Pico Display Base Board

Datasheet

Great platform to experiment with the Raspberry Pi Pico board.
Base for SSD1963 Integrated Display and SD Card.
Supports PicoMite firmware.
Includes on-board components and ports for external devices.
MIT License.

Version 1.5.2

Applying Microcontroller Solutions

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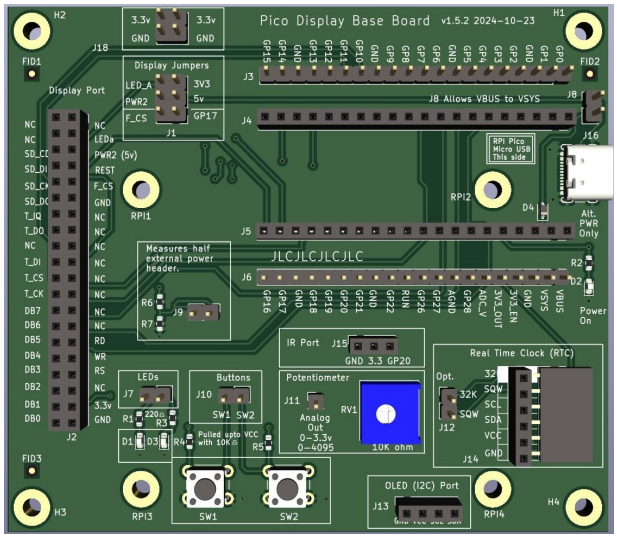
Contents

Product Overview

The Pico Display Base Board v1.5.2 is a printed circuit board (PCB) designed for a Raspberry Pi Pico USB-stick board (“RP2040”) and a SSD1963 TFT LCD display board. The PCB was designed for a project using the PicoMite firmware which provides the MMBasic language and supports all of the devices. The Display Port is wired for the SSD1963 LCD, Touch panel and SD card adapter. Both five-inch and seven inch LCD displays have been tested on this board. Otherwise, the pins can be allocated for generic projects.

The PCB includes certain onboard components and ports for external devices. The male headers provide a flexible means to wire connections to the components. The various ports have PCB connections to Pico pins and permit an easy way to simply insert the external devices. There should be no need to solder any wires nor drill holes for any parts. A separate USB-C connector allows external five (5) volt power adapters to provide power to a seven-inch SSD1963 display and optionally to the VSYS pin of the RP2040.

The product is only the PCB. The RP2040 board, LCD display board, wires and the external devices are not included. However these low-cost components are available from popular online retailers.



FEATURES

- **A carrier port for the Raspberry Pi Pico.**
- **A port for a 5/7-inch SSD1963 LCD display (with Touchscreen/SD Card).**
- **Onboard devices.**
- **Host external IR, RTC and OLED devices.**

APPLICATIONS

- **Interactive GUI display for the Raspberry Pi Pico board (RP2040”) using PicoMite firmware.**
- **Power connector for autonomous operation.**
- **Excluding the Display Port, the board can host any Pico.**

The 40-pin Display Port is wired to specific GPIO pins to provide an 8-bit parallel interface for the LCD display and SPI pins for the Thin Film Transistor (TFT) Touchscreen and SD Card. The PCB includes jumpers for LCD display power and for an assigned Pico pin for the display board's optional flash chip. The Display Port has jumpers for 5 or 7 inch LCD displays. The SSD1963 display boards all have a "standard" 40-pin male header, and so the desired display board is just inserted into the matching 40-pin female port on the PCB.

The matching Pico male headers provide an easy means to wire to onboard devices or to test the with a Logic Analyzer. The male headers can also be used to add connections to sensors and devices on an external breadboard. The RTC Port has two headers so that a module can be inserted vertically or horizontally.

Connections for External Devices:

- OLED Port — I2C logic signals and 3.3-volt power for an OLED device.
- RTC Port — I2C logic signals and 3.3-volt power for a DS3231 RTC device.
- IR Port — A GPIO signal and 3.3-volt power for an Infrared Receiver device.

