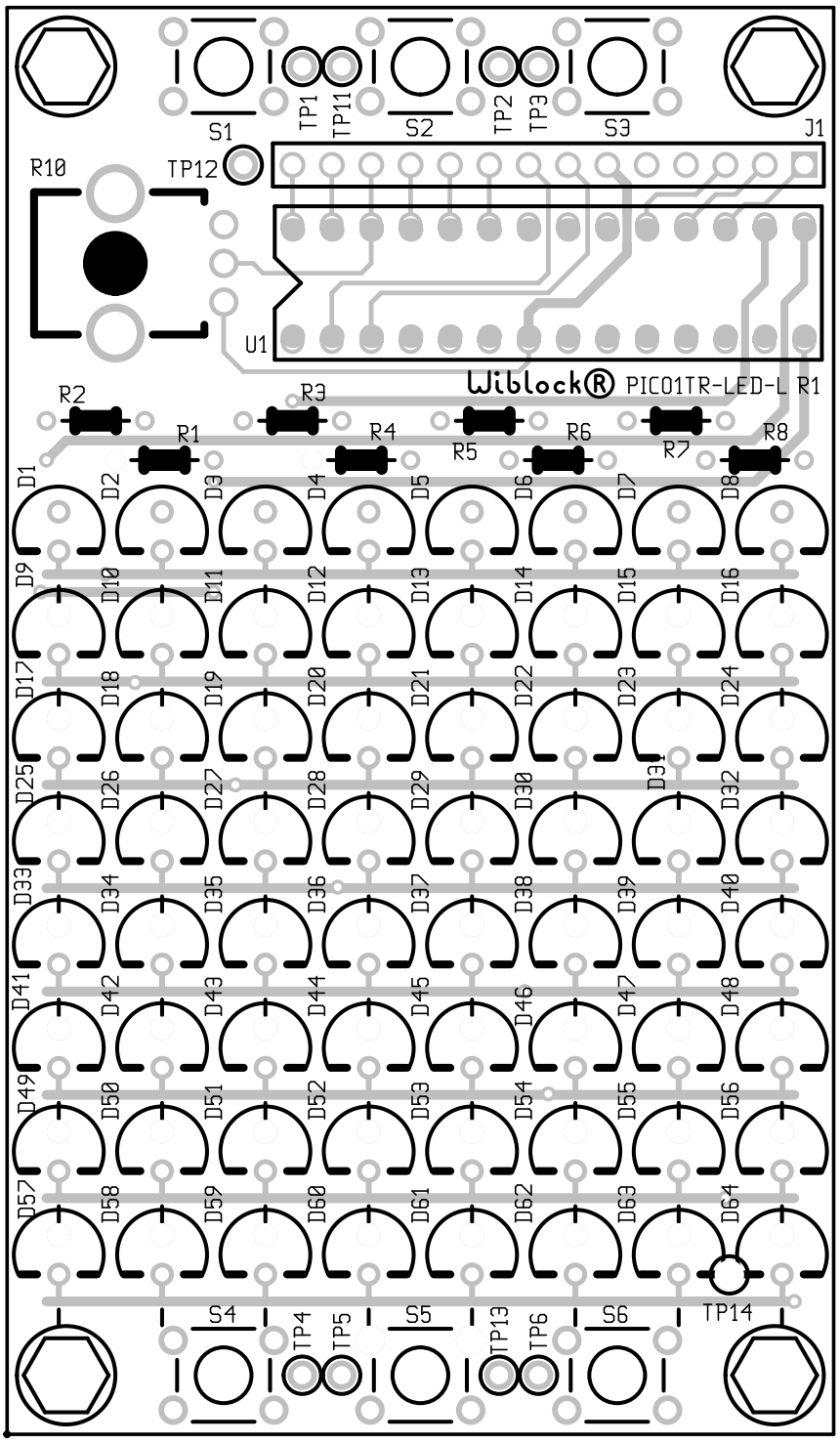

Figure 1: PICO1TR-LED-L Top Side Assembly Drawing (Rev 1)

