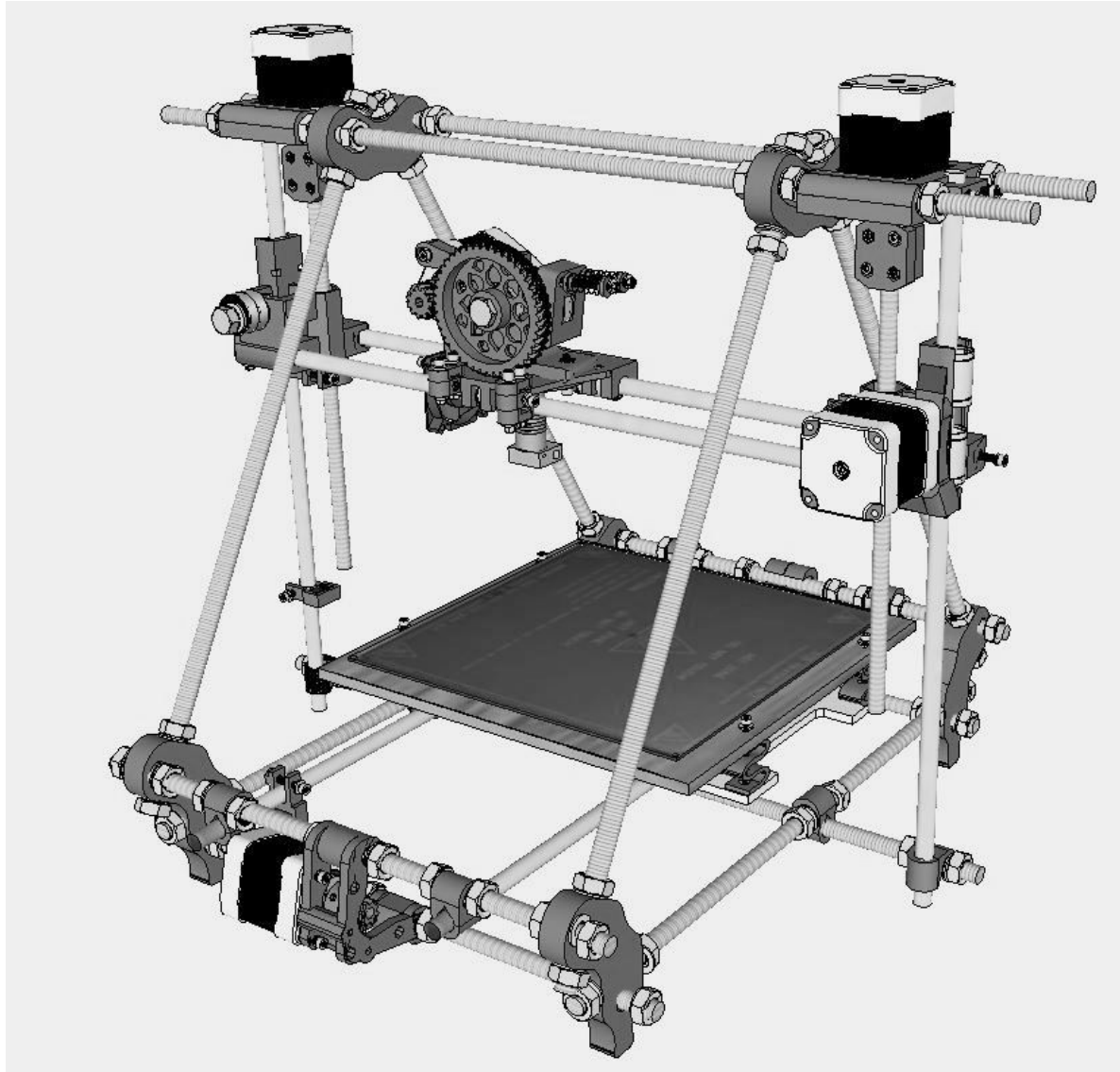


TVRR Prusa



Visual Assembly Guide

November 2013



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Author:

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Eric Rowen

Inspiration:

Gary Hodgson's visual instructions document

(<http://garyhodgson.com/reprap/prusa-mendel-visual-instructions/>)

TVRR SCAD and STL Model Files:

<https://github.com/tvrrug/tvprusa> - Make sure you pick the correct branch for the version of your kit

Inspiration taken from Reprap Mendel Sketchup Models by

Gary Hodgson

https://github.com/garyhodgson/prusa_mendel_visual_instructions/tree/master/src/models

Capo:

