SASC Physics 2020
Rotary Macropad

Build Instructions

This macropad build requires the following items:

- 1x Top Plate
- 1x PCB
- 1x Base Plate
- 1x Pro Micro microcontroller
- 1x Reset Switch
- 1x EC-11 Rotary Encoder
- 1x Encoder Knob (Optional)
- 4x Stick-on feet (Optional)
- 4x M2 Standoff (12mm recommended)
- 8x M2 Screw (6mm recommended)
- 8x MX Switch (9x if no Encoder)
- 8x Keycaps, MX Switch Compatible
- 9x Diode (1N4148 type)

Tools/Items Required:

- Safety Glasses
- Soldering Iron/station
- Solder (0.7mm recommended)
- Side/Flush Cutter
- Fine-nose Pliers (Optional)
- Tape (masking tape preferably as plastic-based tapes may melt from heat)
- M2 Phillips Head Screwdriver
- Helping Hands/Soldering Clamps/PCB Holder (Optional)

CAUTION: The Top Plate has a North/South orientation. The North side of the plate is wider (9mm) than the South side (7mm). Incorrect North/South position of the Top Plate will prevent successful building as the standoffs will not align correctly.

Figure 1 North/South Orientation of Top Plate

The PCB is designed to enable the rotary encoder to be positioned either in the top left or top right, **this build instruction is for the top left position**.

Figure 2 Switch and Component Side of PCB, Top Left Encoder layout.

Read all steps first before starting to ensure full understanding of process.

a. Put on Safety Glasses.

   NOTE: The gap between the legs should be approximately 8mm to fit into the diode footprint on the PCB.

b. Bend all diode legs 90° to diode body by holding diode body and pulling both legs down simultaneously.

   NOTE: Diode orientation markers are commonly a black stripe on one end of the diode body or an engraved line.

   CAUTION: The diode orientation marker should face the square solder pad and thicker line of diode silkscreen.

c. Ensure correct diode orientation is used, and insert diodes through the PCB diode holes on the Component Side, and press diode body until it is flush against the PCB.

d. Bend diode legs outwards slightly on the Switch Side of the PCB to prevent diode from falling out of the PCB when the PCB is inverted for soldering.

WARNING: Soldering Iron will be hot during the build until switched off and cooled. Ensure safe working distance from iron when iron is not being actively used. Keep work area clear of flammable objects and solvents.

e. Turn on iron to appropriate temperature for solder being used.

f. Tin soldering iron tip and clean tip using tip cleaning/brass sponge.

g. Solder all diode legs to solder pads on Switch side of PCB.

WARNING: Hold diode legs as they are being clipped to prevent legs from flying out and landing into eyes and faces. Ensure safety glasses are correctly worn.

h. Once solder has cooled, clip excess diode leg lengths off from Switch side of PCB using cutters.

   i. Clip legs at lowest point to the solder joint as possible, to prevent any interference against other components.

i. Insert Reset switch into Component side of PCB into position SW2, and hold against PCB using tape.

j. Solder all four (4) Reset switch joints on Switch side of PCB. Remove tape once soldered.

k. Remove the two Pro-Micro microcontroller header strips from its anti-static packet.

NOTE: The header strips have a short leg and long leg side through the strip body.

l. From the Component Side, insert the short leg of both header strips into the Pro-Micro footprint. As a zigzag footprint has been utilised, the header strips should sit snugly and not fall out when inverted.

CAUTION: The header strips must be pushed flat against the PCB so that the plastic body is contacting the PCB surface. If the header is not flush, it will prevent sufficient clearance for the base plate assembly.

m. Solder all short header legs to PCB on Switch Side of PCB.

n. From the Switch side of PCB, Insert EC-11 Rotary Encoder into top left footprint.

   i. It may be necessary to manipulate/bend/straighten the five (5) pins and two (2) mount legs to fit through all holes.
   ii. The correct orientation is two (2) pins north and three (3) pins south.
   iii. Use tape to hold the encoder against the Switch side of PCB so the body of the encoder is flush against the PCB.
   iv. Using pliers, bend the two (2) mount legs inwards to press/hold against the PCB to provide extra mechanical strength for the Encoder.

o. Solder all Encoder five (5) pins and two (2) mount legs on the Component side of the PCB.

p. Check MX Switch pins are straight, if any bent pins are found, straighten by gentle bending.