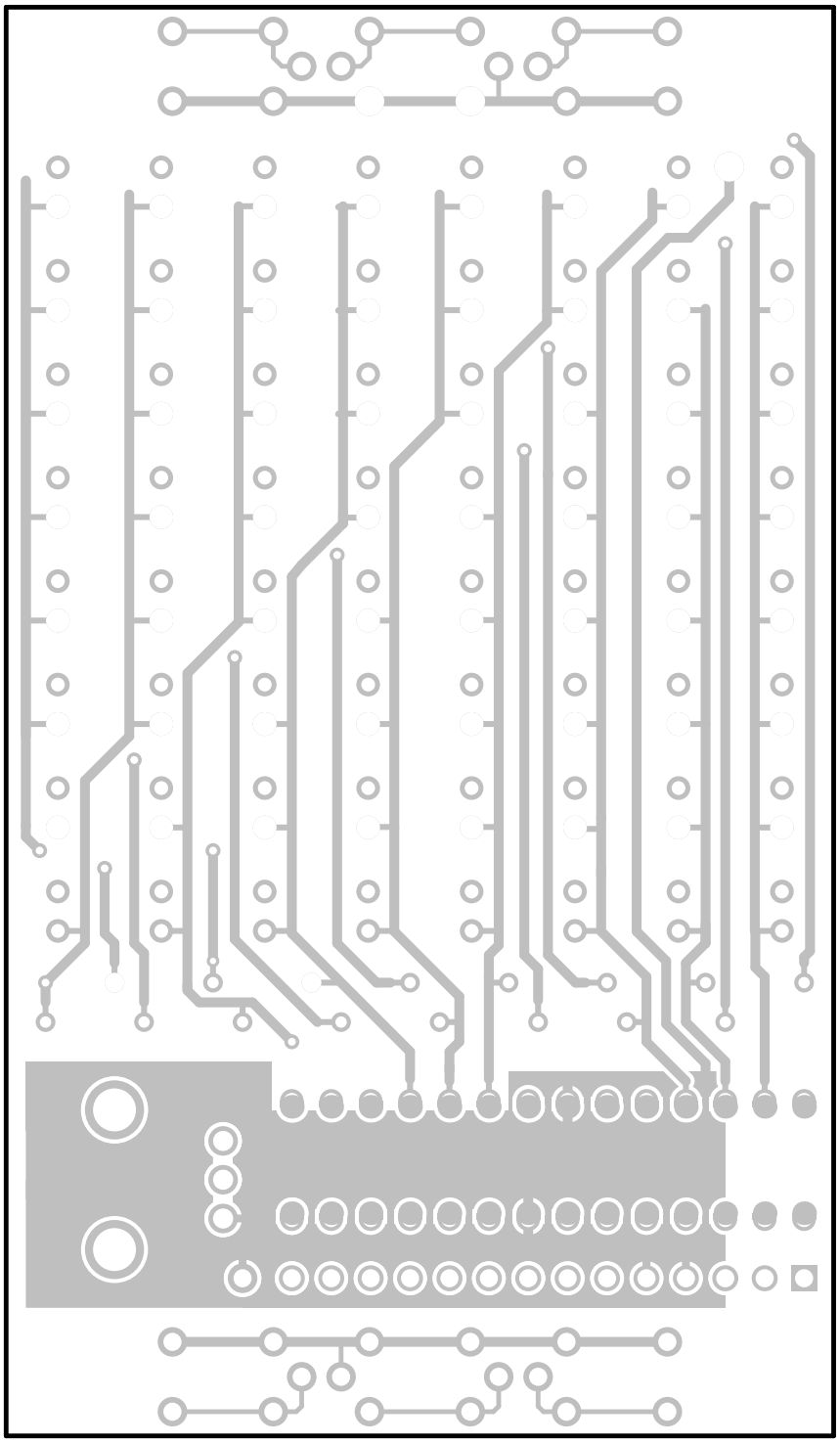

Figure 2: PICO1TR-LED-L Bottom Side Assembly Drawing (Rev 1)

