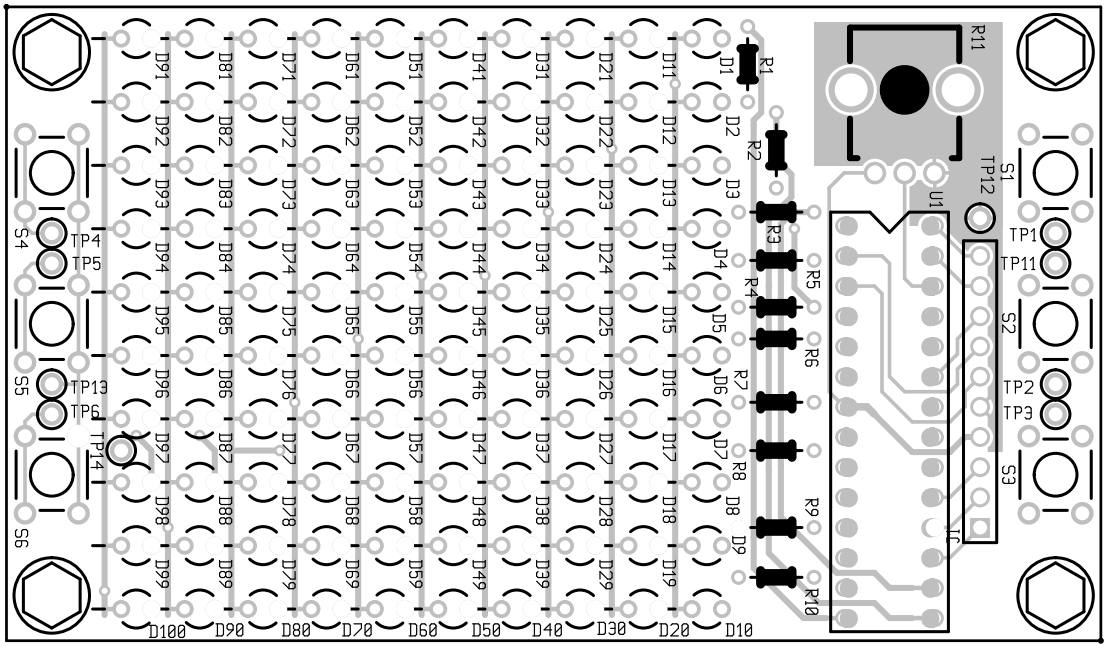

Description

The PICO1TR-LED-S is an 10x10 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

- 10x10 matrix of 3mm 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-S 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 100 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-S 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-S 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-S.

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 deterimining 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-S 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-S-KIT

Qty	Reference	Part Number	Description
100	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, D65, D66, D67, D68, D69, D70, D71, D72, D73, D74, D75, D76, D77, D78, D79, D80, D81, D82, D83, D84, D85, D86, D87, D88, D89, D90, D91, D92, D93, D94, D95, D96, D97, D98, D99, D100	LEDR-1T-GRN-2M00	LED, T1, Green
1		wiblock_PICO1TR-LED-S-PCB	