<http://sketchup.google.com/3dwarehouse/details?mid=86dc5e3cc80958355ad914839c51e370>

Sketchup model:

David Price

Sketchup components:

Printed components, micro-switch, acrylic and plywood plates

by David Price

Stepper motor, PCB, bearings, nuts and bolts

by Iker Martinez (Vamagata)

Threaded and smooth rods

by Alex Villenero

40mm fan

By Stefano Teruzzi

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TVRR Prusa Mendel: GPL (<http://reprap.org/wiki/GPL>)

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- 4: top threaded rods
- 5: Tightening the frame
- 6: Assembling the Y axis
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- 8: Assembling the Z axis
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Introduction

The aim of this document is to provide a visual guide of the steps needed to construct a Thames Valley RepRap group Prusa 3D Printer from round 2 onwards.

The document is intended to provide a guide for the beginner to the construction of a Prusa style 3D printer though it should also be of help to the more experienced person used to mechanical construction and techniques. The author has constructed a round 2 machines and comments have been incorporated from a number of contributors who have practical experience of building this design.

The **tvrrug.org.uk** website is the reference source of all information concerning the design and should be referred to for the most up to date information on parts and assembly.

The inspiration for this guide was a similar visual step-by-step description authored by Gary Hodgson (garyhodgson.com/reprap/prusa-mendel-visual-instructions/) which covered an earlier Prusa Mendel design and extruder. The TVRRUG design covered by this guide introduces a range of improvements to ease the construction and operation of the printer together with the use of the more recent Wade extruder and the successful J-Head hot end

The TVRRUG also developed their own modular electronics system which is covered in other documents and construction guides accessed via their website.

Assumptions/Dependencies

This guide assumes basic DIY skills including mechanical and electrical assembly and competency with hand tools. Only common tools and techniques are required, the set of tools you need being listed later in this guide.

RTFM

“Read The Fine Manual” - this sentiment applies as much to this project as any other complex activity. You should read the whole guide all the way through and ideally browse the tvrrug.org.uk and reprap.org websites, even Youtube. Familiarise yourself with the printer's workings and how other people have approached the construction of Prusa Mendel printers.

If you get in to trouble or have a question then ask away on the TVRRUG Google group (<https://groups.google.com/forum/?fromgroups#!forum/tvreprapug>).

Bill of materials – vitamins (non-printed parts)

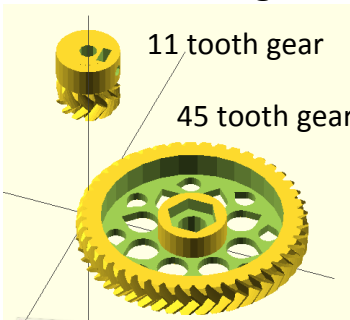
| # | Qty | Item Description | |
|----|-----|--|--|
| 1 | 1 | 140mm×225mm perspex bottom plate | With Items 2,3 & 4 form the print bed |
| 2 | 1 | 225mm×225mm plywood top plate | see above |
| 3 | 2 | 200x200mm glass sheet for heated bed | see above |
| 4 | 1 | PCB Heated Bed | see above |
| 5 | 2 | 8mm×350mm Smooth rod IHC (355 mm for Round-3) | Z-Axis smooth rods |
| 6 | 4 | 8mm×404mm Smooth rod IHC (2* 410 mm, 2*420 in Round 3) | X & Y-Axis |
| 7 | 1 | 8mm×18mm Smooth rod Mild Steel | For the extruder idler pulley |
| 8 | 2 | 15mm 5mm ID plastic tubing | For the Z-Axis motor to threaded rod coupling |
| 9 | 1 | 1750mm×5mm T5 timing belt | |
| 10 | 2 | M8×210mm Threaded rod | Z-Axis drive from motors to X-Axis |
| 11 | 4 | M8×310mm Threaded rod (325 mm for Round-3) | Lower front and rear frame |
| 12 | 6 | M8×370mm Threaded rod (375 mm in Round-3) | For both "A" frames |
| 13 | 3 | M8×500mm Threaded rod | supports Z-Axis smooth rods |
| 14 | 7 | 608 skate bearing | For X & Y idlers and extruder & idler + |
| 15 | 10 | LM8UU linear bearing | Run on the various smooth rods |
| 16 | 3 | M3 grub screw / set screw | Locate pulleys on motors |
| 17 | 45 | M3 nut | |
| 18 | 28 | M3 nylock | |
| 19 | 160 | M3 washer | |
| 20 | 11 | M3×10 bolt | |
| 21 | 4 | M3×25 bolt | |
| 22 | 11 | M3x12 bolt | |
| 23 | 30? | M3x20 bolt | |
| 24 | 5 | M3x30 bolt | |
| 25 | 4 | M3x45 bolt | |
| 26 | 2 | M4 nut | Extruder to X-Carriage |
| 27 | 2 | M4 washer | Extruder to X-Carriage |
| 28 | 2 | M4×20 bolt | Extruder to X-Carriage |
| 29 | 90 | M8 nut | Frame construction etc. |
| 30 | 100 | M8 washer | Frame construction etc. |
| 31 | 1 | M8×40 hex head bolt | Y-Axis idler |
| 32 | 1 | M8×60 hex head bolt | X-Axis Idler |
| 33 | 2 | M3x75mm Threaded Rod | Extruder assembly holds idler to block |
| 34 | 1 | Extruder Mounting Plate (thicksheet) | |
| 35 | 2 | extruder spring 10mm OD, 8mm ID, 31mm length | Part of Extruder assembly |
| 36 | 1 | Hobbed bolt | Part of Extruder assembly |
| 37 | 1 | J-Head Hot end | Part of Extruder assembly |
| 38 | 5 | NEMA 17 bipolar stepper motor | Motors that drive X-Y-Z axis and extruder |
| 39 | 1 | PSU | 12v 30A power supply |
| 40 | 1 | FTDI Cable | provides a USB to UART interface for your PC and the electronics |
| 41 | 4 | Rubber feet | |
| 42 | 4 | Small Bulldog Clips | To hold glass plate (mirror) to item 4 |
| 43 | 12 | small cable binder / ziptie | To hold item 15 linear bearings in place |
| 44 | 1 | 5m x 4mm cable wrap | |
| 45 | 1 | roll of 3mm PLA filament | |
| 46 | 1 | Kapton Tape 25mm x 33m | for optionally covering the heated bed glass plate |
| 47 | 1 | Kapton Tape 5mm x 33m | for securing the elements of the hot end |
| 48 | 1 | 40mm Fan | Attaches to Extruder assembly |