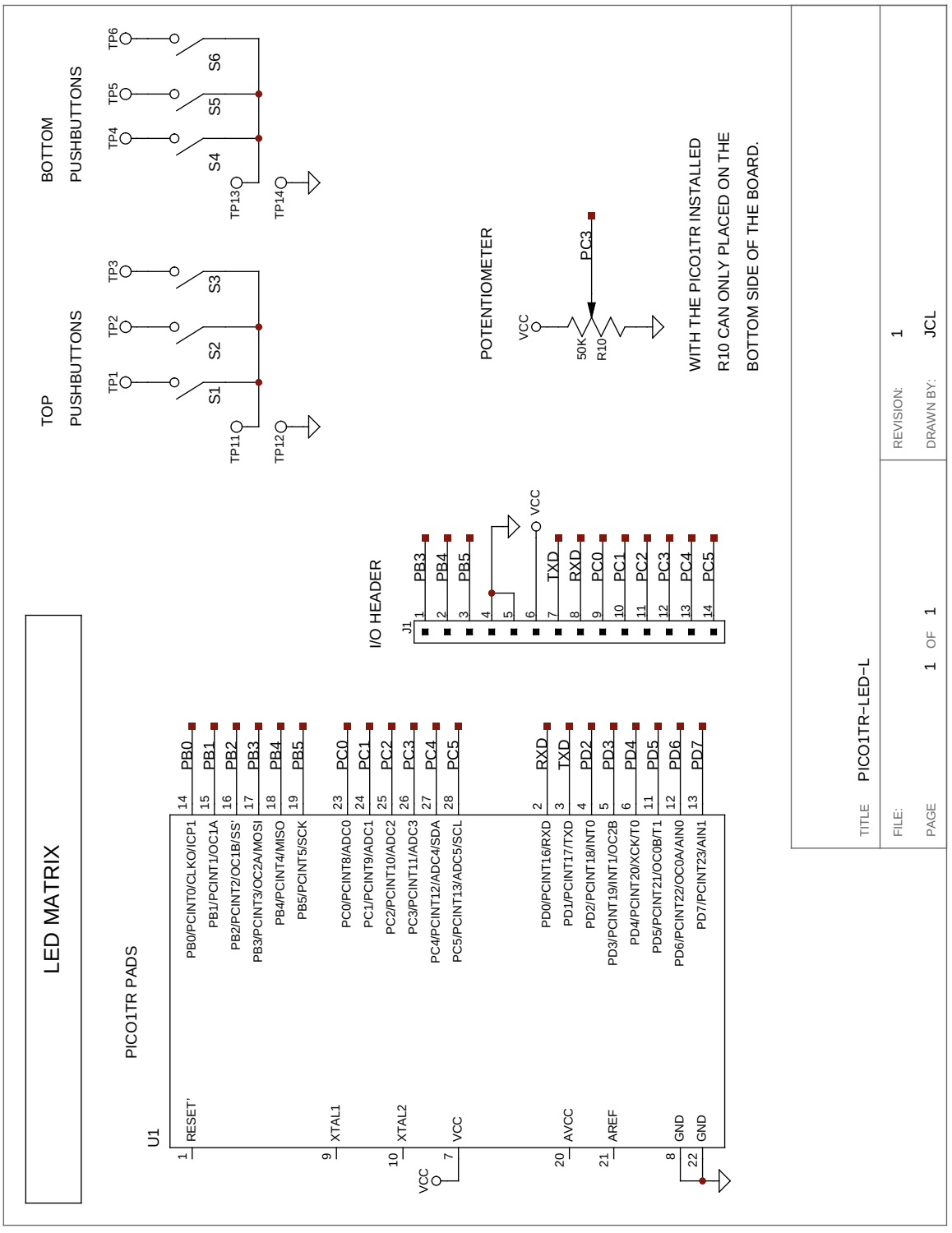

Figure 3: PICO1TR-LED-L (Rev 1)