Table 4: Component List

Kit: PICO1TR-LED-S-KIT

Reference	Part Number	Description
D1	LEDR-1T-GRN-2M00	LED, T1, Green
D2	LEDR-1T-GRN-2M00	LED, T1, Green
D3	LEDR-1T-GRN-2M00	LED, T1, Green
D4	LEDR-1T-GRN-2M00	LED, T1, Green
D5	LEDR-1T-GRN-2M00	LED, T1, Green
D6	LEDR-1T-GRN-2M00	LED, T1, Green
D7	LEDR-1T-GRN-2M00	LED, T1, Green
D8	LEDR-1T-GRN-2M00	LED, T1, Green
D9	LEDR-1T-GRN-2M00	LED, T1, Green
D10	LEDR-1T-GRN-2M00	LED, T1, Green
D11	LEDR-1T-GRN-2M00	LED, T1, Green
D12	LEDR-1T-GRN-2M00	LED, T1, Green
D13	LEDR-1T-GRN-2M00	LED, T1, Green
D14	LEDR-1T-GRN-2M00	LED, T1, Green
D15	LEDR-1T-GRN-2M00	LED, T1, Green
D16	LEDR-1T-GRN-2M00	LED, T1, Green
D17	LEDR-1T-GRN-2M00	LED, T1, Green
D18	LEDR-1T-GRN-2M00	LED, T1, Green
D19	LEDR-1T-GRN-2M00	LED, T1, Green
D20	LEDR-1T-GRN-2M00	LED, T1, Green
D21	LEDR-1T-GRN-2M00	LED, T1, Green
D22	LEDR-1T-GRN-2M00	LED, T1, Green
D23	LEDR-1T-GRN-2M00	LED, T1, Green
D24	LEDR-1T-GRN-2M00	LED, T1, Green
D25	LEDR-1T-GRN-2M00	LED, T1, Green
D26	LEDR-1T-GRN-2M00	LED, T1, Green
D27	LEDR-1T-GRN-2M00	LED, T1, Green
D28	LEDR-1T-GRN-2M00	LED, T1, Green
D29	LEDR-1T-GRN-2M00	LED, T1, Green
D30	LEDR-1T-GRN-2M00	LED, T1, Green
D31	LEDR-1T-GRN-2M00	LED, T1, Green
D32	LEDR-1T-GRN-2M00	LED, T1, Green
D33	LEDR-1T-GRN-2M00	LED, T1, Green
D34	LEDR-1T-GRN-2M00	LED, T1, Green
D35	LEDR-1T-GRN-2M00	LED, T1, Green
D36	LEDR-1T-GRN-2M00	LED, T1, Green
D37	LEDR-1T-GRN-2M00	LED, T1, Green
D38	LEDR-1T-GRN-2M00	LED, T1, Green
D39	LEDR-1T-GRN-2M00	LED, T1, Green
D40	LEDR-1T-GRN-2M00	LED, T1, Green
D41	LEDR-1T-GRN-2M00	LED, T1, Green
D42	LEDR-1T-GRN-2M00	LED, T1, Green
D43	LEDR-1T-GRN-2M00	LED, T1, Green
D44	LEDR-1T-GRN-2M00	LED, T1, Green
D45	LEDR-1T-GRN-2M00	LED, T1, Green
D46	LEDR-1T-GRN-2M00	LED, T1, Green
D47	LEDR-1T-GRN-2M00	LED, T1, Green
D48	LEDR-1T-GRN-2M00	LED, T1, Green
D49	LEDR-1T-GRN-2M00	LED, T1, Green
D50	LEDR-1T-GRN-2M00	LED, T1, Green

Reference	Part Number	Description
D51	LEDR-1T-GRN-2M00	LED, T1, Green
D52	LEDR-1T-GRN-2M00	LED, T1, Green
D53	LEDR-1T-GRN-2M00	LED, T1, Green
D54	LEDR-1T-GRN-2M00	LED, T1, Green
D55	LEDR-1T-GRN-2M00	LED, T1, Green
D56	LEDR-1T-GRN-2M00	LED, T1, Green
D57	LEDR-1T-GRN-2M00	LED, T1, Green
D58	LEDR-1T-GRN-2M00	LED, T1, Green
D59	LEDR-1T-GRN-2M00	LED, T1, Green
D60	LEDR-1T-GRN-2M00	LED, T1, Green
D61	LEDR-1T-GRN-2M00	LED, T1, Green
D62	LEDR-1T-GRN-2M00	LED, T1, Green
D63	LEDR-1T-GRN-2M00	LED, T1, Green
D64	LEDR-1T-GRN-2M00	LED, T1, Green
D65	LEDR-1T-GRN-2M00	LED, T1, Green
D66	LEDR-1T-GRN-2M00	LED, T1, Green
D67	LEDR-1T-GRN-2M00	LED, T1, Green
D68	LEDR-1T-GRN-2M00	LED, T1, Green
D69	LEDR-1T-GRN-2M00	LED, T1, Green
D70	LEDR-1T-GRN-2M00	LED, T1, Green
D71	LEDR-1T-GRN-2M00	LED, T1, Green
D72	LEDR-1T-GRN-2M00	LED, T1, Green
D73	LEDR-1T-GRN-2M00	LED, T1, Green
D74	LEDR-1T-GRN-2M00	LED, T1, Green
D75	LEDR-1T-GRN-2M00	LED, T1, Green
D76	LEDR-1T-GRN-2M00	LED, T1, Green
D77	LEDR-1T-GRN-2M00	LED, T1, Green
D78	LEDR-1T-GRN-2M00	LED, T1, Green
D79	LEDR-1T-GRN-2M00	LED, T1, Green
D80	LEDR-1T-GRN-2M00	LED, T1, Green
D81	LEDR-1T-GRN-2M00	LED, T1, Green
D82	LEDR-1T-GRN-2M00	LED, T1, Green
D83	LEDR-1T-GRN-2M00	LED, T1, Green
D84	LEDR-1T-GRN-2M00	LED, T1, Green
D85	LEDR-1T-GRN-2M00	LED, T1, Green
D86	LEDR-1T-GRN-2M00	LED, T1, Green
D87	LEDR-1T-GRN-2M00	LED, T1, Green
D88	LEDR-1T-GRN-2M00	LED, T1, Green
D89	LEDR-1T-GRN-2M00	LED, T1, Green
D90	LEDR-1T-GRN-2M00	LED, T1, Green
D91	LEDR-1T-GRN-2M00	LED, T1, Green
D92	LEDR-1T-GRN-2M00	LED, T1, Green
D93	LEDR-1T-GRN-2M00	LED, T1, Green
D94	LEDR-1T-GRN-2M00	LED, T1, Green
D95	LEDR-1T-GRN-2M00	LED, T1, Green
D96	LEDR-1T-GRN-2M00	LED, T1, Green
D97	LEDR-1T-GRN-2M00	LED, T1, Green
D98	LEDR-1T-GRN-2M00	LED, T1, Green
D99	LEDR-1T-GRN-2M00	LED, T1, Green
D100	LEDR-1T-GRN-2M00	LED, T1, Green
	wiblock_PICO1TR-LED-S-PCB	