Bill of materials – vitamins (printed parts)

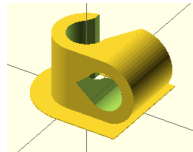
| # | Qty | Printed Part | Description |
|----|-----|---|---|
| 1 | 1 | 11 tooth drive gear (herringbone) | |
| 2 | 1 | 45 tooth M8 hub driven gear (herringbone) | Large wheel obvious which it is |
| 3 | 8 | bar-clamp | For the smooth rods and threaded rods |
| 4 | 4 | bed springs | Fit between the perspex plate and plywood plate |
| 5 | 4 | coupling | For the Z-Axis motors |
| 6 | 3 | end stop-holder | holds a micro switch to indicate axis end of travel |
| 7 | 1 | extruder block | This with items 1 & 2 sit on top of item 16 the X-Carriage |
| 8 | 1 | extruder idler | Fastened to item 7 to hold an idler wheel |
| 9 | 4 | extruder spring retainer | Four quite small items, approx 1 cm diameter |
| 10 | 2 | frame-vertex | The top vertices of the "A" frames. |
| 11 | 4 | frame-vertex with foot | For the base of each "A" frame. |
| 12 | 2 | pulley | Used on the "Y" & "X" axis motors |
| 13 | 2 | rod-clamp | Used to hold the top of the Z-Axis smooth rods to the motor mounts |
| 14 | 2 | x belt clamp | Used with item 15 to hold the belt that moves the X-Carriage |
| 15 | 1 | x belt tensioner | As above holds the belt that drives the X-carriage |
| 16 | 1 | x-carriage | Sits on the two X-Axis smooth rods to carry extruder and hot end |
| 17 | 1 | x-end-idler | Sits on the rhs of the X-Axis smooth rods and holds the idler pulley |
| 18 | 1 | x-end-motor | Sits on the lhs of the X-Axis smooth rods and holds the X-Axis motor |
| 19 | 2 | y-belt-clamp | clamps Y axis drive belt to acrylic plate |
| 20 | 2 | y-idler-bracket | TWO items that holds the idler pulleys on the rear of the frame |
| 21 | 2 | y-motor-bracket | TWO items that holds the Y axis motor on the front of the frame |
| 22 | 2 | z-motor-mount | Hold the Z motors at the top of the frame |
| 23 | 2 | zisolator | Uses a M8 nut on the Z-Axis threaded rods to raise and lower the X axis |

