Bunny and Bear (BNBSX) MKS3 Geared Extruder Assembly

Assembly guide for BNBSX MKS3 geared, extruder for Prusa MK3S and MMU2S printers

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Bunny and Bear SX Extruder (BNBSX)

- Gear reduction via pulley for improved extruder consistency
- Easily swap between single filament MK3S sensor system or Internal sensor lever for MMU2S eliminates clumsy chimney and allows full opening. (Chimney use also supported)
- Motor inset into extruder to be maximally back towards x-axis
- Separately printable hot fins for higher temperature tolerance
- Moment arm reduction via Short body like MK3S Reduced Mass Mid-engined motor placement
INTRODUCTION

Bunny and Bear Short Ears (BNBSX) MK3S Geared Extruder is an advanced, geared extruder for upgrading the Prusa MK3S and MMU2S printers.

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STL files for this extruder are at https://www.thingiverse.com/thing:362699...

(Due to Thingiverse outage June 5, 2019, an archive of STL and 3MF files for version M9 is available at https://github.com/guykuo/Bunny-Science)

Materials needed and Amazon shopping list are in file attached to end of this guide.

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Benefits of this extruder.

Compared to the Prusa R4 extruder...

- Geared 1:3.5 drive for more consistent extrusion
- Isolates filament from extruder motor heat
- Corrected filament path/Bontech alignment
- Lower total mass by about 80 gm
- Reduces moment arm by moving motor closer to x-axis.
- Isolates filament from extruder motor heat.
- Swappable filament sensor systems (armature for single filament, internal lever for MMU2S)
- Internal lever eliminates bulky Prusa sensor chimney
- Internal lever allows full opening of idler door
- Single screw tuning of MMU2S filament sensing
- Single media MK3S sensor armature eliminates steel ball rattling
- Provisioned for LED filament sensor indicator mod
- Only one magnet needed for filament sensor
- Easy motor plate and hot end removal for service
- Hot End PTFE tube changeable without disturbing XYZ calibration
- Separately printable hot fins for heat resistance
- Hot fins tightly encircle hot end.
- Multiple hot end choices, E3DV6, Volcano, or Mosquito hot ends
- Air plenum remains optimum whether E3D or Mosquito installed

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Use the BNB Universal X-carriage for mounting this extruder. [https://www.thingiverse.com/thing:361059...](https://www.thingiverse.com/thing:361059...) BNB Universal X-carriage has cable management features to reduce risk of hot end cable damage during XYZ calibration.

Before doing XYZ calibration, verify that hot end cables will clear head bed clamp with print bed pulled max forward and x-carriage max left.

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Because extruder motor is pushed so far back, this must be mounted on Short Ears version of Bear x-axis to clear the motor x-end. Normal Bear x-axis mounts will impinge against motor. Short Ears x-ends are included in this project.

Once could also mount on Prusa x-axis using the BNB Universal X-carriage, but Prusa x-axis is much more difficult to tension properly.

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Once installed, you also must set and store e-steps for 1:3.5 gearing by sending commands to the printer.

M92 E980

M500

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Videos of BNBSX in operation

[https://youtu.be/z7LmkS7mqpA](https://youtu.be/z7LmkS7mqpA)

[https://youtu.be/9z_EihvkaD8](https://youtu.be/9z_EihvkaD8)

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Step 1 — Guide In Progress

Guide is still a work in progress. Complex or Bunny Science specific steps are completed, but some generic build steps have yet to be written or illustrated.

- Experienced builders can already proceed, but if you need instructions for generic tasks like attaching a cooling fan, PINDA or hot end, those are not yet in guide.

Step 2 — Print Extruder, X-Ends, X-Carriage in PETG

- Print BNBSX parts in PETG with 4 perimeters, 5 top shells, 5 bottom shells, 20% gyroid fill. Bunnies suggest 0.15 mm layer heights for best surface appearance.

- BNBSX Extruder Plated 3mf file has the extruder parts pre-plated including spares of fragile bits. (Files at https://www.thingiverse.com/thing:362699...)

- Print BNB Short Ears X-ends for this extruder. (STL's included in this extruder project)

- Print BNB Universal X-carriage for this extruder. (STL's at https://www.thingiverse.com/thing:361059...)

