
PicX - Pico Experimenter
an experimenters breadboard designed for the PicoMite and PicoMite VGA
by Mixtel90

PCB Version 1.0

This was born out of wrestling with a couple of breadboards and a pile of bits with a VGA connector hanging in the wiring. Not a pretty site. :(

PicX is compatible with the Raspberry Pi Pico and all similar modules with the same pinout. Note that there are some similar-sized modules that are NOT directly compatible. The VGA and PS/2 keyboard options are designed only for the PicoMite, a Raspberry Pi Pico running MMBasic - they are not supported by the standard Python libraries. From hereon it will be assumed that the board is being used with a PicoMite.

This board can be configured to work with all known variations of the PicoMite. All normal configuration is from the top of the board and doesn't require soldering, only changing links.

PicX uses two ready-made low-cost breadboards mounted on the PCB. These are available in various colours so there is room for some customisation here! These don't have power rails so these are provided on the PCB. The track arrangement is such that levering faulty glued-down breadboards off the PCB with a screwdriver is unlikely to damage any tracks beneath them.

Pads are provided alongside the breadboards, GND on the left and the supplies on the right. These allow easy connection of test probes.

Generally, all patch connections can be made using solid core wires (preferable if you want maximum life out of your breadboards) or male-male Dupont links if you must, just as on normal breadboard systems. In this case though, none of the breadboard area is used by the PicoMite..

A Reset button, two active-low user buttons (via short circuit protection resistors) and two active-high LEDs are included.

A 3.5mm stereo jack socket is include, with the Left and Right connections available to the user via a female header. There is no audio filter so this could be used as a serial port, for example.

The 5V supply is supplied via the PicoMite's USB port or via a polarity-protected 2-pin connector.

The 3V3 supply for the user's circuit is normally taken from the PicoMite's regulator so current is limited. However, it is possible to install an optional surface mount (SOT223 - typically 500mA) LDO linear regulator and two 1uF 0603 SMD capacitors beneath the board and disable the SMPS via a solder link if required. In this case the PicoMite is also powered from the linear regulator.

Connectors are included (marked VCC) which can be linked to 5V or GND or can bring in an external supply. You could also use a female-male link wire to connect it to 3V3 if you run out of connections!

The design has been optimised to always allow the maximum number of I/O pins on the PicoMite. If the I2C, VGA and keyboard are all disabled then, unlike many experimenter's boards, every pin is available to the user. You just enable what you need.

No method of saving files has been included. The current PicoMite firmware has its own flash storage and it's easy to rig up a temporary SD card in the breadboard area should one be needed. This has saved a lot of PCB space and doesn't tie up PicoMite pins unnecessarily.

There is an optional I2C bus, with pull-up resistors if required, on the board. It is connected to optional RTC and 1.8" LCD modules. It is up to the user to decide which I2C pins to use if it is required.

When using PicX in a VGA system a link is fitted to connect one of the Green signals. With this link removed and no connection made to the VGA socket, all the VGA pins are available to a non-VGA PicoMite for normal I/O.

Similarly, the PS/2 keyboard can be isolated from the I/O pins.

The PS/2 keyboard is powered from the 5V input and includes level shifting to the 3V3 I/O of the PicoMite. The clock & data connections are brought out to a female header so that, if the PS/2 keyboard isn't being used, the level shifters may be used for something else.

Bill of Materials

Qty	Reference	Description
1		PCB
2		170-pin "mini" breadboard
1		Raspberry Pi Pico with PicoMite firmware and male header pins on the bottom Some other similar modules can be used but check pin compatibility.
1		RTC module. Either small or large.
1		1.8" LCD module SD1306I2C
4		Short M3 spacers and fixings to raise the board off the table (anything suitable)
1	K1	PS/2 socket
1	K2	90 degree VGA connector - short style
1	K3	SMD type 3.5mm stereo jack socket
2	Q1,Q2	VN10KN3-G or 2N7000
1	D1	1A Schottky diode
4	R1,R2,R3,R4	10k resistor
2	R5,R8	270R resistor
1	R6	820R resistor
1	R7	390R resistor
2	R9,R10	4k7 resistor
2	R11,R12	750R resistor
2	R13,R14	470R resistor
1	C1	47uF 10V electrolytic capacitor
3	C2,C3,C4,C5	100nF layer ceramic capacitor
3	Reset,PB1,PB2	6mmx6mm tactile switch
2	LP1,LP2	Red 3mm LED (these are run at 2mA to keep current low)
2		20-pin female header socket (for Pico)
1	J1	20-pin female header socket
1	J2	17-pin 0.1" female header socket (can be usefully cut from a single 40-pin to also give a 20-pin)
1	J3	13+13-pin 0.1" female header
1	J4	10+10-pin 0.1" female header
1	J5	4+4-pin 0.1" female header
2	J6,J7,J10,J11	2-pin 0.1" female header
1	J9	3-pin 0.1" female header
1	J8	4-pin 0.1" female header
4		2-way female link
1	H1	2-pin 0.1" male pin header
1	H2	3-pin 0.1" male pin header
1	H3	2+2-pin 0.1" male pin header
1	H4	5-pin 0.1" male pin header (if using small RTC module)
1	H5	Up to 3-pins, but it's up to the user what you fit here!
1	H6	2-pin 0.1" 90-degree male pin header

The following connectors are required if the large RTC module is used horizontally. This module is normally supplied with a pre-soldered 6-pin 90-degree male header which needs to be removed.

1	4-pin 0.1" male pin header on module
1	6-pin 0.1" male pin header on module
1	4-pin 0.1" female header on PicX
1	6-pin 0.1" female header on PicX

Notes

As usual, fit the lowest components first and work your way up in order of height. It's an idea to fit the breadboards with the male lugs at the top but cut the end lug of the left hand unit off so that they do not interlock. That way you can pull off a single faulty one without disturbing the other. Also, the GND pad at the left hand side isn't obstructed and a third board can be fitted to the right hand side if required.

It's an idea to fit the breadboards using one of the following methods rather than the full self-adhesive pad:

- 1: Use a 1-hole punch. Lift each end of the backing in turn and punch 2 or three holes though it then put it back. You end up with a few adhesive holes which will be enough to hold it and allow easy removal.
- 2: Leave the backing on but fix them with a couple of dabs of hot glue.
- 3: Drill the fixing holes (carefully) and use M2 nuts and bolts.

It's not easy to remove a fully stuck down breadboard without damaging it by pulling out a lot of the contacts. so if you choose that route the breadboard is a single-use item!

In most cases the linear regulator won't be needed. The SMPS on the Pico can supply a reasonable percentage (300mA) of the available current from most USB ports (500mA for USB2, 900mA for USB3). Also the maximum total I/O current for the RP2040 is only 50mA so it can't use the full capacity of the SMPS anyway. It may be worth fitting it if you need low noise operation for the analogue inputs or for audio outputs as the SMPS is noisy. It may also be worth using it if you wish to add, for example, some sort of I/O that requires reasonable current at 3V3.

Make sure you are consulting the correct manual for the firmware you have loaded when you are using this board! :)