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REVISION HISTORY

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Raspberry Pi Pico MMU

The aim of this project is to build on the work of others that already exist, to learn some and dabble in new things and combine that with 3D printing and 3D design, electronics and controls.

So the idea is to build a MMU for my creality K1 Max and document the journey here. I considered simply upgrading to a K2 or to go the K1 upgrade route, but it's costing a lot, I am not convinced the costs justifies the use of my printers and in doing this project, I have a fun project to work on, tinker with Klipper that I have very little experience of apart from rooting my K1 Max. Also having built the sandtable project using a PI Pico 2040, I thought it might be fun to use the stock I have and repeat the process of fitting the technical lego together.

After some research and many articles later, I decided to try out the LH-Stinger Pico MMU. It is well documented and so many options that it becomes quite overwhelming, but I believe that it can be integrated with a rooted K1 Max is reasonable fashion, with the caveat that I want to explore using the Raspberry Pi Pico 2040 as a controller instead.

The theory is that you can flash a RPI Pico 2040 with Klipper and once that is achieved you simply define the IO pins for stepper and servo control in Klipper scrips.

The Basic Steps

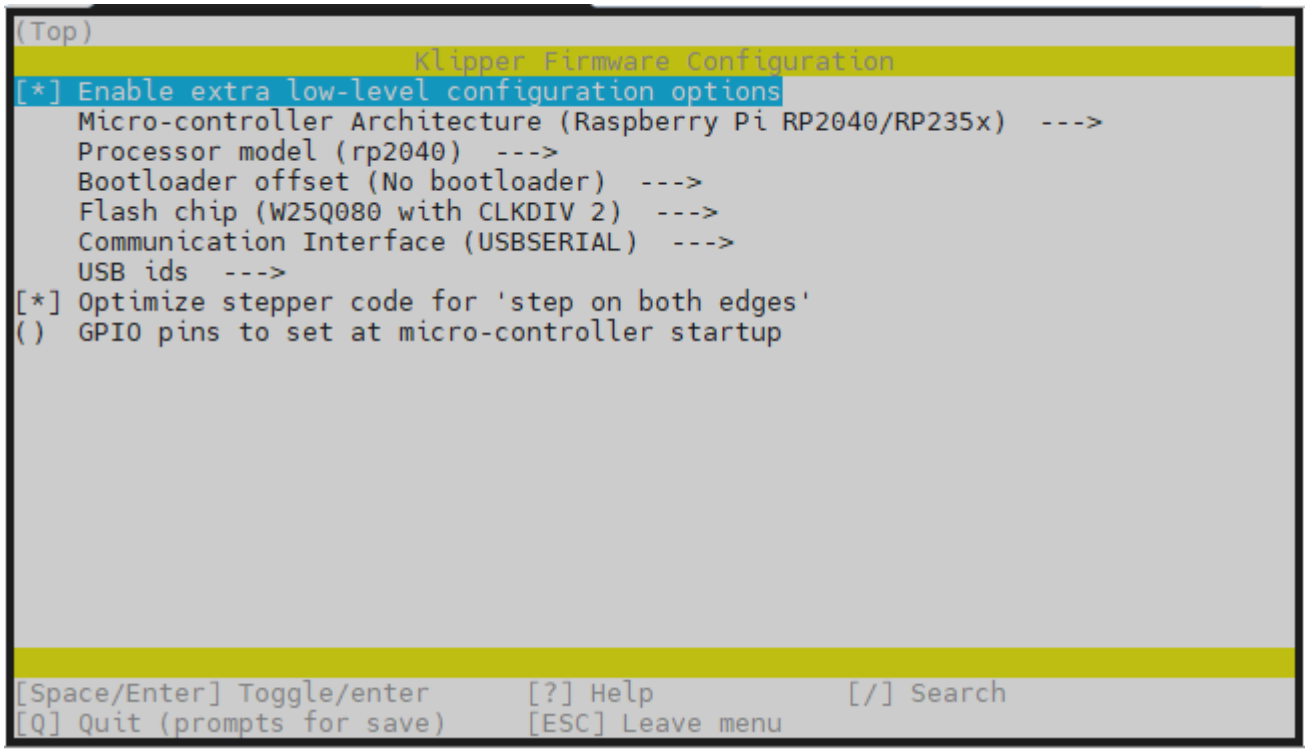
- Install Klipper on a PC
- Create a Configuration
- Build the configuration
- Flash the binary to the Raspberry PI Pico 2040
- Connect the board to the main host application

Install Klipper on a PC

```
git clone https://github.com/Klipper3d/klipper
cd klipper
make menuconfig
```

Create a Configuration

Make Menuconfig brings up this application to easily chose and select options from.



For my test I chose the options as shown above.

The documentation I could find states the following:

Option	Recommended Setting	Why
Enable extra low-level configuration options	□ Enabled	Required for RP2040-specific tuning
Micro-controller Architecture	Raspberry Pi RP2040/RP235x	Matches your board
Processor model	rp2040	Correct for Raspberry Pi Pico
Bootloader offset	No bootloader	Pico uses drag-and-drop UF2 flashing
Flash chip	W25Q080 with CLKDIV 2	Default for most Pico boards; safe choice
Communication Interface	USBSERIAL	Needed to connect via USB to your K1 Max
USB IDs	Leave default	Optional unless you need custom device IDs
Optimize stepper code for 'step on both edges'	□ Enabled	Improves stepper performance (recommended)
GPIO pins to set at micro-controller startup	Leave blank	Only needed for special pin initialization

Build the configuration

```
jattie@Jattie-PC:~/klipper$ make
  Building out/autoconf.h
  Compiling out/src/sched.o
make: arm-none-eabi-gcc: No such file or directory
```

```
make: *** [Makefile:65: out/src/sched.o] Error 127
```

That error means your system is missing the ARM cross-compiler toolchain—specifically arm-none-eabi-gcc, which is required to compile firmware for ARM-based microcontrollers like the RP2040.

