

The Wonderful World of 3D Printing

with example applications to Ham radio

By

Christian Bravo – W4ALF

Ben Von Handorf – KN4COI

What we will cover?

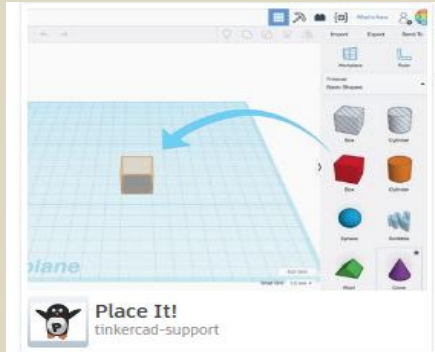
- **What is 3D printing and what can I use it for?**
- **Overview of how it works**
- **What is needed to print at home or Library**
 - **Printers and Printing Basics**
 - **Source of STL files - Thingiverse.com**
 - **Media/Filament PLA/ABS**
 - **Software/s – CURA/Slic3r/Simplify3D/Fusion360**
- **Some Ham Radio related examples of 3D prints we have made**

What is 3D Printing?

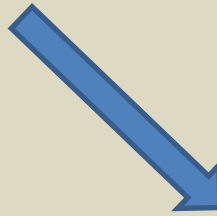
- **3D printing** is a process that builds a three-dimensional object from a computer-aided design CAD model [STL file] usually by successively adding material [PLA] layer by layer by an extrusion type printer.
- **You can use 3D printers to build your own parts for many applications and there are large repositories of pre-made “STL files” that you can download and just print! <http://www.Thingiverse.com> Free!**
- **Many Fields are using 3D printing: Health/Manufacturing/Construction. Still in Infancy!**
- **It's efficient: one file created, print as many as needed.**
- **It's Fun! Create your own prints and specs for projects.**

Overview of 3D Print Process

STL/AMF Files



CAD
Modeling
Software
TinkerCad,
fusion360



GCODE Files

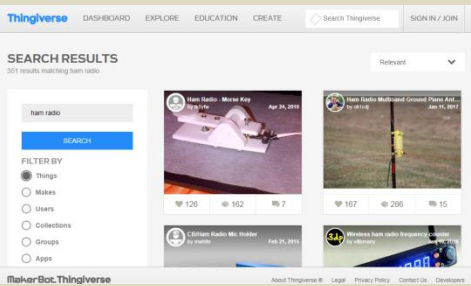


Slicer
Software
CURA

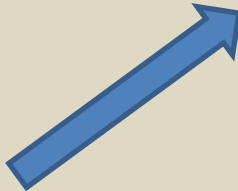
Loading and
Printing of
GCODE Files

Finished
Product

STL/AMF Files



Pre –Made
CAD Files
Thingiverse.com
YouMagine.com



STL Files and Sourcing Online

- **STL file = “StereoLithography”** An STL file describes a raw, unstructured triangulated surface by the unit normal and vertices (ordered by the right-hand rule) of the triangles using a three-dimensional Cartesian coordinate system. Other formats are used: .OBJ, .X3G, .3MF, and .AMF.
- **STL files can be downloaded directly from websites such as:**
 - **Thingiverse.com** and <https://www.youmagine.com/>
 - **Let’s take a look at Thingiverse.com and find something to print. [Ham Radio keyword search]**
 - **We can alternatively create our own STL file using software like Fusion360 [Ben can demo after presentation] or using online CAD tools like TinkerCad.com**

STL file so now what? What up G!

Gcode files via a slicer app 😊

- **Gcode** = *A GCODE file contains commands in G-Code, which is a language used to describe how a 3D printer should print a job. It stores instructions in plain text with each line representing a different command, such as how fast the printer should print, the temperature it should be set at, and where the printing parts should move. GCODE files are created by slicing programs, such as Simplify3D and Slic3r, that translate CAD drawings into G-Code, which a 3D printer can read. Slicing essentially creates Layers of the object for the 3d printer to print.*
- **Filament Settings: 1.75mm PLA**
- **Print Speeds: 40mm**
- **Nozzle and Bed Temps: 195c/60c – 383F/140F**
- **Infill %: 40%**
- **Support Structure: Yes/overhang 60%**
- **Skirt and Brim: purging of filament around print**

We slice our STL file with the slicer app after making setting and the result is a Gcode file that we can now load to the printer!