Most of the general-purpose input/output (GPIO) pins are connected to the above mentioned display and components. However, there are seven unassigned pins which can be defined for the onboard devices or to different sensors that are off-board. PicoMite firmware allows easy reassignment of pins and your project can choose to not use certain devices to free up pins for other uses.

Hardware Details

The PCB was designed to use “generic” external devices to reduce cost and for easier upgrading/replacement. The layout allows development with simultaneous access access to the display and component wiring. Later, a 40-pin ribbon cable can be used to re-mount the display (as needed) for a compact finished project.

All components (the PCB and optional external devices) are self-contained and accessed via male headers. There should be no need to solder any wire nor drill holes for any parts.

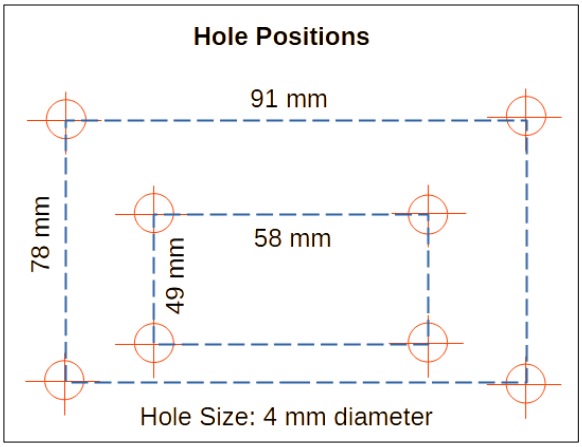
Desktop Power to the Raspberry PI Pico

Insert a standard USB “data” cable into a desktop computer and plug the smaller end into the micro USB port. This provides a nominal five volts (low-current) to the Pico. The Pico board regulates this power to 3.3 volts. The Pico provides 3.3 volt power to all of the GPIO and 3.3v logic devices, and (via jumpers) to a SSD1963 board. The PCB indicates the availability of power by illuminating a small red LED on the left edge of the PCB.

The seven inch SSD1963 uses both 3.3 volts for logic power and requires 5 volt power for the LCD Backlight. The five volt power is provided through a separate USB-C connector. The five volt power is isolated from the Pico or can be connected to the Pico’s VSYS pin via a jumper.

PCB Mounting Holes

The PCB board is 99 mm wide by 86 mm high. The PCB has two sets of mounting holes:



The outer mounting holes are 4 mm from the PCB board edge and could be utilized for mounting or a 3-D printed case. The RPI mounting holes provide a means to mount the PCB to other maker products. The inner “RPI” mounting holes are the same as a Raspberry Pi 4/5 model-B board. The left RPI holes are 22 mm from the PCB left edge. The bottom RPI holes are 7 mm from the bottom of the PCB. The holes fit M3 Nylon or brass hex spacers and screws.

Headers/Ports

The headers are standard 2.54 mm pitch male connectors that can be utilized by standard “DuPont” Female-to-Female wiring cables. The ports are standard 2.54 mm pitch female connectors that can be utilized by devices with standard pitch male headers (basically, you just plug the device into the port).

Pin Definitions

The Pico has 28 GPIO pins and various power pins; twenty pins on each side of the board. The Pico pins are assigned and wired mostly to the Display Port. Below is a table listing the Pico pin assignments to the Display Port and the I2C (GP8/GP9) pins for the external device ports. GP20 is assigned to the IR Port. If one does not use the Display Port, one can re-use its pins elsewhere (via the male headers). For better understanding, please see the schematic in the appendix. Below is a table listing the pin assignments to each header/port.