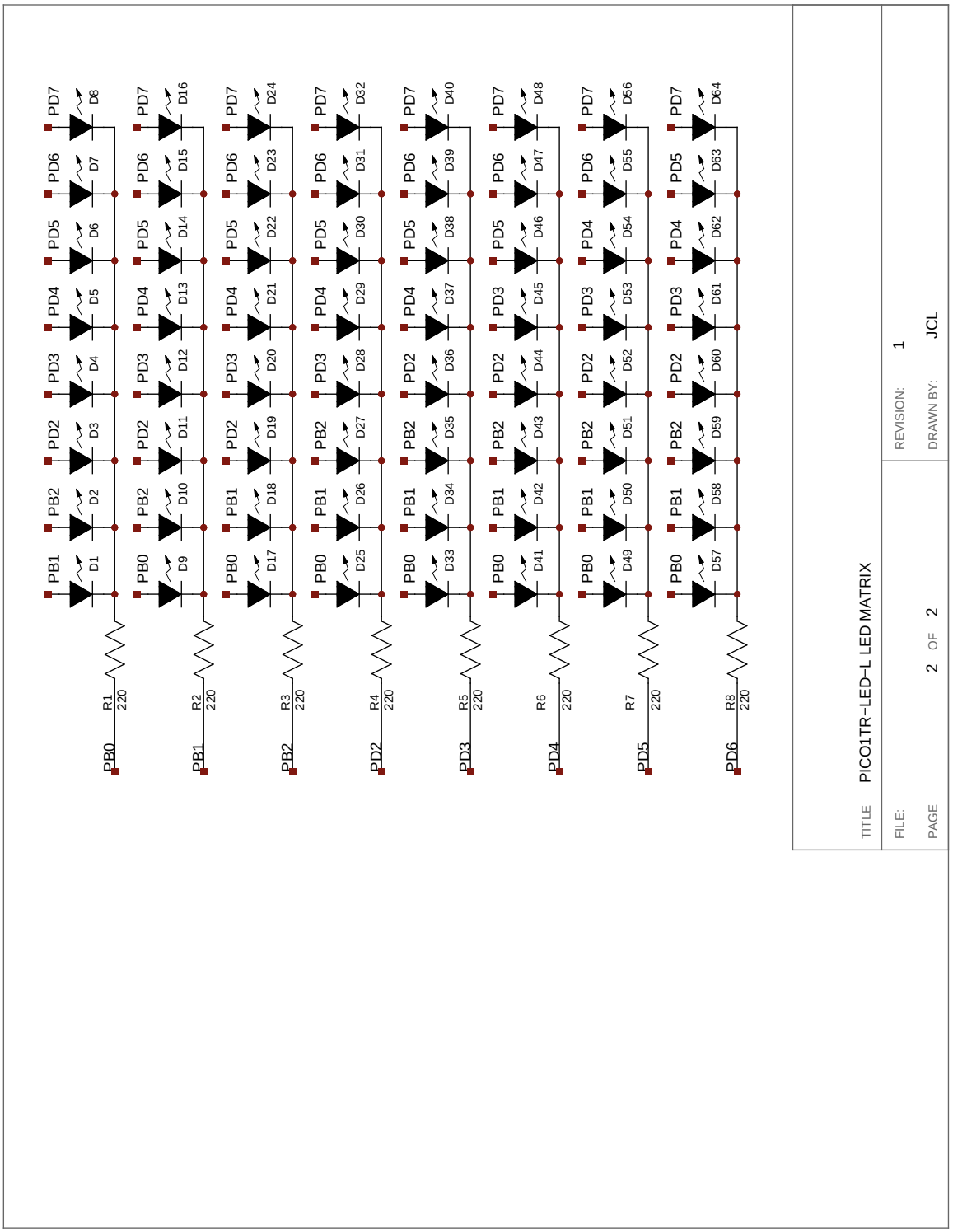

Figure 4: PICO1TR-LED-L (Rev 1)