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Step 3 — Basics - Pre-Drill Bolt Holes

- Clear out each 3mm screw hole with a 3 mm drill bit to make bolt insertion easier.

- There are also a few 2 mm holes to drill.

⚠️ Don't drill out holes intended to be directly threaded like the noctua fan or IR sensor module mount holes.
Step 4 — Basics - Drawing Nuts Into Recesses

- Draw nuts into hex pockets rather than trying to push them into position.
- Be sure nut is rotationally aligned with hex recesss as you draw it in. Misalignment will damage the pocket.
- Washer at bolt head reduces damage to plastic. This is especially important on the motor plate gearbox. Do not over tighten. Just get the nut fully seated. Once nut is seated, remove bolt and washer.
Step 5 — Basics - Flatten Mating Surfaces

- Printed parts mate together more accurately and securely if their mating surfaces are actually flat. Less torque is needed to secure parts whose mating surfaces are in good contact.

- Flatten mating surfaces that were printed on textured print plates by wet lapping with wet/dry 600 sandpaper on flat glass plate.

⚠ Do not lap so much that you dimensionally change size or shape. Remove just the "high" points of the texture

- Remove retraction zits from top surfaces or irregular shapes with light strokes of a metal file. Just one or two strokes are all you need.

- Be mindful of raised features like index pins when flattening surfaces! Do not damage raised features
Step 6 — Bunny and Bear Short Ears X-Axis

- Bunny Science enhanced versions of the Bear x-ends are provided with BNBSX extruder. These "short ears" x-ends feature...
  - Low profile bearing mount clamps that don't obstruct the BNBSX extruder's rearward positioned motor.
  - Linear rod removal assist pusher bolt feature
  - Bear x-axis easy belt tension adjust system

Step 7 — Short Ears X-Ends Hardware

- 4 of M3 x 8mm cap end screws. (Socket head screws are too large profile)
- 10 of M3 hex nuts
- 2 of M3 Nylock nuts
- 5 of M3x18 screws
- 20 tooth GT2 Idler (or re-use stock Prusa smooth Idler)
- 3 mm x 15.5 mm shaft rod
Step 8 — Also See Bear Labs X-Axis Instructions

- Original Bear axis instructions by Grégoire Saunier are good adjunct to these instructions. Bunnies will focus on differences between Short Ears and the original Bear x-axis


- Short Ears assembly is very similar, but clamp screws are shorter, and Bunnies recommend putting x-axis on/off Z-rods WITHOUT trapezoid nuts installed.

Step 9 — Prepare X-ends

- Clear out linear rod mounting holes with 8 mm drill at low RPM.

- Draw in M3 nut for each x-end clamp WITHOUT LMU8 bearings in place. Leaving out the bearings lets the two sides of clamps support each other during process.

⚠️ With the bearings in place, clamp ends cannot abut each other during nut draw-in process. That will result in snapping the plastic clamp if excess torque used.

⚠️ Do not overtighten clamps with bearings inserted. The gap should NOT close with bearings inserted. Attempting to close gaps will break clamp.
Step 10 — Rod Ejector M3 Nuts

- Motor X-end has hex pockets at end of each linear shaft tunnel. Draw one M3 nut into each pocket.

- These nuts can engage a long M3 screw for pushing rods out later.

- Idler X-end does not have M3 nut pockets. Length adjustment M3 screws directly thread into Idler X-end plastic.

Step 11 — Linear Rod Insertion and Removal Tip

- Insertion and removal of linear rods is dramatically assisted by chucking rod in variable speed drill. Spinning rod in and out with a drill is much easier than pushing or pulling rods into position.
Step 12 — Clamp Screw vs Z-axis Screw

⚠️ M3 screws longer than 8mm here will damage Z-axis screw rod. Bunnies recommend verifying clearance.

- Continue checking that clamp screws do not impinge z-screws during tightening.

ℹ️ Outdated photo shows hex socket screw. Current recommendation is round cap head screw. Hex socket screws sometimes needed heads filed to be flush with x-end.

Step 13 — Top Motor X-end Clamp Screw

- If using hex head M3 screws, you may need to file the top clamp screw head to clear motor..