Display and External Device Port GPIO Pin Assignments
Sorted by Pin

Left Side		**Right Side**	
GP0	LCD DB0	GP28	X**
GP1	LCD DB1	GP27	X**
GP2	LCD DB2	GP26	X**
GP3	LCD DB3	GP22	SD_CD
GP4	LCD DB4	GP21	X
GP5	LCD DB5	GP20	Infrared Receiver
GP6	LCD DB6	GP19	T_IRQ
GP7	LCD DB7	GP18	T_CS
GP8	I2C SDA (RTC and OLED)	GP17	X or (optional F_CS)
GP9	I2C SCL (RTC and OLED)	GP16	LCD REST
GP10	T_CLK & SD_CLK		
GP11	T_DIN & SD_DIN		
GP12	T_DO & SD_DO	Note: GP25 is the onboard LED	
GP13	LCD RS		
GP14	LCD WR		
GP15	LCD RD		

Notes: Pins marked as X are unassigned.

* The GP8/GP9 pins are I2C pins and can be utilized simultaneously by several devices as each device has its own distinct address. Hardware pull-ups for the I2C were not included as the expected external devices do not need them.

** These are GPIO though often reserved for Analog Input (ADC pins).

PicoMite/WebMite Firmware

A very good description of PicoMite is described by the author (link):

> *The PicoMite is a Raspberry Pi Pico running the free MMBasic interpreter.*
>
> *MMBasic is a Microsoft BASIC compatible implementation of the BASIC language with floating point, integer and string variables, arrays, long variable names, a built in program editor and many other features.*
>
> *Using MMBasic you can use communications protocols such as I^2C or SPI to get data from a variety of sensors. You can save data to an SD card, display information on colour LCD displays, measure voltages, detect digital inputs and drive output pins to turn on lights, relays, etc. All from inside this low cost microcontroller.*
>
> *The PicoMite firmware is totally free to download and use.*

The Pico Display PCB is designed to interface to many of the devices supported by PicoMite. The MMBasic will seamlessly integrate the touch controller and the SD Card. Files can be stored and displayed via the SD card file system. The PCB is small and simple to make it affordable for multiple projects.

Specifically PicoMite supports these type of devices:

- SSD1306 OLED display**.
- Real Time Clocks (e.g. the DS3231.)
- Infrared Remote Control (e.g. IR1838.)

The PicoMite and WebMite firmware support different features of the LCD Display. The PicoMite supports many more Advanced Graphic Controls. If your interest is the local LCD display, then utilize the PicoMite firmware.

**The PicoMite will only manage one display at a time.

External Devices

The builder is free to choose their favorite external devices and battery source. The board is wired for specific pins as described in the Pin Definitions above to facilitate the organized wiring of a project. But they can freely defined for other devices. Of course the matching Pico male headers can also be utilized for off-board devices or to attach a Logic Analyser.

The PCB is designed to accommodate many of the devices described in the PicoMite User Guide. so that each of the external devices can be inserted into the female port

Suggested external devices are described below:

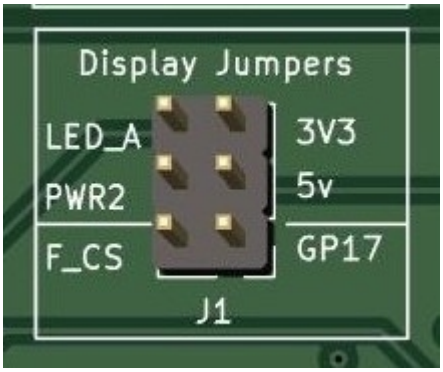
SSD1963 TFT LCD Display Board

The PicoMite/WebMite software includes an 8-bit parallel interface for the SSD1963 LCD display and SPI pins for the integrated Thin Film Transistor (TFT) Touchscreen and SD Card. Also, there is a header pin on the Base Board PCB for the LCD display board's optional flash chip (it is not pre-wired to a Pico Pin).

The Display Port has been tested for 5 or 7 inch LCD display sizes. The SSD1963 display boards all have a "standard" 40-pin male header, and so the desired display board is just inserted into the matching 40-pin female port on the PCB. To get the full benefit, you should purchase a board with an integrated Touch panel and SD Card. Finally, there is a spot for an extra flash chip, but this chip must be added by the user.

