



# 3D PRINTING: REVOLUTIONIZING AMATEUR RADIO

HOW ADDITIVE MANUFACTURING EMPOWERS HAMS

**PRESENTER: KR3L**

# INTRODUCTION

- What is 3D Printing?
  - A technology that builds objects layer-by-layer from digital designs, using materials like plastic, resin, or metal.
- Why Combine Them?
  - 3D printing offers affordable, custom solutions for radio projects, enhancing creativity and functionality.

# INTRODUCTION TO 3D PRINTING AND THE PROCESS

- 3D printing, also known as additive manufacturing, builds objects layer by layer based on a digital 3D model.
- The process typically involves three main stages:
  - Designing the 3D model
  - Exporting it in a compatible format like Stereolithography (STL)
  - Slicing it into layers to generate G-code for the printer.
- This presentation will walk through each stage, to help understand the tools and techniques involved.

# BENEFITS OF 3D PRINTING FOR AMATEUR RADIO

- **Customization** - Tailor parts to specific rigs, antennas, or setups—no need for off-the-shelf compromises.
- **Cost Savings** - Print enclosures, mounts, or tools instead of buying expensive proprietary items.
- **Rapid Prototyping** - Test new designs (e.g., antenna insulators) quickly and iterate without waiting for shipping.
- **Accessibility** - Replace rare or discontinued parts, keeping vintage radios alive.
- **Lightweight Solutions** - Use plastic to reduce weight for portable setups (e.g., QRP operations).
- **Community Sharing** - Download or share 3D models via platforms like Thingiverse or GitHub, fostering collaboration.

# HARDWARE REQUIRED

- **3D Printer:** Entry-level options work fine for most projects.
  - Examples: Creality Ender 3 (\$200), Anycubic Kobra (\$250).
- **Features to look for:** Build volume (at least 200x200x200mm), heated bed.
- **Computer:** For designing or downloading models.
- **Software:** Free options like Tinkercad, Fusion 360, or Cura (slicer).
- **Optional Tools:** Calipers (~\$15): For precise measurements.
- **Sandpaper/files:** For post-processing prints.
- **Soldering iron:** For integrating electronics into prints.



# MATERIALS REQUIRED

- **Filaments - Thermoplastic Material**
  - **Polylactic acid (PLA):** Easy to print, good for non-stressed parts (e.g., enclosures) and costs ~\$20/kg.
  - **Polyethylene terephthalate glycol (PETG):** Stronger, weather-resistant, ideal for outdoor use (e.g., antenna mounts) and costs ~\$25/kg
  - **Acrylonitrile butadiene styrene (ABS):** Durable, heat-resistant, but requires ventilation (e.g., radio stands) and costs ~\$20/kg.
- **Extras:**
  - Adhesive (e.g., painter's tape or glue stick) for better bed adhesion.
  - Small screws/nuts: For assembling printed parts with hardware.

# ALTERNATIVES IF YOU DON'T OWN A 3D PRINTER

- Local Libraries/Makerspaces: Many offer free or low-cost 3D printing services.
  - Bring your design file (STL format) on a USB drive.
- Online Printing Services: Upload designs to sites like Shapeways or Printables.com.
  - Cost: ~\$10-\$30 depending on size/material.
- Ham Radio Club Members: Some members have printers and are willing to help.

# GETTING STARTED WITH 3D PRINTING

- **Step 1: Choose Your Printer:**
  - Start simple - Ender 3 is a ham favorite for its price and community support.
- **Step 2: Learn the Basics:**
  - Watch beginner tutorials (e.g., YouTube channels like Teaching Tech or CHEP).
  - Print a test object (like “3D Benchy”) to calibrate your printer.
- **Step 3: Find or Design Models:**
  - Download from Thingiverse or Printables (search “ham radio”).
  - Design your own with free tools like Tinkercad or Fusion 360 (steep but rewarding learning curve).
- **Step 4: Print and Iterate:**
  - Adjust settings (e.g., 0.2mm layer height, 20% infill) for strength vs. speed.
  - Test, tweak, reprint—experimentation is the ham way!