ℹ️ Cap head screws are lower profile and less likely to be motor clearance issue.
Step 14 — Extruder Body - Post Print Prep

- Extruder Body is printed with an intrinsic support. Remove intrinsic support with knife and pliers.
- Lap rear surface of Extruder Body to flatten its x-carriage mating surface.
- Use metal file to knock off plastic zits on front mating surfaces. Be mindful of the three index pins.

Step 15 — Extruder Body - Front Nuts

- Install three M3 nuts. These will attach extruder to x-carriage.
- Lower M3 nut is easy to install.
- Upper two M3 nuts are more challenging. Begin with M3 x 12 mm screw and washer. Partially seat nut with longer 12 mm screw. Switch to shorter M3 x 8 mm screw to fully seat nut.
- M3 Nylock goes here for version B03.
Step 16 — Extruder Body - Rear Nuts

- Insert hot end cover mounting M3 nuts
- Top cover M3S nut
- PINDA mount used M2S here in older versions, but made PINDA clamp prone to loosening after several hundred hours printing.

You may need to clear out square nut pockets with a x-acto knife before square nuts easily pass.

Step 17 — Extruder Body - E3D Plenum Plate and Hot Fin

- E3D Plenum Plate is held in position by a tab on each of its ends
- Hot fin can be printed in higher temperature material like ABS or Polycarbonate to better resist heat. Another strategy is to have spare hot fins pre-printed, but higher temp material is recommended option.
- Two M2 x 12 mm screws attach hot fins to extruder body
- Just seat and slightly snug the M2 screws. They are threading directly into plastic.

- E3D Plenum Plate is omitted and special hot fin used if Mosquito hot end is installed.
Step 18 — Filament Sensor - Two Options

- For stand-alone, single filament use, armature with bearing detects filament ABOVE Bondtech drive gears.

- For MMU2S, internal lever senses filament separating Bondtech gears. MMU2S uses this to know when filament has reached drive gears.

ℹ️ You can swap filament sensing system WITHOUT a full extruder tear down. Simply remove motor plate and IR sensor board. Then, swap armature and internal sensing lever and move magnet. For now, build the option that matches your needs.
Step 19 — Single Filament Armature

⚠️ Post print process armature only with a knife. Do not use hot air or you risk damaging its interruptor fin.

- Press pivot MR63ZZ 3x6x2.5 mm miniature bearing into BOTTOM of armature.

⚠️ Top of armature’s bearing mount is smaller diameter. Do not press bearing in from top. Be careful not to break the interruptor fin.

- Attach filament sensing MR63ZZ bearing to armature with M3 x 6 mm screw. Bearing should be secure but keep screw loose enough for free bearing rotation.

ℹ️ Armature must be printed in opaque color, preferably black.
Step 20 — Single Filament Armature Install

- Insert armature into sensor pocket of extruder body
- Secure through pivot bearing with M3 x 8 mm screw. Be gentle. This screw threads directly into plastic.

⚠ The M3 screw will never prevent armature from being able to tilt vertically. Do not over tighten attempting to lock down armature. Just get screw full seated.

⚠ The armature must move freely. It is normal for it to be capable of wobbling up & down in its pocket.
Step 21 — Single Filament Armature Magnet

- Insert small, 5 x 10 x 2 mm magnet, from Prusa MK3S sensor system, into pocket right of armature.

- Bunny Science needs only a single magnet. Magnet pulls bearing into filament path. Filament pushes bearing out of path and swings armature. Interruptor fin triggers MK3S IR filament module (to be installed later).

  Magnet strongly attracts bearing making armature less prone to rattling during accelerations.

  When using the single filament armature, you will also place one MR63ZZ Miniature Steel Bearing as a spacer on the idler door hinge screw.
Step 22 — Internal Lever Sensor (MMU2S Only)

- Internal sensor lever is sensor configuration for MMU2S printers. This replaces bulky external chimney with internal lever.

- You may alternatively use the cumbersome Prusa chimney, but Bunny Science internal sensor lever is sleek and allows full opening of idler door.

- 2 x 5 x 10mm magnet from Prusa MK3S sensor system

- MR63ZZ Miniature Steel Bearing 3x6x2.5 mm

- Internal sensor lever for MMU2S

- M2 x 12 mm BLACK STEEL ALLOY screw cap hex screw. This screw MUST be strongly attracted to magnet. Stainless steel will not work. Also, use cap head here for needed compactness.