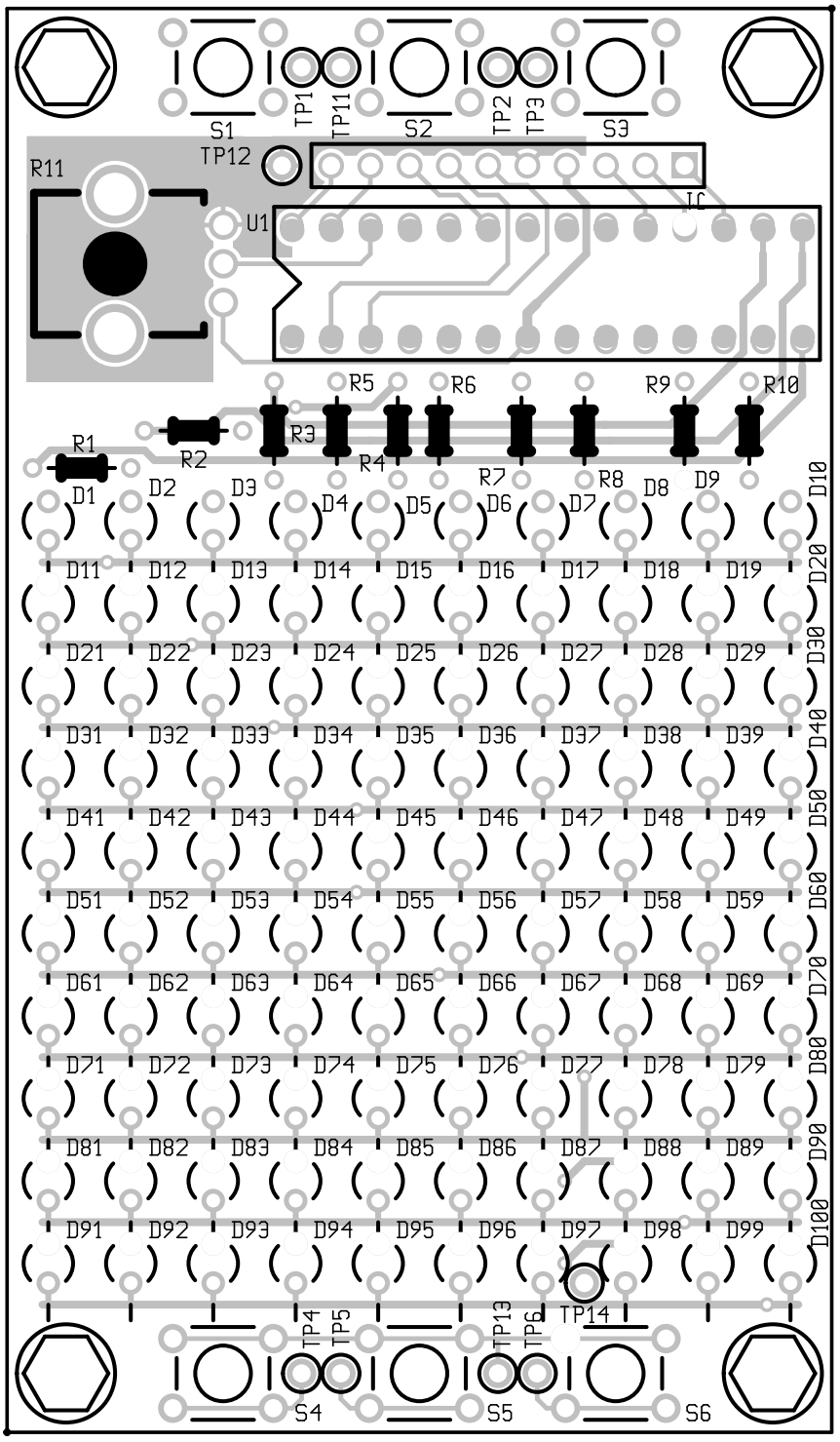

Figure 1: PICO1TR-LED-S Top Side Assembly Drawing (Rev 1)