# USEFUL 3D PRINTING PROJECT IDEAS

- **Antenna Mounts:**
  - Custom tripod bases or car window clips for portable dipoles.
  - Example: Magnetic mount for a VHF/UHF antenna.
- **Radio Enclosures:**
  - Protective cases for QRP radios like the Elecraft KX2 or Yaesu FT-818.
  - Add cutouts for knobs, screens, and ports.
- **Cable Organizers:**
  - Clips or spools to manage coax and power cables during field ops.
- **Insulators:**
  - End insulators for wire antennas (e.g., dipoles or EFHWs).
- **Mic Stands/ Holders:**
  - Desk or mobile mounts for microphones or PTT switches.
- **Balun Housings:**
  - Weatherproof enclosures for 1:1 or 4:1 baluns with mounting points.

# GETTING STARTED

- **Steps:**

- Identify a need (e.g., a broken knob or a shaky antenna mount).
- Find or design a model (search Thingiverse or learn basic CAD).
- Print or outsource the part.
- Test and refine.

- **Resources:**

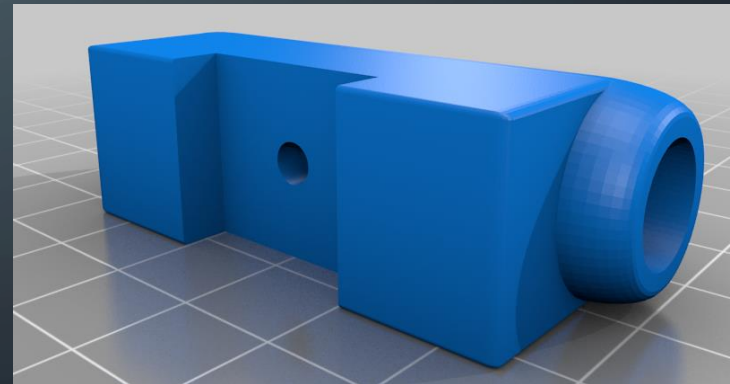
- Online: Thingiverse, Printables.com, YouTube tutorials.
- Ham-specific: QRZ forums, ARRL resources.

# PROJECT - ANTENNA MOUNTS AND INSULATORS

- Description:
  - Custom mounts for Yagi, dipole, or vertical antennas; insulators for wire antennas.
- Example:
  - A weatherproof mount for a portable HF antenna, adjustable for different mast sizes.
- Materials:
  - PLA or PETG for durability; UV-resistant filament for outdoor use.



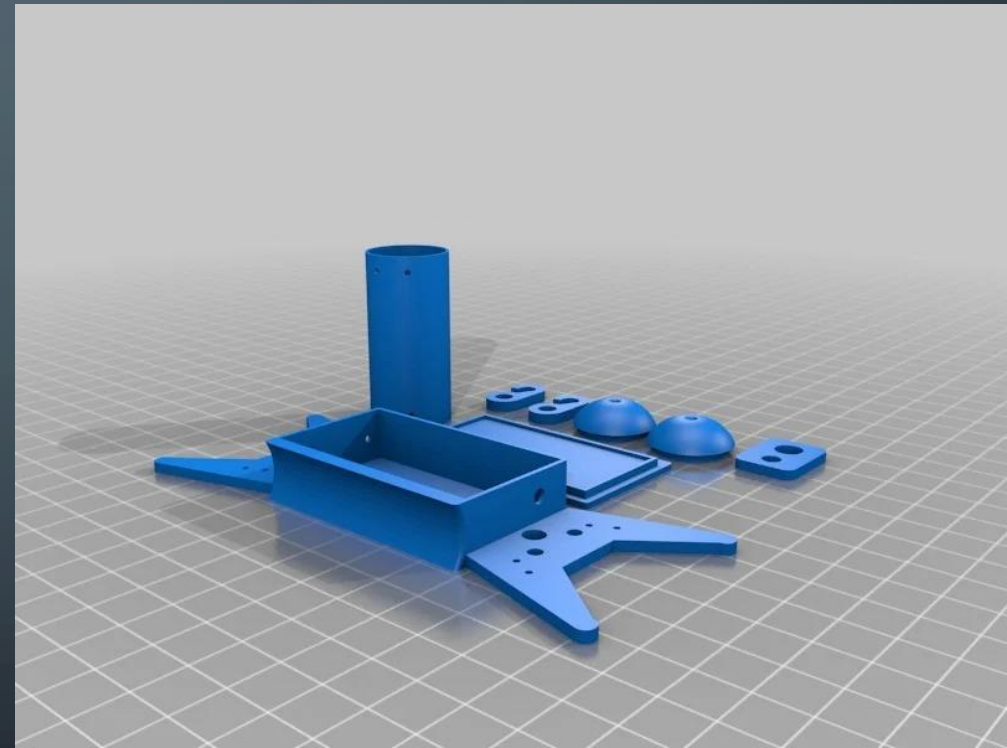
[Dogbone Insulator by sbehnke - Thingiverse](#)