- Optical interruptor bar should be printed in opaque color, preferably black.
Step 23 — Clean Optical Interruptor Fin (MMU2S Only)

- Use sharp blade and/or emory board to clean stringing from optical fin. Try not to alter fin dimensions during cleaning.

- Small leg of the fin does the actual optical interruption. It drops down into light path when filament slightly opens idler door.

ℹ️ Several copies of this piece are plated in extruder 3mf. It is a good idea to have extras, especially your first time assembling the extruder.
Step 24 — Optical Interruptor Bar Bore (MMU2S Only)

- Use 2 mm drill to clear screw bore of optical interruptor bar. M2 Screw must readily slip through the bore.

⚠️ Just as with armature, do not use hot air for post print processing of this piece. The thin optical fin may get damaged.

- A real hex 1.3 mm driver is essential. Attempting insertion of the M2 hex cap screw with an Allen key is guaranteed failure. Use the H1.3 from a micro-screwdriver kit.
Step 25 — Sensor Lever for MMU2S (MMU2S Only)

- Press bearing into bottom of sensor lever.
- M2 black alloy screw will be used to mount optical interruptor bar on lever at 90 degrees. Pre-threading the mounting hole makes things easier later.
- Thread M2 screw into sensor lever. Keep screw perpendicular as you thread it in. Once hole is completely threaded remove the M2 screw.
**Step 26 — Sensor Lever Insertion (MMU2S Only)**

- Slide sensor lever into extruder body.

- **M2 screw should have already been used to pre-thread and removed.**

- Temporarily secure lever with M3 screw and nut.
Step 27 — Attach optical interruptor rod (MMU2S Only)

- Attach optical interruptor rod to sensor lever. Its end has a shallow wedge shape to help with alignment. Rear of extruder body has opening through which a finger can support the lever.

- Fin of interruptor rod should point up. Its small leg is uppermost.

- Insert 2 x 5 x 10 magnet into magnet pocket below optical interruptor bar. If you previously had magnet positioned for armature, move the magnet to this pocket.

- Magnet pulls M2 screw downward and makes optical fin block IR sensor. When Bowden drives no longer have filament between them, idler door closes further and swings lever upward. How far it lever moves is fine tuned via a screw on idler door.

- Here is the internal filament lever sensing filament at Bondtech [https://www.youtube.com/watch?v=YfuO-00C...](https://www.youtube.com/watch?v=YfuO-00C...)
Step 28 — Filament Path Insert

- When the internal sensor lever is in use, no armature bearing prevents filament exiting the opening formerly occupied by the armature bearing. Installing a filament path insert closes that hole.

- This part actually goes into the motor plate, but we cover it here as part of the internal lever MMU2S installation.

- Position the filament path insert into motor plate. It is easier to handle with tweezers.

- Secure filament path insert with M2 x 6 mm screw.

- Sight down filament path and adjust insert position so filament path is enclosed but not constricted.

- Filament path insert MUST be removed for single filament armature sensing option.
Step 29 — IR Filament Sensor Module

- Now that the lever or armature pieces are in place, it is time to test fit the IR sensor module.

- Gently position Prusa IR Filament Sensor module and secure with M2 x 6 mm screw.

⚠️ Do NOT use M2 screw that Prusa supplies. It is too long.

- Verify that optical interruptor fin moves in/out of IR sensor optical path.

- This IR sensor module has an LED indicator modification soldered onto it. Bunnies enjoy easier system testing with LED lighting up when filament is sensed.
  
  https://forum.prusaprinters.org/forum/or...

- 1K ohm total of series resistance.

- LED in series with resistors. LED and resistor attach to V+ and Output of filament module. This requires some skill with surface mount soldering, but is a very useful modification.

- After verifying fit, it is a good idea to remove the IR sensor module and set safely aside extruder assembly is complete. It is possible to leave it installed through the process, but it is safer to temporarily remove it.
Step 30 — LED Indicator Details (Optional Mod)

- Addition of LED indicator to IR filament sensor board simplifies calibration and troubleshoot. Circuit is LED and 1K ohm from +5 to Out.

- 512 ohm resistor. One end soldered to +5

- 512 ohm resistor. One end soldered to Out

- Solder LED across far ends of resistors. This complete electrical connection and physically holds LED in place.