LET'S STEP INTO SLIC3R and see what it looks like *Demo Here*

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We slice our STL file with the slicer app after adjusting settings and the result is a Gcode file that we can now load to the printer!

3D Printing Services is the alternative to buying

- You can go to Kenton county Erlanger branch library and have them print for you!

<https://www.kentonlibrary.org/locations/erlanger>

- You can use 3D Print Services online
- [Sculpteo](#)
- [Ponoko](#)
- [Shapeways](#)
- TinkerCad Partners
- Thingiverse.com

Print Material/Filament

- **Acrylonitrile butadiene styrene (ABS)**
 - Higher Durability/Some UV Resistance, Painting for UV Recommended
 - Harder to work with - /Acetone bath for finish that is smoother
 - If you have overhangs, complex geometries involving support, or are more concerned about surface finish, ABS is often the better choice.
 - Requires proper ventilation, Can emit VOC's [Styrene]
- **Polylactic acid or polylactide (PLA)** is a [thermoplastic aliphatic polyester](#) derived from [renewable](#) biomass, typically from fermented plant starch such as from [corn](#), [cassava](#), [sugarcane](#) or [sugar beet pulp](#).
 - Melting point between 130-180C, May not be suited for High Temp Outdoors
 - High tensile strength/Fairly flexible/Not UV Resistant
 - Most 3d printers are used with PLA

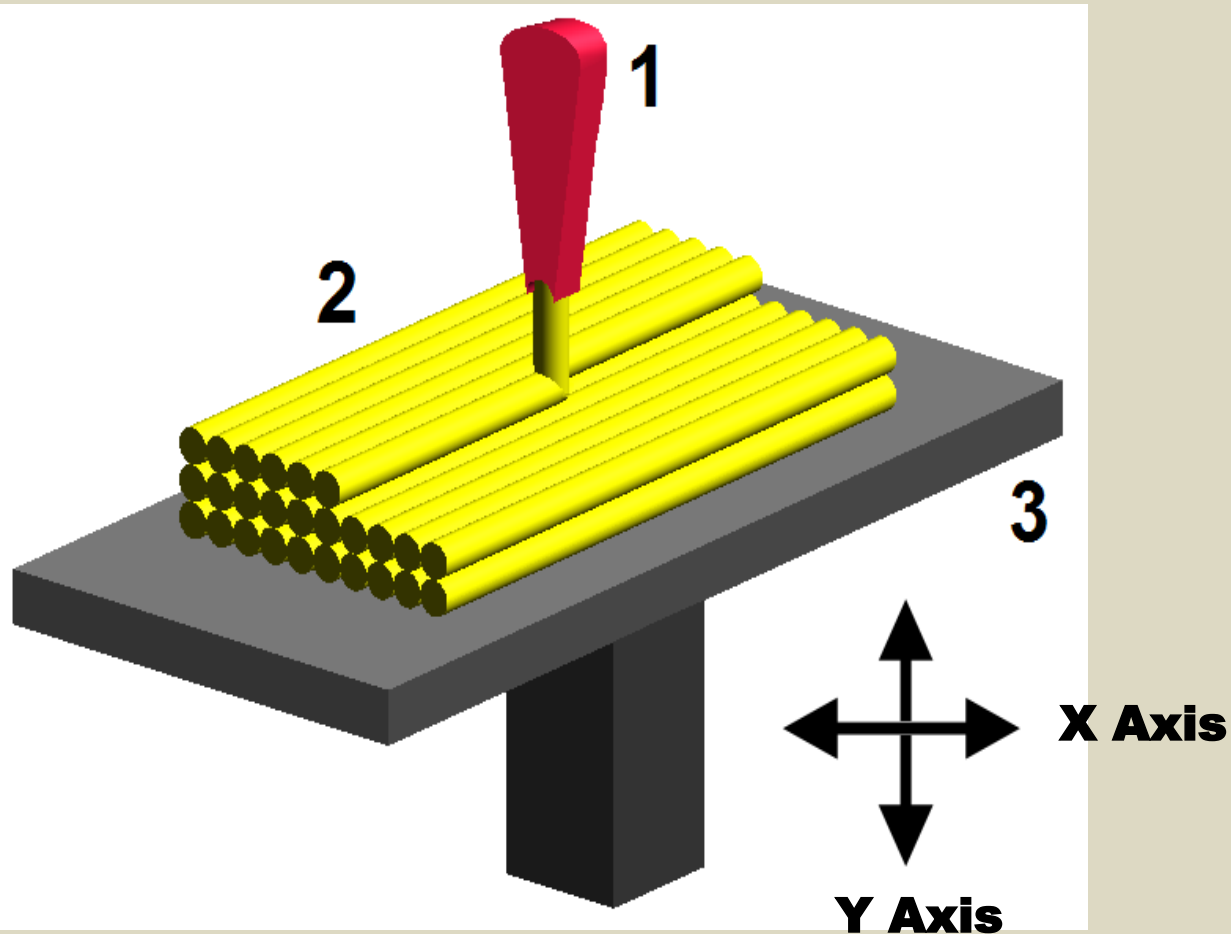
Print Material cont..