Visual guide to printed parts for Round 2 onwards

1x Extruder gear set



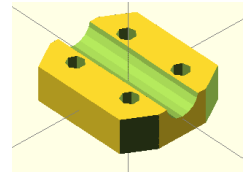
8x Bar clamp



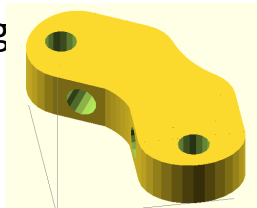
4x Bed spring



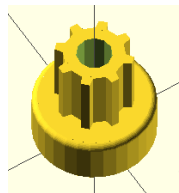
4x Z axis Coupling



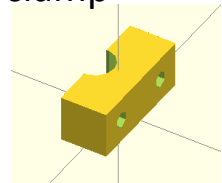
6x Vertex
4 with feet



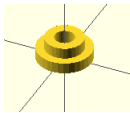
2x Pulley
(X and Y axes)



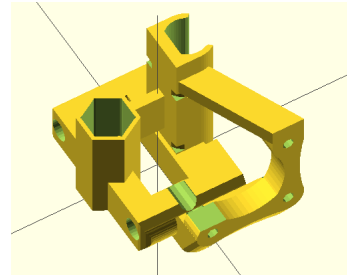
2x Smooth Rod
clamp



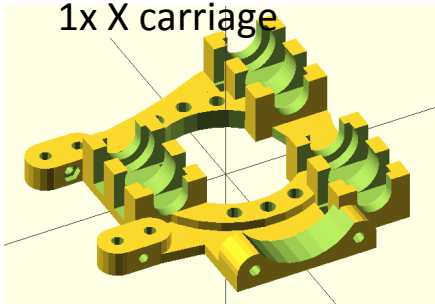
4x Extruder Spring
Retainer



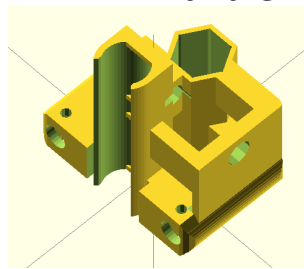
1x X-End Motor (bracket)



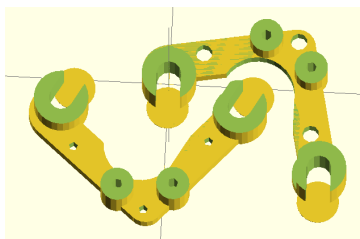
1x X carriage



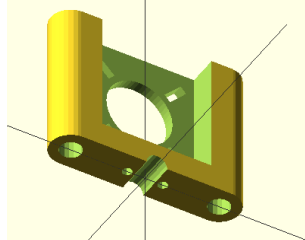
1x X-End Idler



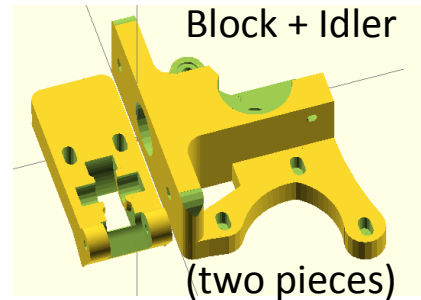
1x Y motor bracket



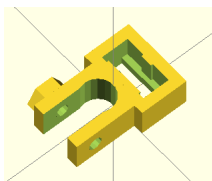
2x Z Motor Mount



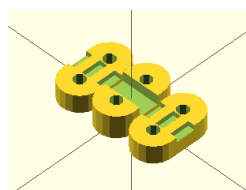
1x Wade extruder =
Block + Idler



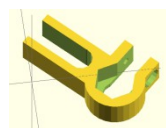
3x Endstop switch
holder



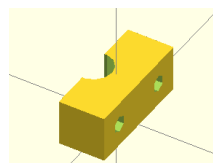
1x X belt clamp
set (3 pieces)