⚠️ If LED polarity backwards, will not light up. Anode to +5. Cathode to Out.

- Bench test by connecting +5 and Gnd to power regulated 5 volt DC supply. Have power supply POLARITY CORRECT or you will destroy sensor. Interrupting optical path will light up LED.

- Chanzon (5 Colors x 20 pcs = 100 pcs) 1206 SMD LED Diode Lights Assorted Kit
  https://www.amazon.com/gp/product/B01CUG...

- McIgIcM 1206 SMD Resistor Kit, 1206 SMD chip Fixed Resistor Kit
  https://www.amazon.com/McIgIcM-Resistor-...
Step 31 — Motor Plate Gearbox - Remove Support Material

- Geometry of BNBSX motor plate gearbox requires printing with supports. Bunnies enjoy the 15 minutes of removal. It is like unwrapping a present!

- Bearing holes are usual stubborn spots. Punch into the center of each gear shaft hole using a length of 5 mm shaft. A light tap of screwdriver handle against end of shaft punches support material free.

- Support material inside and around bearing holes must be fully cleaned out. The front bearing hole is usually the hardest to clean. Pass a small, flat screwdriver in from opposite bearing hole to scrape things out.

- There are small bits of support material deposited around filament path and in surrounding cavities. Be certain to clean all those out.
Step 32 — Motor Plate Gearbox - Flatten Mating Surfaces

- Remove retraction zits and other irregularities from flat mating surfaces.
- Two strokes with a metal file is usually enough.

Step 33 — Prepare Gear Shaft

- Prepare 5 mm diameter shaft rod, Length 55 mm, Pulley Flat 0 to 9 mm, Bondtech Flat 42 mm to end. See
Shaft_Cutting_Guide_Bunny_and_Bear_Short_Ears_55-9-42_mm is the cutting guide for this BNBSX "Short Ears" MK3S extruder

Most 5 mm shaft rods are slightly too large in diameter to fit through 5 mm bearings. Chuck shaft blank in drill and sand down shaft diameter. Entire length of shaft must easily pass through 1050ZZ bearing.

Ideal BNBSX gear shaft is slightly shorter at 53.5 mm, but cut at 55 mm and adjust after test fitting. BNBSX differs in that it needs clearance beyond rear of shaft for internal sensor lever.

BONDTECH shaft flat is most difficult to get correct. Grind only 0.35 mm deep. Too deep and screw will not reach. Too shallow and screw head hits other Bondtech.
Step 34 — Motor Plate Gearbox - Gear Shaft Bearings

- Draw two 1050ZZ Miniature Steel Bearings 5x10x4 mm into front and back bearing mounting holes.

- Use M5 bolt, two washer, and a nut to draw in bearings. Resistance to bearing insertion should be moderate. If you find yourself torquing bolt hard, something is awry. Remove the bearing and recheck for stray filament bits.

⚠ Temptation is to press bearings in too far. They won't be flush with plastic surface. Just get them seated. Stop pressing as soon as you feel bearing bottom. Going too tight will cause misalignment and friction problems.

ℹ If bearing is stuck in hole and you need to remove it, tap it out using M5 Hex driver as punch.

- Front bearing is easy, but rear bearing requires drawing against uneven surface. Use a flat object to support your large washer.

- Pass a 5 mm shaft through both installed bearings. Shaft should spin easily. If not, back out the bearings very slight using a 5 mm hex driver as a punch. Adjust alignment and depth of bearings until you achieve free motion.

ℹ Bearings when aligned are low friction. You should be able to hold the shaft horizontally. Tap the motor plate and watch motor plate swing back and forth for about ten seconds.

- The bearings will not fall out. Shaft locks installed later will stabilize their depth in mounting holes.
Step 35 — Motor Plate Gearbox - Embed Nuts

- Three regular M3 nuts and one M3 Nylock must be installed.

- On the Motor Plate Gearbox, it is absolutely necessary to use washers with your drawing bolt. Otherwise, head of bolt will damage index depressions around the bolt holes. That makes mating motor plate with extruder body difficult.

- M3 Nylock for idler door bolt. We use Nylock here because idler door bolt is not secured under tension. It needs Nylock to help keep it in place.

