

## 3D PRINTING AND DESIGN REFERENCE DOCUMENT

<b>Document Title:</b>	Kinetic Sand Table
<b>Document No.:</b>	1734601619
<b>Author(s):</b>	jattie
<b>Contributor(s):</b>	

### REVISION HISTORY

Revision	Details of Modification(s)	Reason for modification	Date	By
0	Draft release	Document Essential References and Resource for Building a Kinetic Sandtable	2024/12/19 09:46	jattie

# Kinetic Sand Table Design and Build

The objectives for the project is to 3D print as many of the parts as possible and to build low budget linear stages to construct the basic system and build it up from there.

- Electronics/Controllers
  - GRBL Controller
  - CNC Shield
  - Stepper Drivers for shield
- Linear Hardware
  - Stepper motors
  - Linear Stages
  - GT2 drive belts
  - GT2 Idlers
  - GT2 Stepper Attachments
  - Belt Clamp
- Playlist <sup>1)</sup>

## Electronics

### GRBL Controller

After some extensive research I discovered grbIHAL<sup>2)</sup>. grbIHAL is the updated version of GRBL. GRBL is an open-source firmware that converts G-code commands into motion control signals for CNC (Computer Numerical Control) machines. It's widely used for controlling CNC routers, mills, lathes, laser cutters, and other automated machinery.

grbIHAL essentially makes it possible to use a wide range of low cost 32 bit microcontrollers. Some popular grbIHAL supported microcontrollers are :

- RP2040: Raspberry Pi Pico
- ESP32: Popular for IoT projects
- STM32: Various models like STM32F1xx, STM32F3xx, STM32F4xx, STM32F7xx, and STM32H7xx
- LPC176x: Used in many embedded systems

- SAM3X8E: Found in Arduino Due
- Teensy 4.x: High-performance microcontrollers
- NXP iMXRT1062: Used in Teensy 4.x boards

This allows for a wide range of options to avail of to build a very low cost grbl interface. There are handy web based tools to select the controller of choice and build the firmware code for you.<sup>3)</sup> The alternative route is to build the code using VSCode. The [full tutorial is here](#).

The basic steps are:

