Maus-Tec Electronics

DIY Soldering Kit

MTK-PX100

Pressure Logger Shield
0 – 100 kPa (Gauge)

Congratulations on purchasing a Maus-Tec Electronics DIY Soldering Kit! Maus-Tec DIY kits and tinker modules are the perfect start to a new project, or addition to your current projects, and this one is full of ideas waiting to happen!

This guide will provide you with information relating to this specific project. The World Wide Web has a variety of instructional videos for soldering, should you want a refresher before starting. Armed with that knowledge, it is time to gather your tools!

Prerequisites

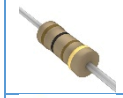
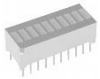
At the bare minimum, you will need:

- Solder Iron (Adjustable Preferred)
- Solder (No-Clean Flux Core!)
- Side cutter pliers for trimming leads
- A fire and heat resistant workstation
- Smooth Jazz

For best results, we also recommend some solder wick, a heat sink clamp, and a "helping hands" or board clamp. Another stackable shield can help align the pin headers, too!

Kit Contents

This kit includes all the parts needed to assemble the project. Please familiarize yourself with each of the components included, it will make it easier to find later!

Drawing	Marking	Qty
	Resistor, 100 ohms *(Brown, Black, Brown)* R4, R5, R6, R7	4
	Resistor, 10k ohms *(Brown, Black, Orange)* R2, R3	2
	Resistor, 750 ohms *(Violet, Green, Brown)* R1	1
	LED, Yellow, 3mm D2	1
	LED, Red, 3mm D1	1
	LED Bar Graph BAR1	1
	Tactile Switch SW1	1
	Capacitor, 100nF *(104)* C2	1
	Capacitor, 330nF *(334)* C3	1
	3.5mm TRS Jack J1	1
	Dual Op-Amp *(MCP6002-I/P)* U1	1
	DIP-8 IC Socket (For U1)	1
	Pressure Sensor SN1	1
	Trimmer, 10k *(P 103)* RV1	1
	Terminal Block J2	1
	Capacitor, 10uF *(50v 10u)* C1	1
	Pin Headers, Pack	1

The images shown above are approximate, your actual components may vary. Please double check the listed markings on your components, especially resistor color bands and capacitor values.

Assembly Instructions

When assembling through-hole circuit boards such as this, it is generally easiest to start with the shortest components and work your way up. How exactly you do this is up to your own style. Remember, evenly heat the pad and the lead of each component, and do not spend too much time heating the joint, as some components are sensitive to heat.

1. **Resistors** are usually the first component soldered. Locate the strip of four **100 ohm** (brown, black, brown) resistors, and place them in R4, R5, R6, and R7. Next, locate two **10k ohm** (brown, black, orange) resistors, and place these in R2 and R3. Finally, solder the **750 ohm** (violet, green, brown) resistor into R1. Solder and trim leads.

2. **Ceramic Capacitors** are usually next. Locate the **330nF** (marked 334) capacitor and put that into C3. Place the **100nF** (marked 104) capacitor into C2. Solder and trim leads.

3. **Electrolytic Capacitors and LEDs** are about the same height, so you can do those all next. **POLARITY MATTERS!** Locate the red and yellow LED and install them in D1 and D2 respectively, aligning the short leg (flat side of LED) with the square pad, or flat marking. Install the **10uF** capacitor into C1, with the **WHITE STRIPE ON THE WHITE HALF OF THE CIRCLE.** Solder and trim leads.

4. **IC Sockets and LED Bars** can go next, as they are about the same height. Grab the **DIP-8 Socket** and place that in U1, aligning the notch on the top of the socket to the notch printed on the PCB. Solder. Next, place the **10-Segment Bar Graph** display and place that in BAR1, aligning the diagonal corner of the display with the marked corner or square pad on the PCB. Solder.

5. **Plugs and Terminals** can go next. Locate the **3.5mm TRS Jack** and **Terminal Header** and solder these in at the two positions by the label "Mark Trigger".

6. **Tactile Switches** are easy since the kinked pins hold themselves in the board! Find the tactile switch and solder that under the label "Record". Note that it is slightly wider than it is tall.

7. The **Trimmer Potentiometer** included with your kit is next. Solder that into RV1, noting that it only goes in one way.

8. **The Pressure Sensor** is a surface mount component, but not too hard. For top-port pressure sensors, one corner is angled. Align this to the dot printed on the board and solder the pads.

9. Finally, **Pinheaders** should be soldered in along the sides. These leads you do NOT want to trim, as they plug into the Arduino.

Inspection and Finishing Touches

Congratulations, you have soldered everything to the board! Take a moment to inspect your solder joints to ensure you do not have any defects. Some things to look out for:

- **Solder Bridging** is when solder unintentionally bridges two adjacent pins. If this is the case, re-heat the solder and try to separate the pins. You may need solder wick to clean up excess solder.

- A **Cold Solder Joint** is when the solder was not heated enough, or the joint moved as it was cooling, and results in a *dull, grey-looking solder finish.* Reheating the joint and letting it cool without movement will resolve this.

- **Under-Soldering** a joint happens when you do not flow enough solder onto the pad and lead of the component. This can result in only partial coverage of the pad, or a loose pin. Remember, your solder joints should be a smooth taper from the edges of the pad up the leg of the component.

- Similarly, **Over-Soldering** happens when you flow too much solder. This usually won't be an issue, but you can clean this up with solder wick if the joint looks exceptionally blobular. (real word).

Awesome job! Now it is time to see if it works.

After you have looked over your solder work, it is time to *carefully* insert the IC into its socket. Align the notch at the top of the IC with the notch in the socket, and gently press it in.

Firmware, Stack and Run

The firmware for this can be downloaded at the following link. It is a starting point to test the board and show you one way to interface with the components here!

`github.com/MausTec/`
`arduino-pressure-shield`

Carefully stack your shield onto your Arduino Uno compatible development board, flash the firmware, and power on the board.

If everything works correctly, a readout of the pressure will be shown on the bar graph. You can adjust the trimmer potentiometer to amplify the signal for lower-pressure applications.

If an SD card shield is installed, pressing the "Record" button will begin logging the data to the SD card. Press the button again to stop logging. Data is also streamed over the USB Serial connection. The baud rate is defined in the source code.

The two "Mark Trigger" connections can be wired to a switch, which will change the mark field in the logs to a 1 while held down. This is useful for flagging events of interest!

Theory of Operation

There are two main parts to this shield: analog pressure sensing, and digital LED multiplexing. This quick overview should explain each.

The pressure sensor maps its full range of pressure to 0-5v (approximate) in a linear fashion. This analog reading is buffered through the MCP6002 Operational Amplifier, which can also act as a signal gain. This gain stage prevents your device's ADC (Analog to Digital Converter) from loading down the output of the pressure sensor. In addition, lower pressure readings can be amplified to use the full range of your device's ADC, allowing greater resolution with smaller values.

The LED bar and two additional LEDs use a method called "Charlieplexing" to drive 12 individual LEDs from only 4 pins of your microcontroller. This uses the pins in a bidirectional mode, which any combination of one input and one high-level output pin driving one LED in the matrix. The software example uses a lookup table for these combinations, but other algorithms exist for charlieplexing. For the exact wiring of this matrix, please see the Schematic.

Schematic and design files are on GitHub:

`github.com/MausTec/`
`eom-uno-pressure-shield`