

Replica Enigma Machine Rotor



Craig Heath

[VIEW IN BROWSER](#)

updated 7. 6. 2023 | published 7. 6. 2023

Summary

An accurate replica of a World War 2 cipher machine rotor.



9.54 hrs



3 pcs



0.15 mm



0.40 mm



PLA



95 g



Prusa
MK3/S/S+

[Learning](#) > [Engineering](#)

Tags: [cryptography](#) [education](#) [history](#)

WARNING: This is a CHALLENGING project. You will need a well-calibrated 3D printer, and the patience to handle a lot of very fiddly small screws.

This replica model is based on accurate blueprints and measurements from an actual World War 2 **Enigma machine** rotor. There are some changes to the internal structure to make it easier to print and assemble, and the clip which locates the movable number ring has been made thicker for strength and durability in plastic rather than the original steel.

Printed Parts

Black PLA (original Bakelite)

- Pin Cover
- Pin Housing (inner)
- Pin Housing (outer)
- Plate Housing (front)

Silver PLA (original Zamak alloy and steel)

- Clip Handle
- Clip Pin
- Notch Plate
- Number Ring (I, II, III, IV or V)
- Thicker Clip
- Thicker Retainer
- Thumb Wheel

Gold PLA (original Brass)

- Bushing
- Casing (I, II, III, IV or V)
- Plastic Pins
- Plates (back)

Screws

- 6 M3.5 x 6 (brass, cheese head, slotted)
- 4 M3 x 5 (steel, cheese head, slotted)
- 12 M2 x 5 (steel, cheese head, slotted)

Assembly

You will need glue to assemble the clip - I use super glue (cyanoacrylate) with PLA. I also recommend precision slotted screwdrivers and needle-nose pliers to handle the screws.

1. Clip

Take the Thicker Clip, Clip Handle and Clip Pin parts. Glue the clip handle and clip pin into the clip in the orientation shown (photo 1b) with a small amount of glue - I apply it with a cocktail stick. Make sure that the cut out on the clip handle faces outwards. Don't get glue on the protruding part of

the pin, it will interfere with it working - I partially insert the pin and then apply glue in the gap before pushing it fully in.

2. Plate Side

Take the Plate Housing (front), Pin Housing (inner), Plates (back) and Bushing parts. Insert the bushing into the pin housing and the plates into the plate housing (photo 2b). Line up the 3 holes in the middle of the two assemblies and join them together using 3 of the M3.5x6 screws (photo 2c). The screws will be making their own thread in the plastic so you may need to press quite hard to get them started. Tighten the screws gradually in turn so that the pieces end up flush together (photo 2d).

3. Pin Side

Take the Pin Housing (outer), Pin Cover and Plastic Pins parts. Insert the plastic pins into the pin cover (photo 3b), then insert both into the pin housing, lining up the notch (photo 3c). Line up all 3 screw holes with the parts from step 2 and attach them with the remaining 3 M3.5x6 screws (photo 3d).

4. Thumb Wheel

Take the Thumb Wheel part and slide it onto the parts from step 3 with the screw holes on the pin side. Rotate the thumb wheel so that all 4 screw holes line up. Attach it with 4 of the M2x5 screws (photo 4b).

5. Movable Ring

Take the Number Ring and Notch Plate parts. With the recesses in the notch plate upwards, line up the notch in the notch plate with the cut out in the number ring. Attach it with 4 of the M2x5 screws (photo 5b).

6. Casing

Place the Casing part inside the movable ring from step 5, with the lip upwards and the screws upwards on the movable ring. Slide both parts over the assembly from step 4, thumb wheel downwards, lining up the protrusion on the casing with the notch in the pin housing (photo 6b). Attach the casing with the 4 M3x5 screws using the larger screw holes. It is difficult to get these screws into place in the recessed holes - I use needle nose pliers holding the screw by the head (photo 6c) and then pressing it in from the side (photo 6d). Tighten the screws enough so that they are flush to the casing, but don't overtighten them (photo 6e).

7. Retainer and Clip

Take the Thicker Retainer part and the clip from step 1. With the rotor oriented so that the 2 closer-together brass screws are at the bottom (photo 7b), the retainer goes on the left hand side and the clip goes on the right hand side with its pin end at the top. Attach them to the casing with the remaining 4 M2x5 screws using the pairs of smaller screw holes - needle nose pliers will help, as in step 6. Ensure that the upright part of the retainer is facing the movable ring (photo 7c). Only tighten the screws enough so that the retainer and clip are flush with the casing - it is easy to overtighten these small screws.