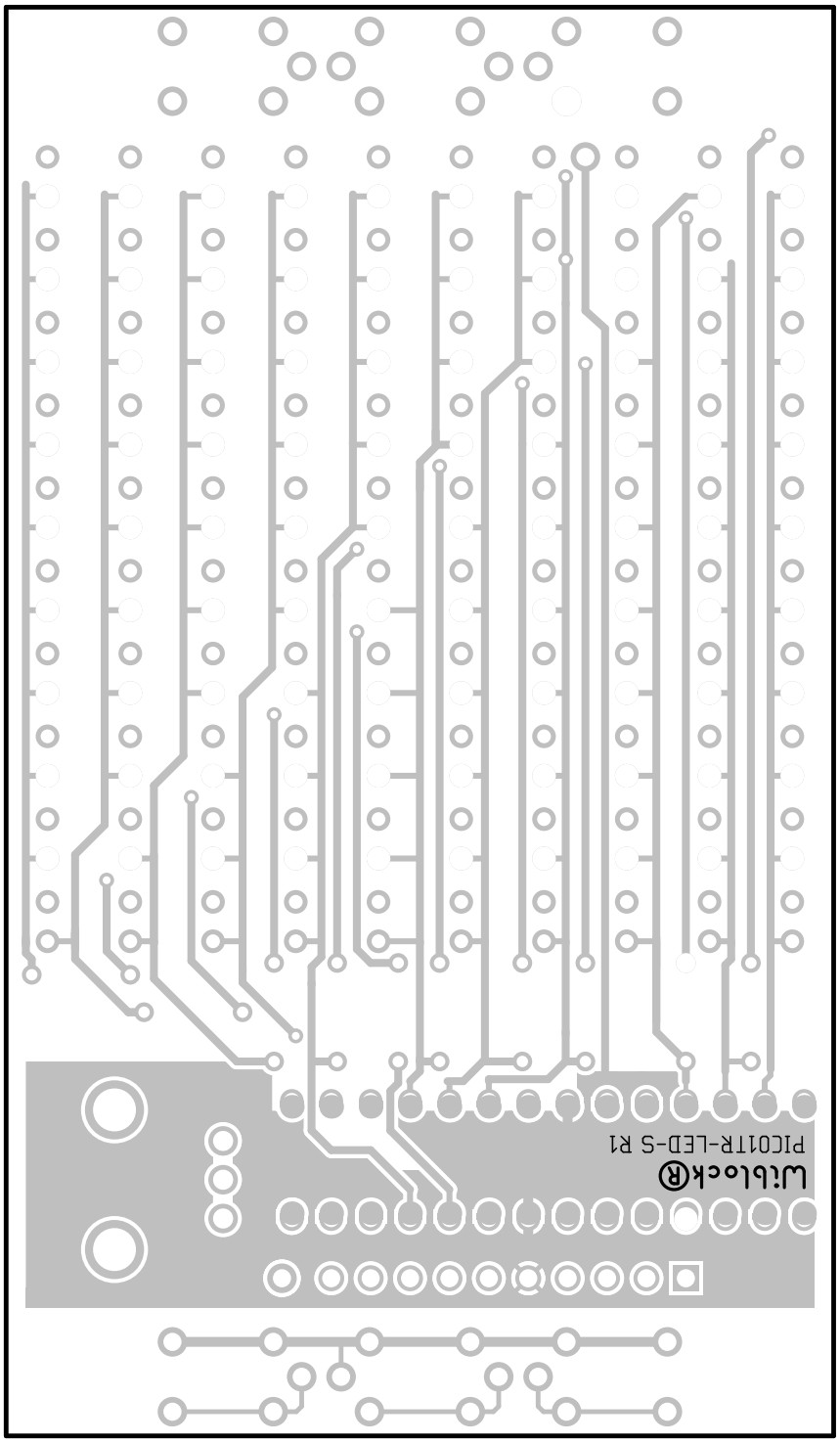

Figure 2: PICO1TR-LED-S Bottom Side Assembly