Some other options

- **Carbon PLA – Contains Carbon Fiber material add durability. Has some conductivity due to high Carbon content**
- **Conductive PLA, for low current/V applications only**
- **PVA, PETG, TPU**

- **Popular Brands: Hatchbox/Solutech/GizmoDorks/Dikale**
- **Typical Diameter of Filament: 1.75mm**
- **PLA - 67-72% of tensile strength of injection molded parts**
- **Strength and flexibility depends on filament type/Temps/infill % and design of object!**
- **Comes in rolls and generally costs about \$20 per Roll**

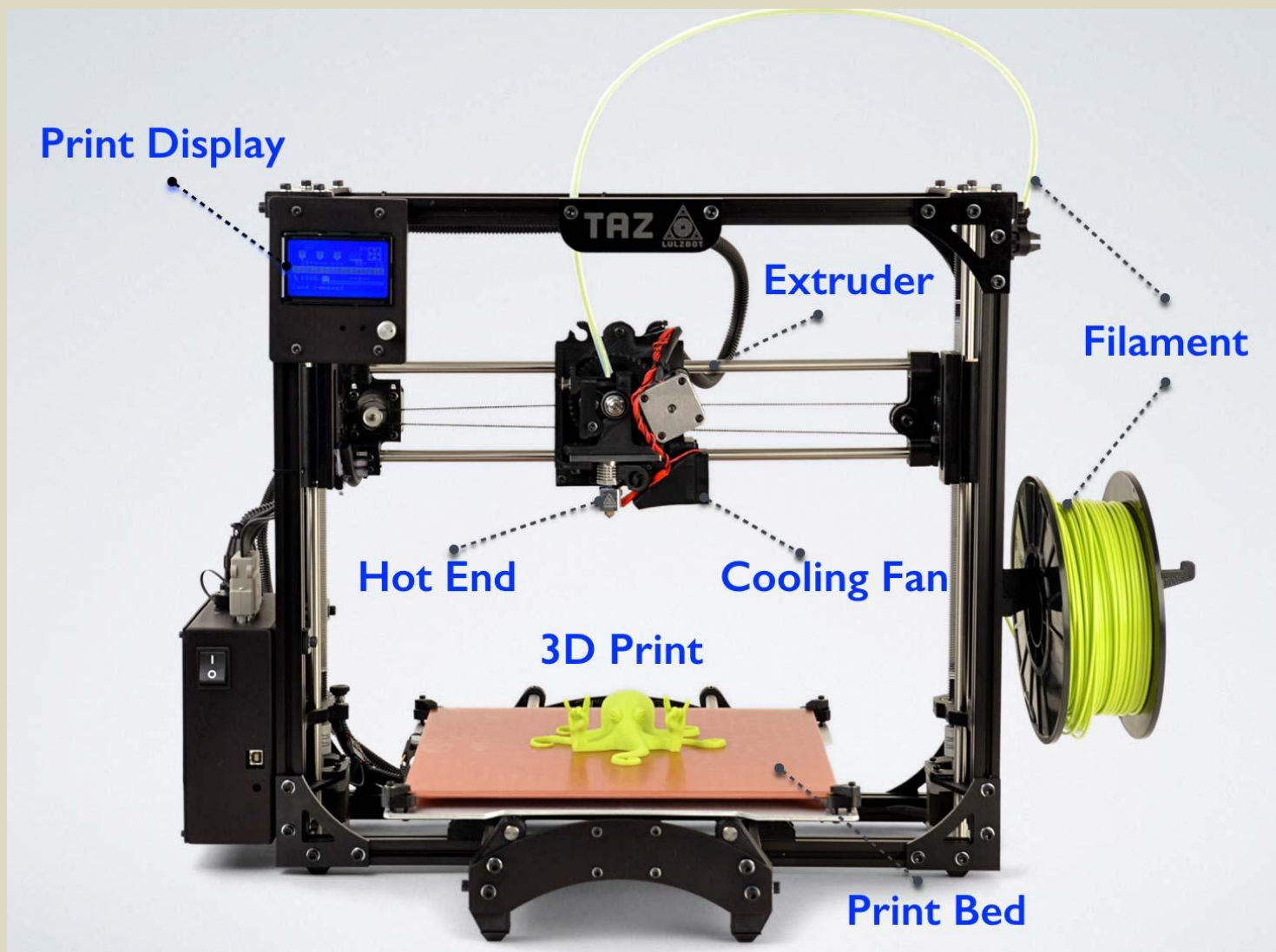
FDM = Fused Deposition Modeling: Material is deposited Layer by Layer onto the bed of the Printer