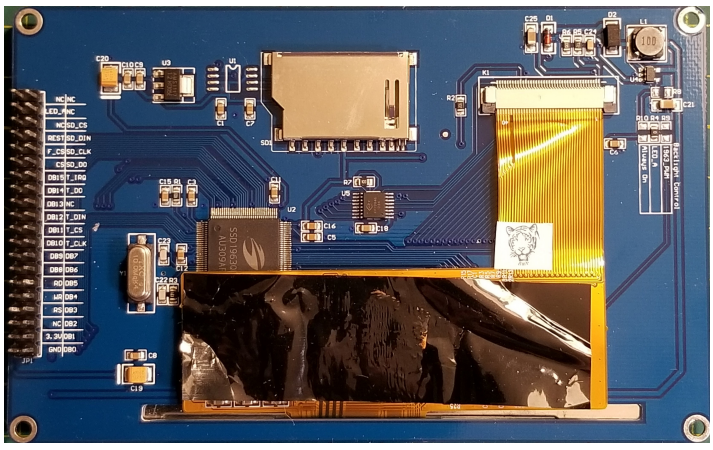
SSD1963 LED_A Backlight Jumpers

The SSD1963 board requires power to one or more LED_A pins to illuminate the display's backlight.

On the Pico Display Base Board is a male header to connect power to the LCD Backlight. A jumper is placed across the LED_A and 3V3 pins. For the seven-inch display, a second jumper is placed across the PWR2 and 5v pins. (Note: this was done to allow a project to use an external switch or to use separate power sources.)	

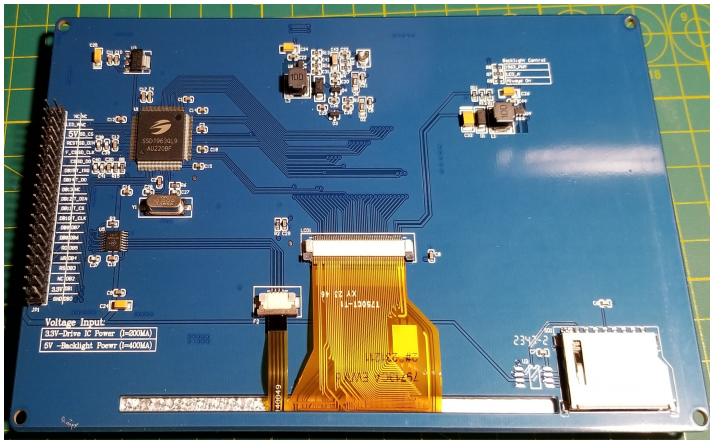
5-inch SSD1963 board

The 5-inch LCD display has 800 x 480 pixels resolution.

TFT LCD Display (Front)	TFT LCD Display (Back)
	

7-inch SSD1963 board

The 7-inch LCD display has 800 x 480 pixels resolution.

TFT LCD Display (Front)	TFT LCD Display (Back)
	

Display Port

Below is enlarged view of the LCD Display pinouts. The 40-pin male header is already soldered to the board. Check the pinout of your prospective LCD display to ensure it has the proper configuration.

Enlarged View (showing the pin definitions)	Notes
	SD_xx pins are used for the SD Card. T_xx pins are used for the touchscreen. DB_xx pins (and others) are used by the display LCD. LED_A is usually connected to 3.3 volts. NC(“5”) The pin below it is connected to 5 volts.

Real Time Clock Board

The PicoMite supports interfaces for PCH8563, DS1307, DS3231 real time devices. The PCB was tested with the DS3231 board. The DS3231 has an attached battery holder for a CR2032 “coin” battery.

OLED Board

Besides the large TFT displays the PicoMite also supports small I2C OLED displays typically called SSD1307 devices. The PCB was tested with a small 0.96 inch OLED (Yellow/Blue 128x64 pixels) display board.

Infrared Receiver Board

The PicoMite supports an Infrared Receiver. The PCB was tested with the Infrared Receiver (IR1838) board which included a small handheld “remote”.

Schematic

The schematic was created on Kicad 7.