Drawing (Rev 1)

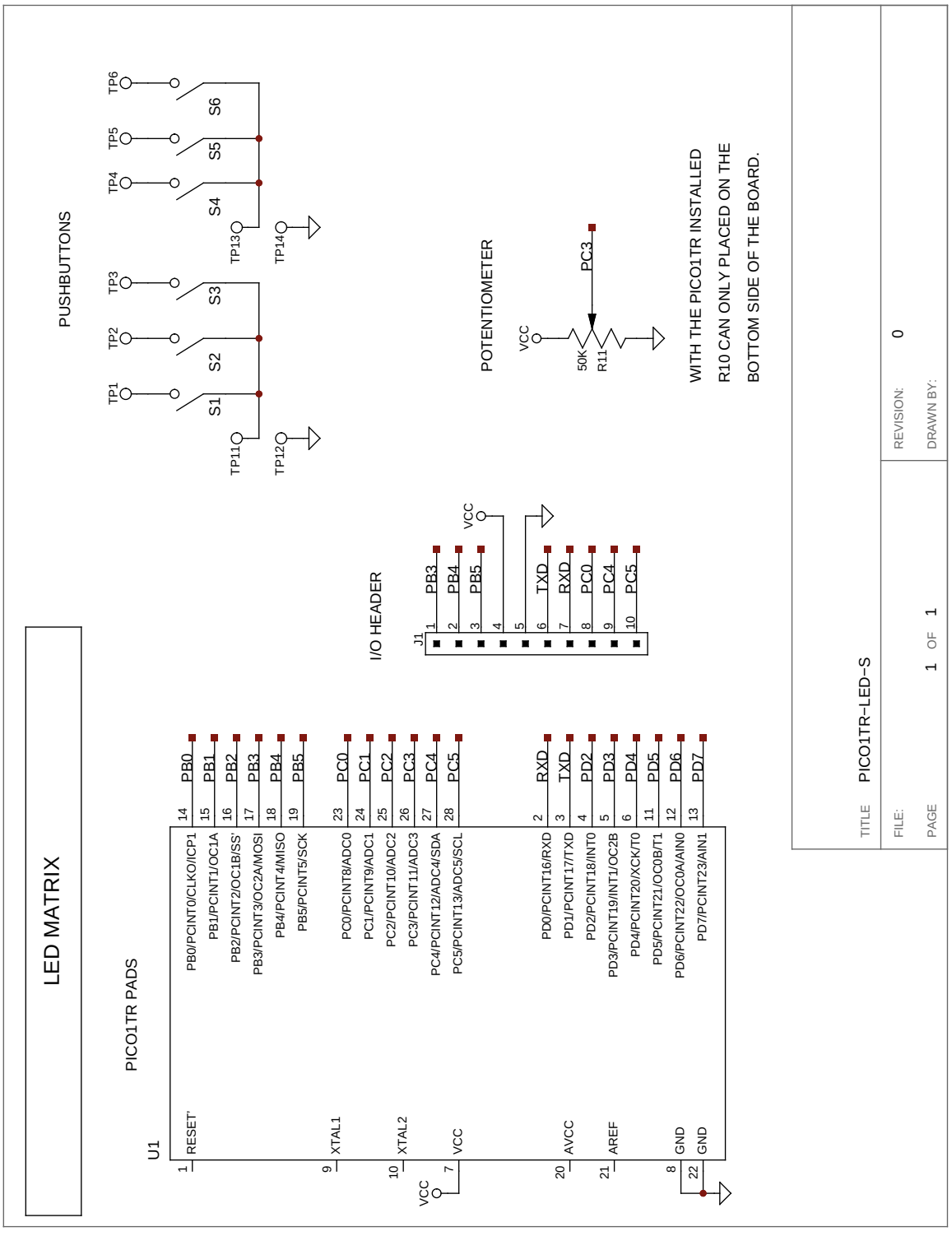

Figure 3: PICO1TR-LED-S (Rev 1)

