

## **PicoMite VGA XPerimenter**

For Version 1.0 PCB

This pcb is designed to be low cost and rugged, yet usable as it stands as well as being very expandable. In a way it follows on from my LEO designs in that it's primarily aimed at educational use.

The board size is 86mm x 50mm, which allows for two to be manufactured from a single 100mm x 100mm board, leading to low production cost in small quantities. If these are panelized you should specify 7mm waste areas at each end of the board.

The PCB can be built in two different forms, VGA or Control version. By default the board will be built as a stand-alone VGA device. The GPIO pins are connected directly to the PicoMite, but in education for the younger end it may be an idea to use a bolted on "hat" with series resistors for each pin to prevent outputs being directly shorted to either supply rail. Perhaps screwless terminals could also be fitted.

The control version replaces the VGA connector with a third I/O header. A simple link is changed to split the two "green" signals onto two separate pins. This version can also be a "backpack" for a ILI9341 LED TFT touch display.

Power to the board can be via the USB connector, 5V DC via a 3.5mm barrel jack connector (recommended - polarity protected), 5V DC via a pin on H3 (Control version only) or 3V3 DC via any of the 3V3 pins (if the on-board 3V3 supply is disabled).

**SPECIFICATIONS**

Both versions are designed to run MMBasic by Geoff Graham and Peter Mather.

**\*\*\* VGA version (the default) \*\*\***

This is a "home computer" version, with VGA display and PS/2 keyboard. It can be enhanced with, for example, sound capabilities using external components on a daughter board. Twelve I/O pins on H1 are available to the user, with an optional RTC module plugged into H2.

Based on PicoMite VGA

GPIO port H1:

```
--GP0
--GP1
--GP2
--GP3
--GP4
--GP5
--GP6
--GP7
--GP22
--GP26
--GP27
--GP28
--3V3
--GND
```

GPIO port H2:

```
--GP10 (used for SPI by SD card)
--GP11 (used for SPI by SD card)
--GP12 (used for SPI by SD card)
--GP14 (used for I2C by RTC)
--GP15 (used for I2C by RTC)
--3V3
--GND
--3V3
```

Port H2 is arranged to allow an optional small RTC module to be plugged into it. When used for I2C it relies on the pull-up resistors in the RTC module so if it is used as a general purpose I2C port then external pull-ups will be required. Pads have been provided for two size 1206 surface mount resistors on the bottom side of the board.

VGA connector

PS/2 keyboard connector

**\*\*\* Control version (can be built as an option) \*\*\***

This is intended to be more of a "controller" module. The VGA display isn't used, the connector being replaced by header H3. If the board is to be assembled as a Control version then cut the solder-blob link marked VGA and make the link marked I/O. This transfers GP19 to H3. Resistors 5 to 8 should be replaced by wire links unless series resistors are required for some reason.

If the PS/2 socket is omitted and a 14-way female header fitted to the rear of the board, this version can be a "backpack" for a ILI9341 LCD TFT display, mounting back-to-back behind it on 9mm spacers. The two board fixing holes at the SD card end line up with the display fixings, as does a third hole adjacent to H3. A 1mm guide hole is provided to drill the fourth display mounting hole if it is required. Isolated pads are provided for a 14-pin SIP socket on the outer side of H3. It isn't practical to get PCB tracks to this using a 2-layer PCB, but possible wiring is given later. The SD card holder on the display is not used so the 4-pin connector is not required.

Based on the standard PicoMite  
 GPIO port H1 as VGA version  
 GPIO port H2 as VGA version

GPIO port H3 (fitted instead of the VGA connector):

```
--GP16
--GP17
--GP18
--GP19
--GP20
--GP21
--3V3
--GND
--5V
```

PS/2 keyboard connector (optional)

H3 includes a 5V supply intended to power a LCD TFT display on a "piggyback" board.

**ADDITIONAL OPTIONS FOR BOTH VERSIONS**

```
--LM4040 3V0 reference voltage chip for the ADC
--Surface mount Reset button (on bottom of board)
--Short (5mm or 6mm) pillars to be used as feet.
--If the RTC module is used, it must be plugged into H2, using pins +, D, C and - (G11 is no connection on the module) and must overlap the SD card socket. The position is indicated on the PCB.
```

## BILL OF MATERIALS

- 1 PicoMite VGA XPerimenter PCB
- 1 K1 - 3.5mm/1.3mm barrel jack connector - Mouser 490-PJ-031D, ebay
- 1 K2 - PS/2 female socket - ebay - HA1607
- 1 K3 - 15-pin 3-row DB15F 90 degree VGA connector (Only for VGA version)
  - RS 481-443, AMP 1-1734530-1, MULTICOMP SPC15430, Element14 1557991, Toby Electronics HL15S
- 1 K4 - Full size SD-card socket Hirose DM1AA-SF-PEJ(72) - RS 685-0799
- 1 D1 - SB140 or 1N5818. You can often get away with a 1N4001 here. It will drop about 0.75V at 100mA.
  - Only the keyboard will be affected by the lower voltage.
- 1 U1 - Raspberry Pi Pico with PicoMite or PicoMite VGA firmware depending on version to be built
- 1 U2 - LM4040 3V0 voltage reference (optional)
- 2 Q1, Q2 - N-channel mosfet TN0702. 2N7000 are also reported to work.
- 1 H1 - 2x7 male pin header
- 1 H2 - 1x7 male pin header
- 1 H3 - 1x10 male pin header (Not for VGA version)
- 1 C1 - 100uF 10V electrolytic capacitor
- 2 C2, C3 - 100nF multilayer ceramic capacitor
- 4 R1, R2, R3, R4 - 10k
- 2 R5, R8 - 270R
- 1 R6 - 390R
- 1 R7 - 820R
- 1 S1 - Surface mount pushbutton (optional)

**NOTES**

The three GPIO port connectors, H1-H3, are on the same 0.1" grid, so "piggyback" boards can be made using ordinary stripboard or padboard. These can be secured to the main board using pillars and screws through fixing points that are on the same 0.1" grid.

Board assembly is designed to be relatively simple. The PicoMite is surface mounted, as is the full-size SD card holder. All other components are standard through-hole parts. Small location holes are provided to line up the PicoMite for soldering and the SD card holder has locating pegs for the same purpose.

A solder-blob link is provided (marked 3EN) which, if linked, will disable the on-board switching supply of the PicoMite. This allows the PicoMite to be powered directly from a 3V3 supply fed into one of the GPIO pins. Note that the PS/2 keyboard is unlikely to work if this is done.

Settings for the VGA version:

OPTION SYSTEM I2C GP14, GP15                      This sets up the I2C bus for the RTC if used.

OPTION SDCARD GP13, GP10, GP11, GP12

If the Control version is to be used as a "backpack" for a ILI9341 display then possible connections might be:

T\_IRQ - GP16

T\_CS - GP17

LED - GP18 (PWM1A)

D/C - GP19

RESET - GP20

CS - GP21

as all these are user definable. Then link:

T\_CLK - SCK - GP10

T\_DIN - MOSI - GP11

T\_DOUT - MISO - GP12

GP10, GP11 & GP12 are available on pads adjacent to C1 as well as on H2.

The following setup could then be used:

OPTION SYSTEM SPI GP10, GP11, GP12

OPTION SDCARD GP13

OPTION LCDPANEL ILI9341, LANDSCAPE, GP19, GP20, GP21, GP18

OPTION TOUCH GP17, GP16

(Just to give myself an extra little challenge, the bottom ground plane is not connected to anything. It led to a single instance of having to connect a GND pin to a grounded area - and it's in a place where it's not likely to be used. :) )