- Regular M3 Nut

- Regular M3 Nuts, but be mindful of excessive bolt length during drawing in process.
Step 36 — Hot End Cover

- Hot End Cover
- E3D Plenum Plate
- M3S square nut for fan mount
- Hot End Hot Fin
- M3 nuts for fan and fan shroud mounts
- Two M2 x 12 mm screws

Step 37 — Hot End Cover

- Hot fin holds E3D plenum plate via tabs and grooves. Do not over-tighten M2 screws. They are threading into only plastic.
Step 38 — Hot End Cover - Upper Fan Nut

- Insert M3S into slot.
- Advance M3S to upper hole for regular fan position.
- Push further into pocket to lower bolt hole for Volcano.
Step 39 — Hot End Cover - Lower fan and nozzle nuts

- M3 nuts pressed into inside of hot fin
- Bottom left nut will anchor fan shroud. Bottom right nut is for parts cooling fan mounting.
- You may now test fit complete hot end cover against extruder

⚠️ When attaching motor plate and using filament detection armature, ALWAYS have a piece filament inserted to move armature out of way. Otherwise motor plate could crush the armature.
Step 40 — Bunny Science 56 Tooth 2GT Pulley

- Embed M3S square nut and M3 x 4 mm set screw into pulley. Leave set screw out far enough to permit easy gear shaft passage.

⚠️ This is another piece that you must be very careful about using hot air to clean. Pulley edges are quite prone to deformation with a hot air gun.

Step 41 — Bunny Science Compact Shaft Lock

- Embed M3 square nut and M3 x 3 mm set screw into each of two compact shaft locks

⚠️ If you use longer, 4 mm long set screws, verify that they clear surround plastics during shaft rotation.
Step 42 — Motor Plate Gearbox Parts 1

- Assemble motor plate gearbox from parts previously prepared.
- BNBSX Motor Plate Gearbox with bearings and hardware already installed
- Bunny Science 56 tooth 2GT pulley
- Bunny Science Spacer
- BS compact shaft lock x 2

Step 43 — Motor Plate Gearbox Parts 2

- GT2 140-2GT-6 continuous loop timing belt
- 16 tooth GT2 drive pulley
- Bondtech drive gear (with set screw)
- STEPPERONLINE Nema 17 Bipolar Stepper Motor 0.7A 13Ncm (18.4oz.in) 17HS10-0704S

If you don’t already have a set of MIP drivers in your toolbox, bunnies highly recommend them. They engage hex sockets tighter and more securely than anything else they have used. Great for reducing head stripping risk.
Step 44 — Gear Shaft and Shaft Locks

- Verify that shaft lock set screws are backed out so shaft care freely pass through them.
- Pass Bondtech end of shaft through front bearing.
- Put two compact shaft locks on shaft. Tapered ends of locks should be directed towards bearing, Leave set screws LOOSE.
- Pass shaft through 2nd bearing and another 2 cm further.
Step 45 — Bondtech Drive Gear

- Put Bondtech drive on shaft. Align its set screw with flat and position so shaft extends about 0.25 mm beyond Bondtech.
- Tighten Bondtech set screw
- Slide shaft in/out to align Bondtech filament teeth groove centered with plane of filament path.
- Secure shaft in this position with shaft locks. Each lock lightly touches its respective bearing locking shaft in place.

Step 46 — Motor and Spacer

- Insert motor into motor plate gearbox. Motor plate is notched and recessed for easy motor insertion. Do not secure the motor yet.

  - Mind the direction of motor connector. It must be pointed leftward or up (viewed from front)

- Loosely secure motor with three M3 x 6 mm screws and washers. Leave the screws LOOSE.

- Add spacer to shaft. Flat side of spacer should be oriented up (away from gearbox).
Step 47 — Pulley, Belt, and Drive Gear

- Check that pulley and drive gear set screws are loose.

- New line. Hold pulley, belt and drive gear together and slide all three into position simultaneously.

Step 48 — Secure Pulley on Shaft

- Slide large pulley down shaft until it almost contacts spacer.

- Align drive shaft with pulley set screw. You can do so by turning the shaft.

- Tighten large pulley set screw. With motor and belt LOOSE, you can reach in above or below belt.