- **1 – Extruder**
- **2 – PLA Filament**
- **3 – Heated Bed of Printer**

- **Z axis [up/down]**

3D Printer Anatomy – Main Parts



3D Printers

- **Z resolution: .1mm to .3mm typical/ higher end 65 microns 100 microns = .1mm**
- **Heat Bed/Non Heat Bed 50-60C/122-140F anything other than PLA needs a Heated Bed**
- **Cooling Fans – important near the hot end**
- **Extruder and Nozzle/hot end avg is .4 mm - typical temps 180c/356F to 230c/446F**
- **Loaded SD card w/Gcode files or wifi/networked or plugged to computer**
- **Filament typical is 1.75mm diameter**
- **Build Area = Bed sizes/volume you can print**
- **X width Y depth Z height
200mmx200mmx180mm/8x8x7inches**
- **Time to print? Small item may take 20min? E.g. dipole center passed in presentation. Larger print make take overnight like induction coil passed around. Typical speeds are 30mm/s [slower] to 60/80mm/s [faster]**

3D Printers – Brands & Sourcing

- Affordable \$200-\$300 Range Printers
 - Prusa
 - Monoprice
 - Creality
- More Expensive to the thousands \$x,xxx...
 - Makerbot
 - Creality
 - Ultimaker
 - Lulzbot
- Check AMAZON!



da Vinci Mini Wireless 3D Printer (Includes: 300g Filament, PLA/PETG/Antibacterial PLA/Metallic/Carbon PLA)

by XYZprinting


★★★★☆ 589 customer reviews

Price: \$179.95 & FREE Shipping. Details

Color: Black/Red

\$179.95 from 6 sellers

- Compact and productive: The da Vinci mini 5.9" X 5.9" X 5.9" Aluminum printer bed features a 100mm diameter nozzle.
- Connect wirelessly to your home network.
- The Da Vinci mini filaments are made using environmentally friendly and non-toxic materials.
- The Da Vinci mini streamlines its printing process.



Monoprice Select Mini 3D Printer (120 x 120 x 120 mm) Build Plate, Sample PLA Filament And MicroSD Card, Printable 3D Models

by Monoprice

★★★★☆ 1,658 customer reviews | 685 answers

Price: \$219.99 & FREE Shipping

Style: Mini V2

Mini Pro Mini V2

Color: Black

Resources and Links

CAD Programs:

Fusion 360 [Free <\$100K income from printing]

TinkerCad [Free/\$]

OpenScad [Free]

Slicer Programs:

Slic3r [Free], CURA [Free], Simplify3D [\$]

Printers:

Monoprice, Prusa, Creality, FlashForge

STL file sites:

Thingiverse.com, Youmagine.com

Netflix Movie about 3D Printing: Print The Legend

[Intro info: http://my3dconcepts.com/explore/main-components-of-desktop-3d-printers/](http://my3dconcepts.com/explore/main-components-of-desktop-3d-printers/)

End

- Walk up and Q&A
- Software Demos CAD [Ben] and Slicers [Christian]