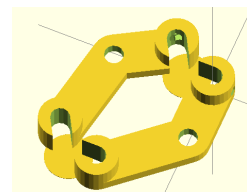
2x Isolator



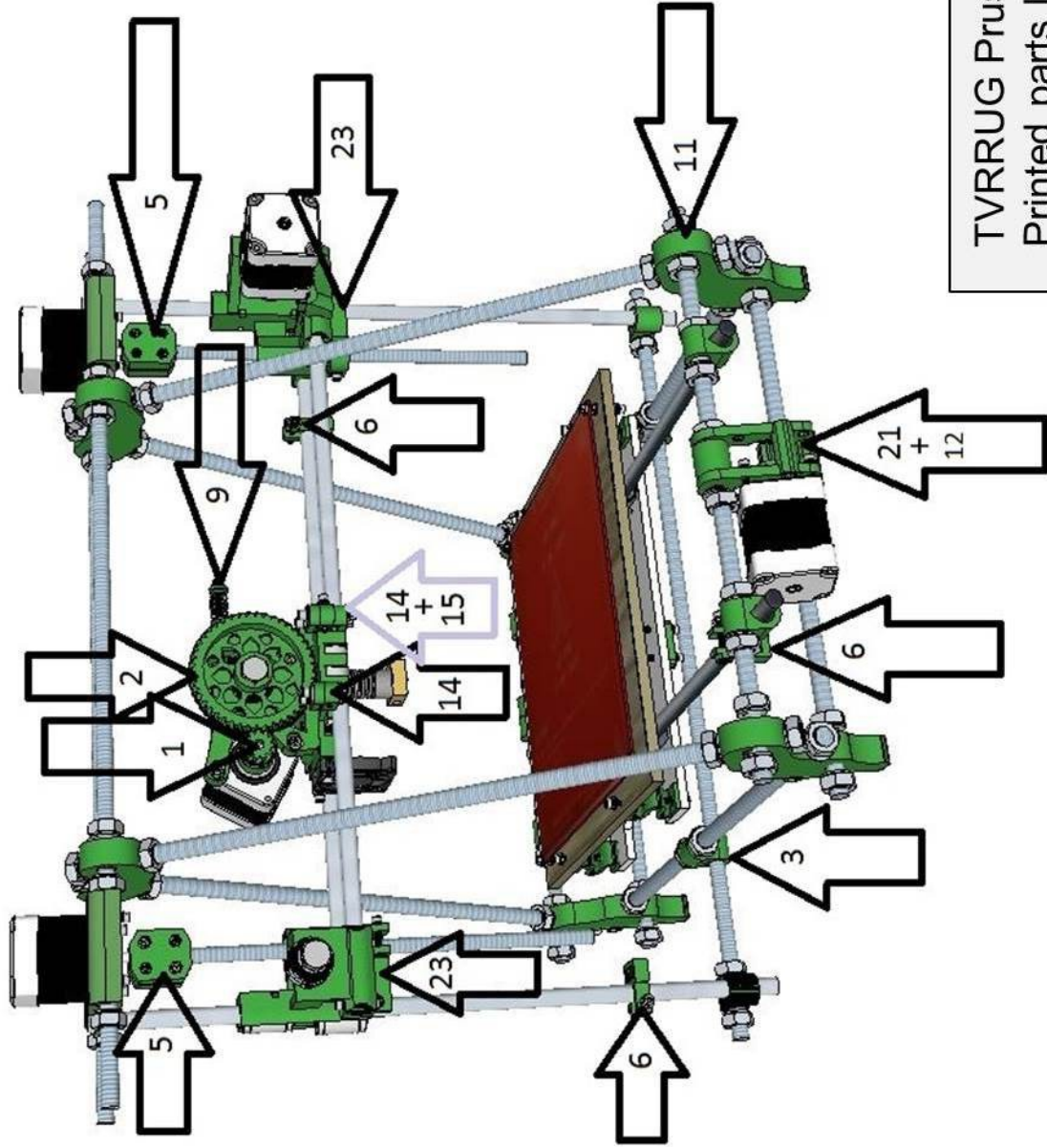
2x Smooth Rod
clamp



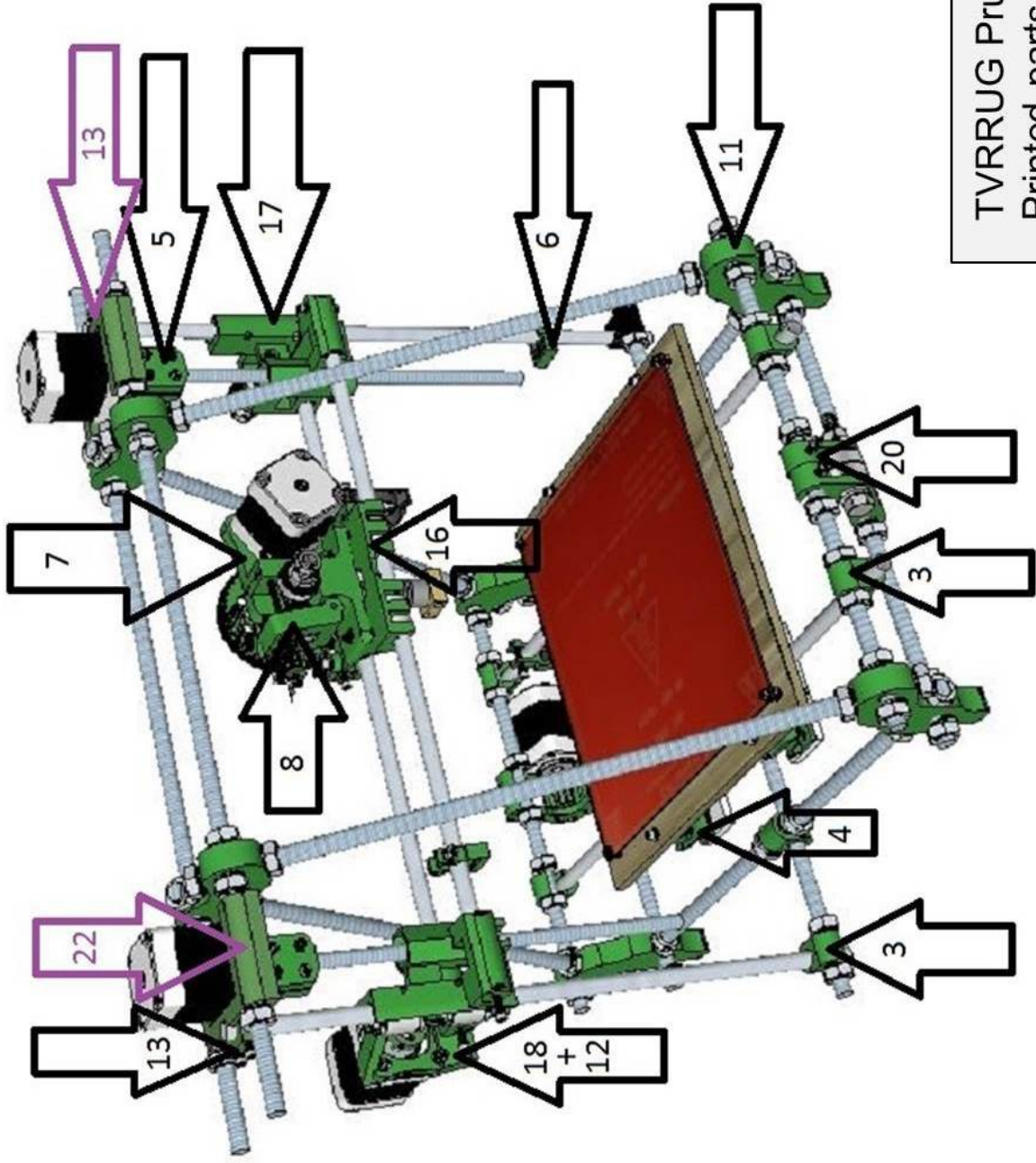
1x Y idler bracket



| | |
|----|---|
| 1 | 11 tooth drive gear (herringbone) |
| 2 | 45 tooth M8 hub driven gear (herringbone) |
| 3 | bar-clamp |
| 4 | bed springs |
| 5 | coupling |
| 6 | endstop-holder |
| 7 | extruder block |
| 8 | extruder idler |
| 9 | extruder spring retainer |
| 10 | frame-vertex |
| 11 | frame-vertex with foot |
| 12 | pulley |
| 13 | rod-clamp |
| 14 | x belt clamp |
| 15 | x belt tensioner |
| 16 | x-carriage |
| 17 | x-end-idler |
| 18 | x-end-motor |
| 19 | y-belt-clamp |
| 20 | y-idler-bracket |
| 21 | y-motor-bracket |
| 22 | z-motor-mount |
| 23 | zisolator |