- Align drive gear with belt and secure its set screws on motor shaft. Take care to engage motor shaft flat.
Step 49 — Tighten Motor

- Rotate motor on its pivot bolt to take up belt slack. You don't need to make belt super taught like the X and Y belts. It simply should not be loose.

- Secure motor in position with its bolts

- Motor Plate Gearbox assembly is now complete.

Step 50 — Idler Door

- Bondtech drive door has pocket for M2S square nut. Clear out the overhands completely.

- Bondtech shaft must be inserted in direction illustrated. It will not fit from other side. Fully seat the shaft.

- M3 x 12 mm screw directly threads into plastic of idler door. This will be used to adjust internal filament sensor system. For now, advance its tip to just flush with inside surface of idler door.

- Filament sensor adjust screw is only used with MMU2S, but it is reasonable to install one now in case of later change to MMU2S
Step 51 — Idler Door Sensor Screw (MMU2S Only)

- When filament sensor adjust screw is correctly set, it minimally extends beyond idler door. This picture show how little it will extend after calibration. For now, leave its tip flush with idler door inside surface.
Step 52 — Critical Length Screws (Overview)

- Some M3 screws in BNBSX Extruder are critical, custom length. These must be ground to make their ends flush with associated nut. Otherwise, screw tips impinge on other objects.

- Hot End Cover mounting screws must not protrude beyond rear of extruder body. B02M8 and newer use standard M3 x 30 mm. Older required custom 27 mm long.

- Lower center extruder body mounting screw can protrude into plenum. This is especially problematic if wider, Mosquito hot end is installed.

- Motor plate mounting screws protruding into motor bay impinge on motor body.

ℹ️ Bunnies recommend pre-fit testing of all critical length screws. Simply cutting to spec length may not be as perfect.
Step 53 — Critical Length M3 Screws - Hot End Cover

- Hot end cover M3 x 30 mm mounting screws are now standard metric length 30 mm.

⚠️ Custom length M3 x 27 mm (if hot end cover older than rev B02M8)

 verifica que los extremos de los tornillos no sobresalgan del lado posterior de la extrusora. Refine las longitudes de los tornillos si es necesario.

- After verifying proper fit, remove hot end cover. We will re-attach it when installing hot end.

Step 54 — Critical M3 Screw Lengths, Extruder Body

- Attach extruder body to BNB Universal X-carriage with three M3 custom length screws. Leave these slightly loose for now.

  - M3 x 27 mm (location from front, upper left motor bay)
  - M3 x 16 mm (location from front front, lower left motor bay)
  - M3 x 7 mm (location from front, lower, middle plenum)

⚠️ Verify that bolts do not extend beyond their associated nuts when tightened.
Step 55 — Other Extruder / Carriage screws

- Insert two M3 x 12 extruder body mounting screws, but leave them slightly loose.

⚠ Best alignment of extruder body x-carriage is achieved if final tightening of bolts is done after all bolts are inserted.

- M3 x 30 mm motor plate mounting screw. Optionally, grind this to 27 mm for easier motor plate removal.

- M3 x 40 mm idler door hinge screw. Just insert this one, but don't engage its Nylock yet. We are inserting now only to help with alignment.

⚠ Tighten screws to two finger firmness after all are inserted.
Step 56 — Hot End Lead Dress

- Place extruder near table edge or on box to let extruder leads freely hang down. Position hot end into groove mount.
- Align hot end rotation to make heat block square with extruder
- Clamp hot end in place with two M3 x 30 mm screws. (If older than revision M8 parts, use custom length M3 x 27 mm)

⚠️ Extruder is at risk of falling with extruder wires hanging off table edge.

Step 57 — Install Motor Plate Gearbox

- Motor plate gearbox slight straight back onto extruder body. Registration pins create a light snap together fit.

⚠️ NEVER remove or insert motor plate with idler door tensioned. Completely loose tensioner screw beforehand.

⚠️ Optical armature can be crushed by motor plate. Use a filament in filament path to keep armature out of way during motor plate installation.
Step 58 — Motor Cable

- Insert wisdom here.

Step 59 — Noctua Fan

- to be written
Step 60 — Idler Door Install

- If single filament armature sensor, place 1050ZZ bearing on hinge bolt as spacer in place of internal sensor lever.