   CAUTION: Ensure correct Top Plate North/South orientation is used to prevent standoffs from being misaligned.

q. Orientate Top Plate to correct North/South Orientation.

r. Insert into the Top Plate the MX switches, with the MX switch pins on the North side. Leave top left position empty. Ensure MX switches are fully snapped into Top Plate

s. Lower Top Plate with switches over already soldered Encoder, and align switch pins so that all switch pins insert through the Switch side of the PCB.

t. Tape switch and Top Plate assembly to PCB to stop the assembly falling off when inverted.

   CAUTION: Do not contact Pro-Micro header strip with hot iron, as this will melt/deform the header strip.

u. Invert assembly, and solder all switch pins on Component Side of PCB.

v. Remove Pro-Micro microcontroller from its anti-static packet.

   NOTE: The Pro-Micro pins have specific pin assignments that are marked on its silkscreen on the microcontroller PCB.

w. Check the orientation of the Pro-Micro for its placement on top of the header strips.

   i. Identify the correct orientation for the RAW and TX pins on the Pro-Micro.
   ii. Insert Pro-Micro over the long legs of the header strips so the RAW and TX pins are matched to the Component Side PCB silkscreen

   CAUTION: Incorrect orientation of the Pro-Micro will result in incorrect pin assignments to the QMK code, and will prevent completion of build with 12mm M2 Standoffs.

   NOTE: Correct orientation will result in the Micro-USB port to be sandwiched between the Component side PCB and the Pro-Micro PCB.

x. Ensure the Pro-Micro is sitting flat and flush against the header strip, and solder all Pro-Micro Pins.

   i. Ensure no bridging occurs between header pins, as this will cause shorts on the microcontroller.
   ii. Excess solder that form a bridging joint may be cleared by using a clean soldering iron tip to wick away excess solder in-between the two bridged pins.
   iii. Re-flow the solder with the iron tip, and draw/pull the bead of solder upwards in a smooth motion between the two pins until the bead breaks tension.

y. Clean soldering iron tip, and re-tin with fresh solder.

WARNING: The soldering iron will be hot and can still cause injuries until it fully cools. Ensure safe working distance until iron is cool. Keep work area clear of flammable objects and solvents.

z. Turn off soldering iron.

WARNING: Place flush cutters against pin and gently close cutter against pin, cover the pins with one hand, and clip pin. This will reduce the likelihood of the clipped pin flying into someone's eyes and face. Ensure Safety glasses are correctly worn.

aa. Using flush cutters, trim excess long legs of Pro-Micro header strips to as low as possible against solder joint on Component side of PCB.

bb. Clean work area of all debris, diode legs, header legs, and wipe down surfaces of soldering splutter and residues.

cc. Dispose of hazardous materials in accordance with correct disposal procedures to your work environment.

dd. Remove Safety Glasses.

ee. Wash hands to clean soldering residues if available.

ff. Using a Phillips head screwdriver, attach screws and standoffs through Top Plate, and Bottom Plate.

gg. Attach stick-on feet to Bottom Plate to prevent screws from scratching surfaces.

hh. Insert MX keycaps onto switch stems.

ii. Insert Encoder knob onto Encoder stem.

The macropad is now complete and ready for software flashing.

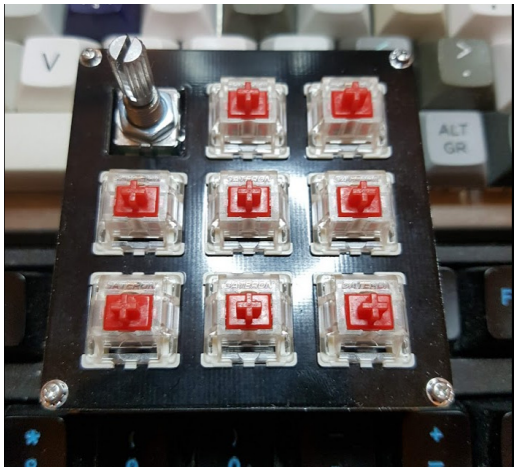

Figure 3 Completed Macropad without Encoder knob or keycaps