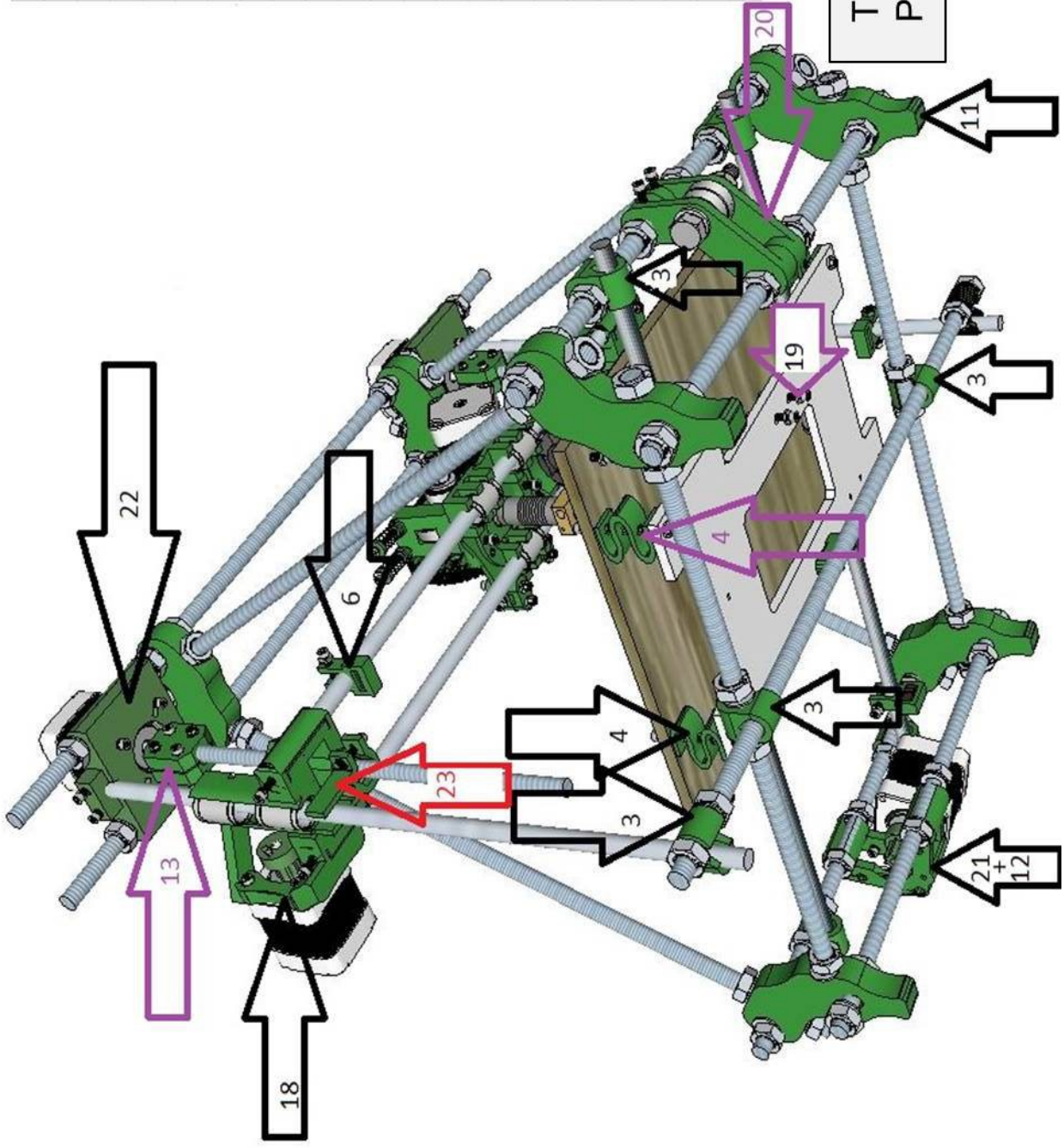
TVRRUG Prusa round 2 onwards
Printed parts list 1 of 3



| | |
|----|---|
| 1 | 11 tooth drive gear (herringbone) |
| 2 | 45 tooth M8 hub driven gear (herringbone) |
| 3 | bar-clamp |
| 4 | bed springs |
| 5 | coupling |
| 6 | endstop-holder |
| 7 | extruder block |
| 8 | extruder idler |
| 9 | extruder spring retainer |
| 10 | frame-vertex |
| 11 | frame-vertex with foot |
| 12 | pulley |
| 13 | rod-clamp |
| 14 | x belt clamp |
| 15 | x belt tensioner |
| 16 | x-carriage |
| 17 | x-end-idler |
| 18 | x-end-motor |
| 19 | y-belt-clamp |
| 20 | y-idler-bracket |
| 21 | y-motor-bracket |
| 22 | z-motor-mount |
| 23 | zisolator |

TVRRUG Prusa round 2 onwards
Printed parts list 2 of 3

| | |
|----|---|
| 1 | 11 tooth drive gear (herringbone) |
| 2 | 45 tooth M8 hub driven gear (herringbone) |
| 3 | bar-clamp |
| 4 | bed springs |
| 5 | coupling |
| 6 | endstop-holder |
| 7 | extruder block |
| 8 | extruder idler |
| 9 | extruder spring retainer |
| 10 | frame-vertex |
| 11 | frame-vertex with foot |
| 12 | pulley |
| 13 | rod-clamp |
| 14 | x belt clamp |
| 15 | x belt tensioner |
| 16 | x-carriage |
| 17 | x-end-idler |
| 18 | x-end-motor |
| 19 | y-belt-clamp |
| 20 | y-idler-bracket |
| 21 | y-motor-bracket |
| 22 | z-motor-mount |
| 23 | zisolator |