- If MMU2S internal lever, hinge bolt goes through lever bearing then idler door

- Secure tip of hinge bolt in Nylock, but don't tightly tension the bolt. It must not deform the plastics.

⚠️ No white nylon washers are used in Bunny Science design. Parts have inherent tapers to replace washers in Prusa design.
Step 61 — Idler Door Tensioner Screw and Spring

- Insert idler door tension adjust screw and spring. Only one screw and spring are used in BNBSX.

ℹ️ Correct tension is typically with top of screw head completely flush with extruder body.
Step 62 — Print Fan and Shroud

- Use two M3 x 18 mm screws attach parts cooling cooling fan. You can add a M3 washer to lower right screw, but not to top screw.

⚠️ Fan's top mounting tab may impinge belt path due to unavoidable tight spacing. Bunnies could not alter this spacing without breaking important spatial relationships.

- Shave top of fan with Xacto knife. Reduce its top by down about 0.5 mm. Only front 5 mm needs modification. Fan plastic shaves readily and controllably. Remove only enough to clear belt.
Step 63 — PINDA Probe

- Place a piece of paper on print bed.
- Manually lower x-carriage until nozzle tip just touches paper. (Nozzle must be clean and power off)
- Completely loosen PINDA probe
- Let PINDA probe rest upon 0.8 mm thick PINDA height gauge. [https://www.thingiverse.com/thing:355564](https://www.thingiverse.com/thing:355564). If you lack a gauge, a zip tie is usable, but sometimes a bit too thick
- Clamp PINDA in position.
Step 64 — Top Cover

- Top covers supplied for stand alone, MMU2S, PC4-M6, PC4-M10, and Pallete 2
- 10 mm, top cover PTFE tube for standalone cover should be internally chamfered on both ends.
- MMU2S and Palette 2 owners, pass PTFE tubing all the way through top cover and another 5 mm past bottom of cover INTO extruder body.
  
⚠️ 10 mm PTFE segment is not used with covers having full pass-through. PC4-M10, MMU2S and Pallete2 covers have full PTFE pass through.

- Frosted tape inside top cover LED observation window is an excellent diffuser.
**Step 65 — Mount Extruder on X-Axis**

- Feed print fan cable into right guide slot
- Form loop in PINDA cable and feed into right guide slot.
- Hot end cooling fan and extruder motor cable were previously routed to left guide slot
- PINDA, print fan, hot end fan, and extrude motor cable pass between x-rods
- Hot end heater and thermistor cables pass below bottom x-rod

**Step 66 — Secure Extruder with X-Carriage Top Cover**

- Orient both top LMU8 bearings with a bearing rows up.
- Place x-carriage (with attached extruder) onto top bearings.
- Clamp top bearings in place with top cover
Step 67 — X-Carriage Cable Dress

- Insert wisdom here.

Step 68 — X-Belt Installation

- Add 4 tooth long segment of GT2 belt in unused path to reinforce thin, toothed plastic segments.
- Top belt path for Bear axis
- Bottom belt path for Prusa axis
- With tensioner bolts engaged but only screwed in 1-2 turns, insert x-belt NEARLY taught, but remaining loose. There is plenty of adjustment range. No need to stretch belt while putting into clamp.
Step 69 — Wire Bundle Dress

Step 70 — Internal Lever Filament Sensor Calibration (MMU2S only)

- In this step, we adjust the filament sensor to reliably detect presence of filament between Bondtech gears. Idler door must be tensioned during adjustments.

  If motor does not permit manual turning of pulley for inserting/removing filament, loosen and retighten idler door tension screw to manipulate filament.

- Insert filament into printer and advance it through Bondtech drive gears. The idler door will swing slightly outward when filament is between drive gears.

- Display filament sensor state on LCD during this process. Better yet, watch LED indicator. If you have installed LED indicator mod on IR sensor board,
Turn M3 sensor adjust screw on idler door CLOCKWISE (in) until sensor indicates no filament (LED goes off). Just two or three revolutions should be max.

- Turn M3 sensor adjust screw COUNTER-clockwise (out) until sensor starts indicating filament is present. Continue another 1/2 to 3/4 counter-clockwise for reliable detection.

- Test setting by removing and reinserting filament between Bondtech gears.

**Step 71 — Installation Completed**

- Ready for XYZ Calibration and Live-Z adjustment