[INSULATOR FOR YAGUI ANTENNA BOOM  
20 ELEMENT 10 by F1NSR - Thingiverse](#)

# ULTRALIGHT END-FED TRIBAND HALF-WAVE ANTENNA

- Description:
  - These are all the mechanical parts to build a superlight version of a popular design for a compact tri-band end fed antenna for 40, 20, and 10 m with a loading coil.
  - The antenna is basically the design described by VK3YY at <https://vk3yy.wordpress.com/2014/08/31/end-fed-for-40m20m10m/>.
  - The 3D-printed parts allow, however, for a much lighter version with a better handling.



[Ultralight Endfed Triband Half-Wave Antenna by mfhepp - Thingiverse](#)

# BEST PRACTICES FOR 3D PRINTING

- Material Choice:
  - Use PETG or ABS for outdoor durability; PLA for indoor.
- Test Fit:
  - Print small prototypes to ensure accuracy.
- Share Designs:
  - Contribute to the ham community online.
- Safety:
  - Ventilate when printing, especially with ABS.

# THE FUTURE OF 3D PRINTING IN AMATEUR RADIO

- Endless Possibilities:
  - From antennas to full enclosures, the only limit is imagination.
- Community Growth:
  - More hams adopting 3D printing every day.
- Call to Action:
  - Try a simple project and share your results!
- With a 3D printer in the shack, the only limit is your imagination - and maybe your filament spool.

The image features a dark blue background with white, stylized circuit board traces in the corners. These traces consist of straight lines of varying lengths and angles, ending in small white circles, resembling a PCB layout. The traces are located in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text.

# ADVANCED 3D MODELING

# CREATE 3D OBJECTS

- This is not for the faint of heart and is beyond the introduction to 3D printing.
- If you want to create something to be printed, it will require exact measurements.
- You will need 3D modeling software, next slide
- It will require a few tries to create an object from scratch.
- If starting out, I would recommend downloading an already made object for you to learn the printing process, the drawing can come later.



# SELECTING 3D MODELING SOFTWARE

- Choosing the right software depends on your experience level and the complexity of your design.
- Research from various sources, including educational and community forums, highlights the following options:

# BEGINNERS CAD SOFTWARE

- Tinkercad ([Tinkercad](#)) is frequently recommended for its simplicity.
- It is web-based, free, and ideal for manipulating basic shapes to create detailed models, making it perfect for entry-level students and hobbyists.
- Its intuitive interface and extensive shape library, as noted in [10 Best 3D Printing Software for Beginners | Xometry](#), facilitate quick learning and design.

# ADVANCES CAD SOFTWARE

- Blender ([Blender](#)) is a free, open-source tool with robust features for complex modeling.
- While it has a steeper learning curve, it includes a 3D printing toolkit for analyzing meshes, as mentioned in [15 Best 3D Printing Software for Beginners in 2024](#).
- It is suitable for users looking to explore advanced techniques, with cross-platform compatibility for Windows, macOS, and Linux.

## OTHER OPTIONS

- SketchUp offers a user-friendly interface with a free version, while Fusion 360, from Autodesk, is free for students and hobbyists and is noted for its advanced CAD capabilities in [Top 12 Free and Paid 3D Modeling Software in 2025 - Ankermake US](#).
- These tools cater to different needs, with some focusing on solid modeling for guaranteed manifold outputs, essential for 3D printing, as per [Software for 3D Printing - 3D Modeling Software/Slicers/3D Printer Hosts](#)

# QUESTIONS