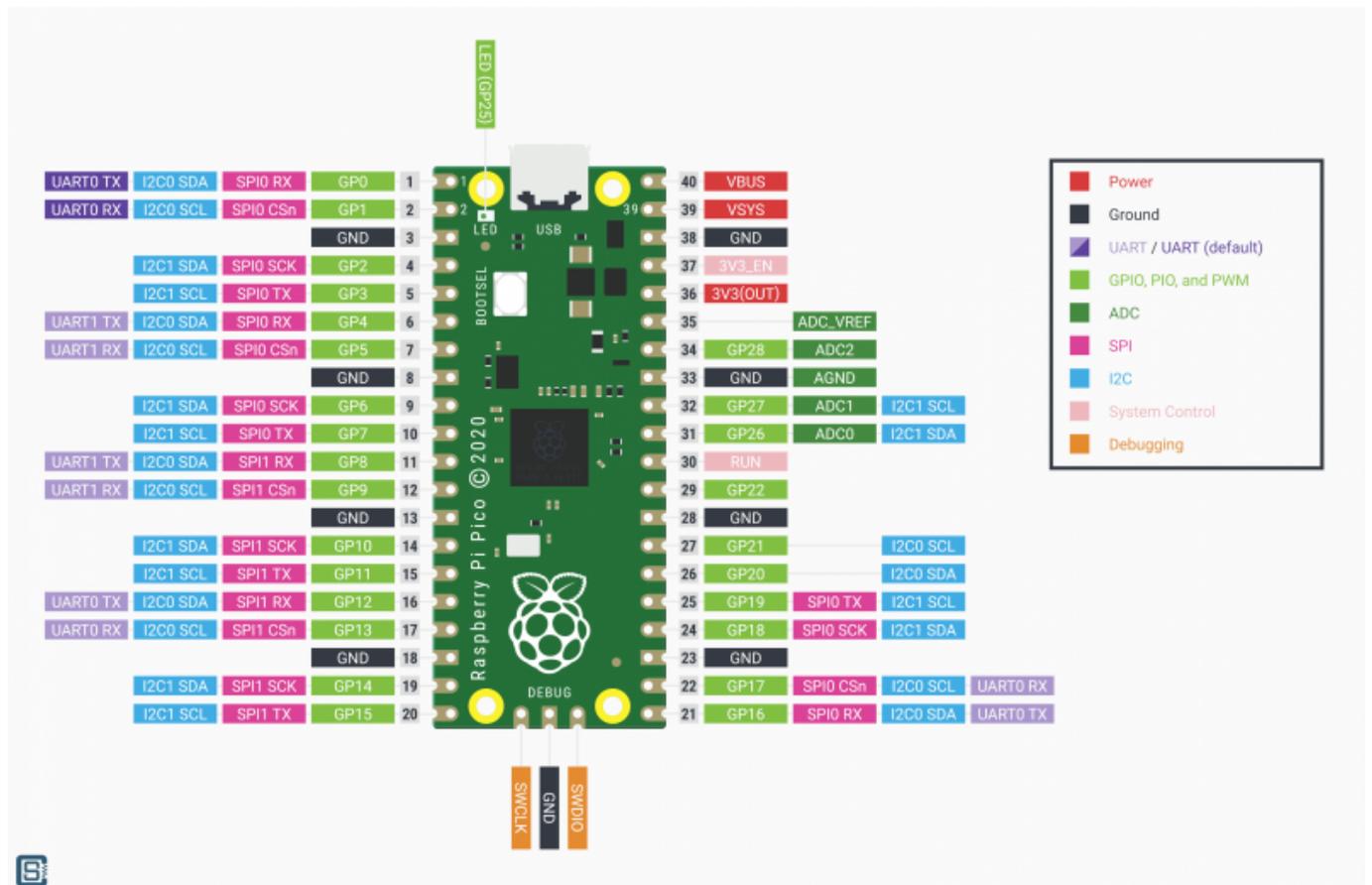


- Create firmware <sup>4)</sup>
- Power off the Pico 2040 by unplugging the USB, hold in BOOTSEL and plug it back in. Upload the firmware.
- Connect to the unit using IOSender XL <sup>5)</sup>

That's it, you now have a GRBL controller.

## Connecting Steppers to the GRBL controller

The pinouts for a Pico 2040 are as follow:



Following the grbIHAL software mapping for the firmware <sup>6)</sup> we deduce the following map to actual pinouts:

GRBL Function	Pico GP Pin
Step Output X	2
Step Output Y	3
Step Output Z	4
Direction Output X	5
Direction Output Y	6
Direction Output Z	7
Steppers Enable	8
Limit X	9
Limit Y	10
Limit Z	11

## Stepper Drivers

There are a few projects for Pico specific shields, however they are costly to get hold of and the Arduino community has very low cost and mature products that is compatible, or at least I believe it is and will explore this and test it for this purpose.

I will explore the CNC Shield that is discussed in detail here <sup>7)</sup>

As an alternative we explored TB6600. <sup>8)9)10)</sup> These units are very low cost and available on Amazon.

The different models of these types of units are tabled below for comparison.