TVRRUG Prusa round 2 onwards
Printed parts list 3 of 3

General guide to assembly

First things first

The very first thing you should do is check the inventory. Take time as soon as you receive the kit and before you start construction to **check and identify all parts**, it is useful here to use plastic trays tubs etc. to hold parts before/after checking quantities and identification, this makes construction easier and ensures that you don't lose some of the very small parts. Ensure you have all the parts on the enclosed component sheet or as listed on the website for your version of the kit. If anything is missing or damaged then contact the distribution organiser straight away as errors are much easier to resolve now rather than months after a release has been distributed.

The second thing you should do is read through ALL assembly instructions before you start building the printer. Being familiar with the overall structure and design will help you understand much of the detailed items as you progress through the assembly.

Fettling, easing etc

Whilst these 3D printers are reasonably accurate they are not high precision machines and you will need to check how well rods, screws and nuts fit in to the various plastic parts before construction and do some filing to ease their fit as necessary. For the most part a simple circular hand file will do the job and using a drill bit in reverse is particularly good at reaming out the 3, 4 and 8mmholes.

Each section starts with a view of what is to be assembled, a list of the parts you need and notes on any preparation, easing and fettling required.

However much you are tempted **do not use a Dremel or other high speed tool**, you will likely melt the plastic and end up with a very much larger, misshapen hole than you intended.

You are urged to check out the tvrrug.co.uk and rerap.org websites for construction guides before you start as they both contain useful tips and guidance. Join the tvrrug Google Group (<https://groups.google.com/forum/#!forum/tvrrug>), lurk and ask questions as quite a few people have built this printer now and an answer is usually given quite quickly.

Evolution

One of the primary characteristics of this machine is that it can print it's own parts, it was designed specifically to do that. This means you can print your own spare parts and are encouraged to do so for the high wearing, eg extruder gears, and the more fragile parts, eg end-stop holder and bar clamp. It also means you can design your own variations and improvements, maybe a whole new machine. Initially though you may want to look at some existing enhancements such as the Guidler (thingiverse object 19142) designed by Richrap to improve filament handling or the nut rosettes (thingiverse object 6599) to make bed height adjustment easier.

Improvements

In building this printer you are joining a community of enthusiasts. If you find a different way of doing something, particularly if it is a better/simpler/quicker or cheaper way than described in this guide or on the website then tell us via the Google Group so everyone can benefit. In the same spirit the author welcomes comments and suggestions on this guide.

Tools and facilities

Essential

- A flat level surface to build on with sufficient space for parts tools and equipment to stay without constantly having to put them away.
- Open Ended Spanners 13mm (1/2" AF)
- Open ended and ring spanner for M3 (5.5mm)
- Allen keys 1.5, 2.5 & 3mm
- A "square" (Tri-Square/Try-Square)
- Spirit level
- Feeler gauges (for nozzle height settings)

Electronics

- Soldering Iron
- Solder
- Solder sucker or solder wick (de-soldering braid)
- Multimeter
- Side-cutters
- Tweezers
- Loupe or magnifying glass

Useful/Optional

- Cordless, adjustable speed, reversible, drill (Draper 9.6v Cordless, Stock Number 24918 is cheap and fits the bill)
- Set of Swiss Files
- Drill bits various sizes including 5/16" (8mm) (frame vertices etc.)
- Loctite
- Hammer
- Small bench vice (Stanley 83-069 is a good one)
- Patience

For completeness we have included the tools required for the electronics construction from the tvrrug.org.uk website;

- Soldering iron, if using a variable temperature controlled soldering station, set it to 365°C (or the correct temp for your solder type)
- Steel pan scrubber or other soldering iron tip cleaner
- Thick and fine solder
- Blu-Tack – to hold components while soldering (this tip copyright Michel :))
- Desolder braid and/or pump – in case of solder bridges
- Long-nose pliers
- Side cutters with flat-back jaws for trimming legs clean to board – the clippings are sharp and fly all over the place unless you cover them with your hand. Beware your eyes
- Tweezers – for placing and holding the surface-mount resistors while soldering
- Anti static earthing strap
- An LED torch or other bright light source for – reading capacitor values
- Magnifier
- Resistor colour code chart and/or multimeter for identifying resistors