This is resolved by installing the missing tools

```
jattie@Jattie-PC:~/klipper$ sudo apt update
sudo apt install gcc-arm-none-eabi binutils-arm-none-eabi libnewlib-arm-none-eabi
```

Build then runs to completion as expected.

```
jattie@Jattie-PC:~/klipper$ make
  Compiling out/src/sched.o
  Compiling out/src/command.o
  Compiling out/src/basecmd.o
  Compiling out/src/debugcmds.o
  Compiling out/src/initial_pins.o
  Compiling out/src/gpiocmds.o
  Compiling out/src/stepper.o
  Compiling out/src/endstop.o
  Compiling out/src/trsync.o
  Compiling out/src/adccmds.o
  Compiling out/src/spicmds.o
  Compiling out/src/i2ccmds.o
  Compiling out/src/pwmcmds.o
  Compiling out/src/buttons.o
  Compiling out/src/tmcuart.o
  Compiling out/src/neopixel.o
  Compiling out/src/pulse_counter.o
  Compiling out/src/lcd_st7920.o
  Compiling out/src/lcd_hd44780.o
  Compiling out/src/spi_software.o
  Compiling out/src/i2c_software.o
  Compiling out/src/thermocouple.o
  Compiling out/src/sensor_adxl345.o
  Compiling out/src/sensor_lis2dw.o
  Compiling out/src/sensor_mpu9250.o
  Compiling out/src/sensor_icm20948.o
  Compiling out/src/sensor_hx71x.o
  Compiling out/src/sensor_ads1220.o
  Compiling out/src/sensor_ldc1612.o
  Compiling out/src/sensor_angle.o
  Compiling out/src/sensor_bulk.o
  Compiling out/src/sos_filter.o
  Compiling out/src/load_cell_probe.o
  Compiling out/src/rp2040/main.o
  Compiling out/src/rp2040/watchdog.o
  Compiling out/src/rp2040/gpio.o
  Compiling out/src/rp2040/adc.o
  Compiling out/src/generic/armcm_boot.o
  Compiling out/src/generic/armcm_irq.o
  Compiling out/src/generic/armcm_reset.o
  Compiling out/src/generic/crc16_ccitt.o
  Compiling out/src/rp2040/timer.o
  Compiling out/src/generic/timer_irq.o
  Compiling out/src/rp2040/bootrom.o
  Compiling out/src/rp2040/usbserial.o
```

```
  Compiling out/src/generic/usb_cdc.o
  Compiling out/src/rp2040/chipid.o
  Compiling out/src/rp2040/hard_pwm.o
  Compiling out/src/rp2040/spi.o
  Compiling out/src/rp2040/i2c.o
  Building out/compile_time_request.o
Version: v0.13.0-213-gd34d3b05b
  Building rp2040 stage2 out/stage2.o
  Preprocessing out/src/rp2040/rpxxxx_link.ld
  Linking out/klipper.elf
  Building out/lib/elf2uf2/elf2uf2
  Creating uf2 file out/klipper.uf2
```

Flash the binary to the Raspberry PI Pico 2040

- Plug the Pico into your computer while holding the BOOTSEL button, it will mount as a USB drive.
- Copy klipper.uf2 to the Pico drive, it will reboot automatically.

Test the Connection

- Plug the flashed pico into K1 Max USB Port
- Establish an SSH connection to the K1 Max and found the new serial device.

```
root@creality /root [#] ls /dev/serial/by-id/
usb-Klipper_rp2040_E66058388361172C-if00
root@creality /root [#]
```

We seem to have a successful Klipper installation on the Pico 2040.

Connect the board to the main host application

Some basic testing to confirm all is well, add the basic config and simply blink the LED on the Pico 2040.

```
[mcu pico_2040_mmu]
serial: /dev/serial/by-id/usb-Klipper_rp2040_E66058388361172C-if00

[output_pin pico_led]
pin: pico_2040_mmu:gpio25
pwm: False
shutdown_value: 0
```

Adding the config and restarting Klipper however yield this error:

```
MCU Protocol error

This type of error is frequently caused by running an older
version of the firmware on the micro-controller (fix by
recompiling and flashing the firmware).

Your Klipper version is: 09faed31-dirty
```

```
MCU(s) which should be updated:
mcu: Current version 1.3.0.40-5-g6977eaff-dirty-20230711_100121-ubuntu
nozzle_mcu: Current version 1.3.0.40-5-g6977eaff-dirty-20230711_100254-ubuntu
leveling_mcu: Current version 1.3.0.40-5-g6977eaff-dirty-20230711_095416-ubuntu
Up-to-date MCU(s):


Once the underlying issue is corrected, use the "RESTART"
command to reload the config and restart the host software.

mcu 'pico_2040_mmu': Multi-byte msgtag not supported
```