Last update:  
2024/12/20  
11:25

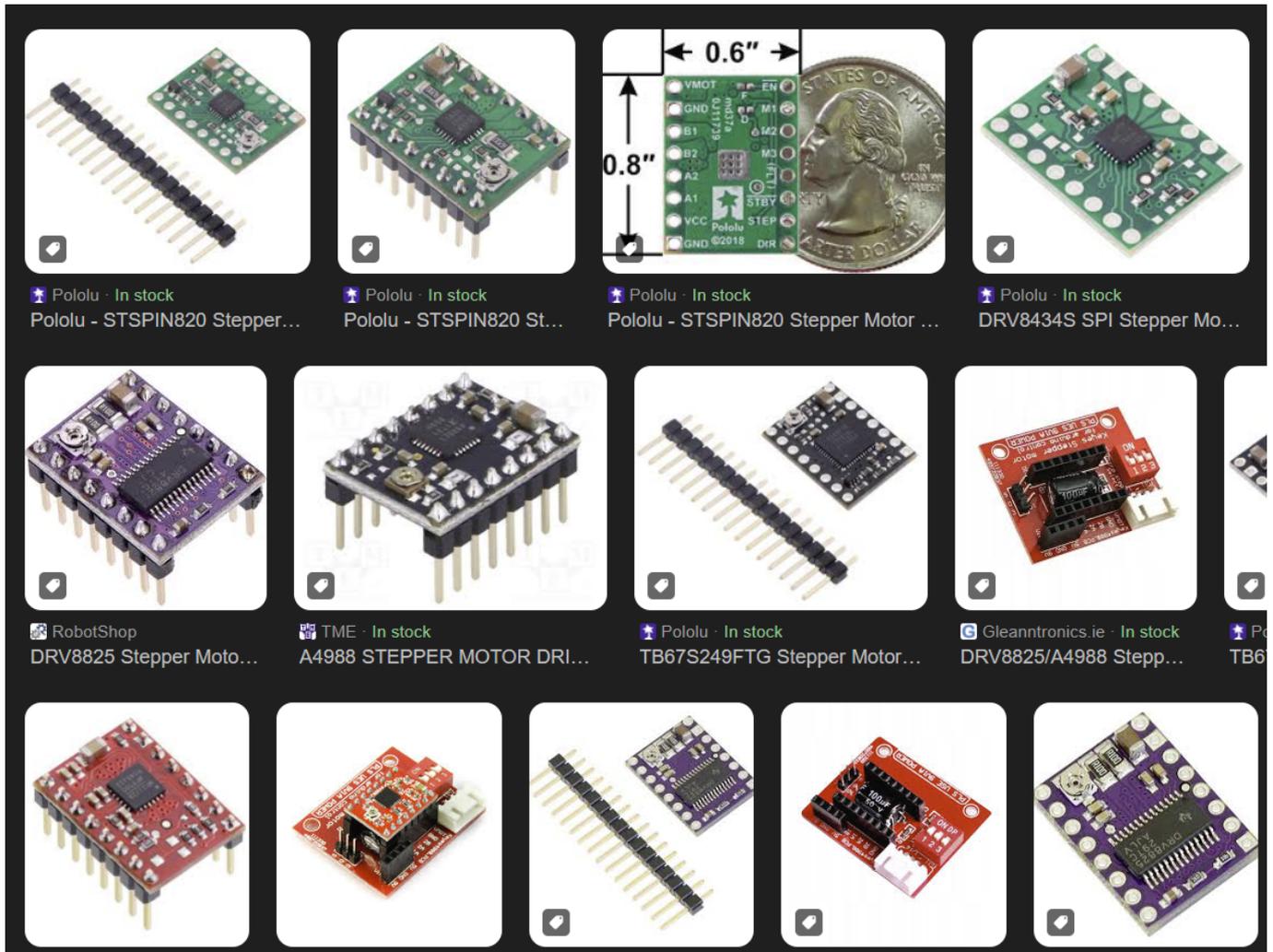
04\_projects:02\_kinetic\_sand\_table

[http://3dfaq.net/04\\_projects/02\\_kinetic\\_sand\\_table?rev=1734693959](http://3dfaq.net/04_projects/02_kinetic_sand_table?rev=1734693959)



Feature/Driver	TB6600	DM556	DM556T	DM542	ERP60	DM860H	DM860S	DM860T
<b>Input Voltage</b>	9-42V	20-50V						
<b>Output Current</b>	0.5-4A	0.5-5.6A	1.8-5.6A	1.8-5.6A	1.8-5.6A	1.8-5.6A	1.8-5.6A	1.8-5.6A
<b>Microsteps</b>	1, 2/A, 2/B, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32
<b>Control Interface</b>	Digital							
<b>Protection Features</b>	Overcurrent, Overheat							
<b>Applications</b>	General use, CNC machines							