Congratulations, your rotor is complete! (photo 8)

Ring Settings

Part of the settings of the Enigma machine was the “ring setting” of each rotor. You can change the ring setting in this replica rotor in the same way as the real thing: Use your thumbnail in the slot in the clip (Clip Handle part) to pull the pin out of the number ring; you can then rotate the number ring so that, when you release the clip, the pin will go in next to a different number.

Five Rotor Set

German army Enigma machines came with a set of five rotors, three of which would be put into the machine at any one time. Each of these five rotors had a different internal wiring, which was an essential part of the strength of the cipher. The replica rotor doesn't have internal wiring, but there are also two external differences in the rotors: The casing has a dot pattern (like dice faces) to visually distinguish the five variations, and the notch in the number ring was next to a different number:

Rotor	Notch Position
I	25
II	13
III	4
IV	18
V	8





The .3MF files given here use the Casing and Number Ring parts for rotor I. You can replace those with the parts for other rotors in PrusaSlicer using the “Replace with STL” function and selecting the appropriate .STEP files provided.

Update 7th June 2023:

- Added clearance for bushing in Pin Housing (inner)
- Deeper chamfers in Number Ring screw holes

Model files

 PrusaSlicer 3MF files		3 files
	bakelite-parts.3mf	
	zamak-parts.3mf	
	brass-parts.3mf	

 STEP files		23 files
	bushing.step	
	casing-i.step	
	casing-ii.step	



casing-iii.step



casing-iv.step



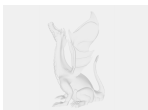
casing-v.step



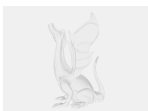
clip-handle.step



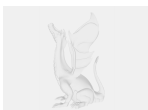
clip-pin.step



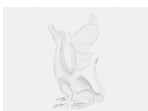
notch-plate.step



number-ring-i.step



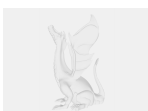
number-ring-ii.step



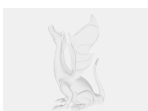
number-ring-iii.step



number-ring-iv.step



number-ring-v.step



pin-cover.step



pin-housing-inner.step



pin-housing-outer.step



plastic-pins.step

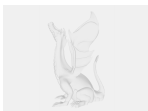


plate-housing-front.step



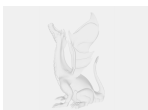
plates-back.step



thicker-clip.step



thicker-retainer.step



thumb-wheel.step



STL files

23 files



bushing.stl



casing-i.stl



casing-ii.stl



casing-iii.stl



casing-iv.stl



casing-v.stl



clip-handle.stl



clip-pin.stl



notch-plate.stl



number-ring-i.stl



number-ring-ii.stl



number-ring-iii.stl



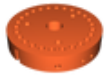
number-ring-iv.stl



number-ring-v.stl



pin-cover.stl



pin-housing-inner.stl



pin-housing-outer.stl



plastic-pins.stl



plate-housing-front.stl



plates-back.stl



thicker-clip.stl



thicker-retainer.stl



thumb-wheel.stl

Print files



bakelite-parts_015mm_pla_mk3s_4h19m.gcode

🌀 PLA 📏 0.40 mm 📏 0.15 mm ⌚ 4.32 hrs ⚖️ 44 g 📄 Prusa MK3/S/S+



zamak-parts_015mm_pla_mk3s_3h27m.gcode

🌀 PLA 📏 0.40 mm 📏 0.15 mm ⌚ 3.44 hrs ⚖️ 34 g 📄 Prusa MK3/S/S+



brass-parts_015mm_pla_mk3s_1h47m.gcode

🌀 PLA 📏 0.40 mm 📏 0.15 mm ⌚ 1.78 hrs ⚖️ 16 g 📄 Prusa MK3/S/S+

License ©

This work is licensed under a
[Creative Commons \(4.0 International License\)](#)



Attribution-ShareAlike

- ✗ | Sharing without ATTRIBUTION
- ✓ | Remix Culture allowed
- ✓ | Commercial Use
- ✓ | Free Cultural Works
- ✓ | Meets Open Definition