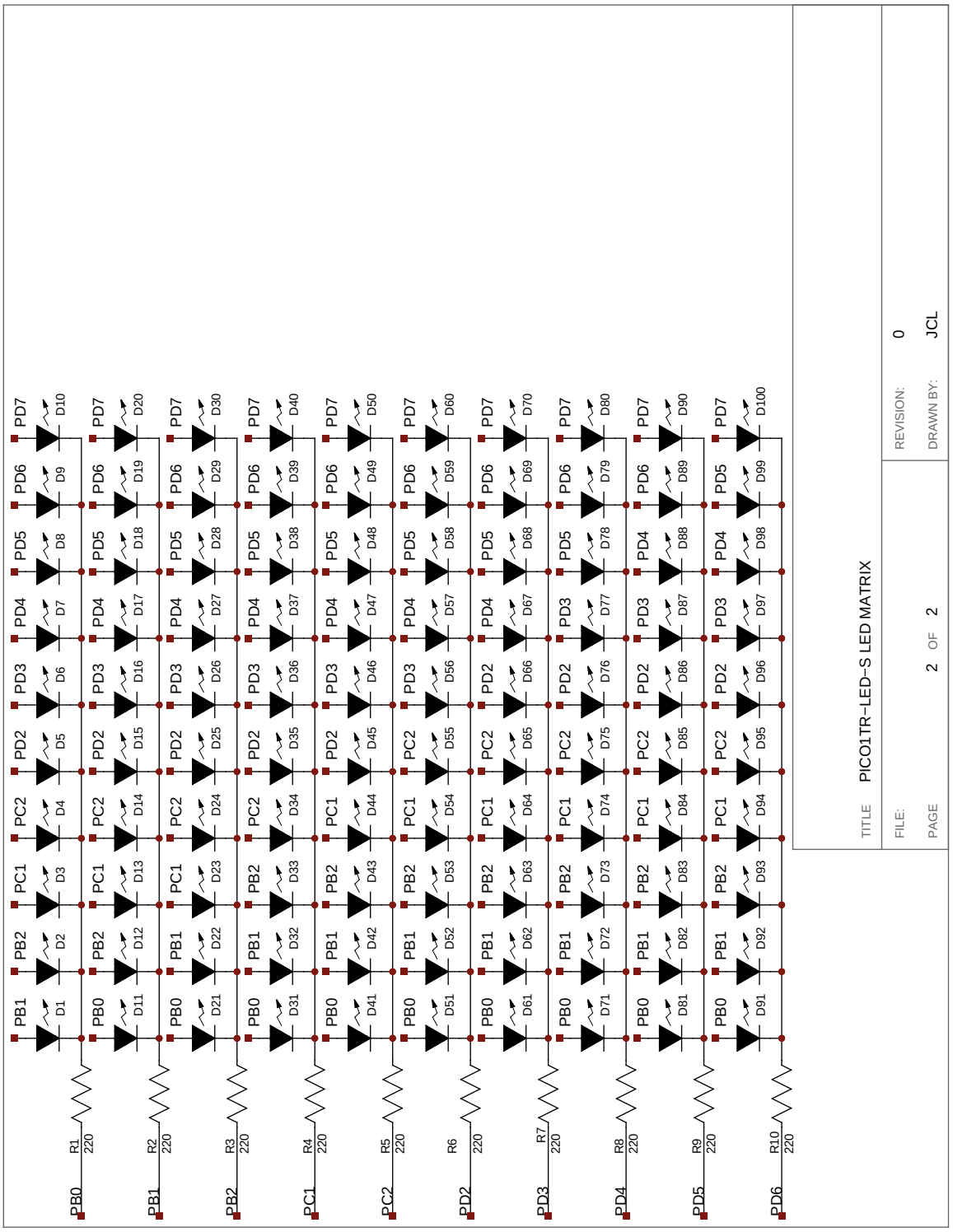

Figure 4: PICO1TR-LED-S (Rev 1)