The other option is smaller packaged driver like these:



Feature/Driver	STSPIN820	DRV8834	A4988	MP6500	A5984	TB67S249	DRV8434	TMCM-1260
<b>Operating Voltage</b>	7-45V	2.5-10.8V	8-35V	8-40V	8-40V	8-40V	8-40V	8-40V
<b>Max Output Current</b>	1.5 Arms	1.5 A	2 A	2.5 A	2.5 A	2.5 A	2.5 A	2.5 A
<b>Microstepping</b>	Up to 1/256	Up to 1/32	Up to 1/16					
<b>Protection Features</b>	Overcurrent, Overtemperature, Short-circuit, Undervoltage lockout, Thermal shutdown	Overcurrent, Short-circuit, Undervoltage lockout, Overtemperature, Low-power sleep mode	Overcurrent, Short-circuit, Thermal shutdown					
<b>Package Type</b>	QFN 4x4 mm	HTSSOP/VQFN 24-pin	DIP-16	DIP-16	DIP-16	DIP-16	DIP-16	DIP-16
<b>Applications</b>	3D printers, Medical equipment, Industrial printers, Robotics	Toys, Printers, Cameras, Robotics	3D printers, CNC machines, Robotics	3D printers, CNC machines, Robotics	3D printers, CNC machines, Robotics	3D printers, CNC machines, Robotics	3D printers, CNC machines, Robotics	3D printers, CNC machines, Robotics

The TMC2208 and TMC2209 are known for their silent operation due to their StealthChop technology.

## Stepper Motors

My stepper motor choice is from what I already have on hand, is popular and abundantly available. Any Nema 17 motor will suffice.

<b>Brand</b>	Creality 3D 42-40
--------------	-------------------

Last  
update:  
2024/12/20  
11:25

04\_projects:02\_kinetic\_sand\_table

[http://3dfaq.net/04\\_projects/02\\_kinetic\\_sand\\_table?rev=1734693959](http://3dfaq.net/04_projects/02_kinetic_sand_table?rev=1734693959)

<b>Item Name</b>	RepRap 42 Stepper Motor
<b>Article number</b>	42-40
<b>SKU</b>	3204120126
<b>Step angle</b>	1.8degrees
<b>Rated voltage</b>	4.83V
<b>Current rating</b>	1.5(A)
<b>Rated speed</b>	1-1000(rpm)
<b>Rated torque</b>	0.4(NM)
<b>Ambient temperature</b>	-20 °C ~ + 50°C
<b>Length</b>	40mm
<b>Application</b>	3D printer
<b>Shaft</b>	Round shaft

## Linear Hardware

1)

<https://github.com/texx00/sandypi>

2)

<https://github.com/grbIHAL/core/blob/master/README.md>

3) 4)

<http://svn.io-engineering.com:8080/?driver=RP2040>

5)

<https://github.com/terjeio/ioSender/releases/>

6)

[https://github.com/grbIHAL/RP2040/blob/master/boards/generic\\_map.h](https://github.com/grbIHAL/RP2040/blob/master/boards/generic_map.h)

7)

<https://all3dp.com/2/arduino-cnc-shield/>

8)

[https://www.amazon.co.uk/gp/product/B07SBZ9SM5/ref=ox\\_sc\\_act\\_title\\_1?smid=A3G751PYK8M98N&psc=1](https://www.amazon.co.uk/gp/product/B07SBZ9SM5/ref=ox_sc_act_title_1?smid=A3G751PYK8M98N&psc=1)

9)

<https://www.makerguides.com/wp-content/uploads/2019/10/TB6600-Manual.pdf>

10)

<https://www.watelectronics.com/tb6600-stepper-motor-driver-module/>

From:

<http://3dfaq.net/> - **3D Printing Wiki**

Permanent link:

[http://3dfaq.net/04\\_projects/02\\_kinetic\\_sand\\_table?rev=1734693959](http://3dfaq.net/04_projects/02_kinetic_sand_table?rev=1734693959)

Last update: **2024/12/20 11:25**

