# Low-Cost Piezoelectric Droplet-on-Demand Generator Manual

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Month Year

## Declaration

This design is based entirely on the work of Harris et al. in their paper "A low-cost, precise piezoelectric droplet-on-demand generator" (DOI: 10.1007/s00348-015-1950-6). Their high-quality research and generous sharing of information has been invaluable. Since their paper already provides exhaustive details on principles and testing, this manual focuses on practical implementation.

The key advantages of this version are:

- Significantly lower cost (helpful for budget-constrained researchers)
- Improved modularity and mobility

**Important Notes:**

- Components were sourced from affordable domestic Chinese suppliers - international alternatives may cost more
- While PLA FDM printing was used, resin-based printing is strongly recommended unless using 100% infill with chemical/physical reinforcement

## 1. Components and Specifications

### *1.1. Essential Components*

- Nut cap (25cm×25cm, M6)
- 3D printed nozzle (M6, preferably 45° angled tip)
- Piezoelectric buzzer (35mm diameter)

### *1.2. Experimental Supplies*

- RTV silicone
- Teflon coating
- Tubing (3mm ID/5mm OD & 4mm ID/7.2mm OD)

### *1.3. Common Lab Equipment*

- Rubber pad
- Tripod
- Lift platform
- Peristaltic pump (Kamoer LLS Plus V2 recommended)

### *1.4. Optional Components*

- Signal generator (RIGOL DG1032Z)
- Power amplifier (SA-PA003)

(Photos and detailed pricing available at: `YourWebsite/Designs/Download/BillOfMaterials`)

## 2. Design Overview and Preparation

### *2.1. Main Components*

- **Reservoir**: Maintains constant liquid level via overflow system
- **Generator**: Core droplet generation unit
- Signal input system

### *2.2. Preparation Steps*

(i) 3D print models from `YourWebsite/Designs/Download/3DModel` (STEP files)
(ii) For PLA printing: Use 100% infill and apply waterproofing
(iii) Test nozzle oil-repellency (Teflon-coated nozzles recommended)
(iv) Securely attach piezoelectric ceramic to generator opening (brass side in)
(v) Screw nozzle into nut cap and wrap with thin tubing for friction

## 3. Assembly Instructions

### *3.1. Main Assembly*

(i) Secure rubber pad to reservoir bottom (avoid blocking tubing paths)
(ii) Place components on lift platform
(iii) Position reservoir-cover lightly on reservoir
(iv) Connect tubing as shown in Figure 1:
  - Thin tube from pump outlet to cover (extend below inner ring)
  - Thin tube from pump inlet to reservoir bottom center
  - Thin tube from reservoir side outlet to generator

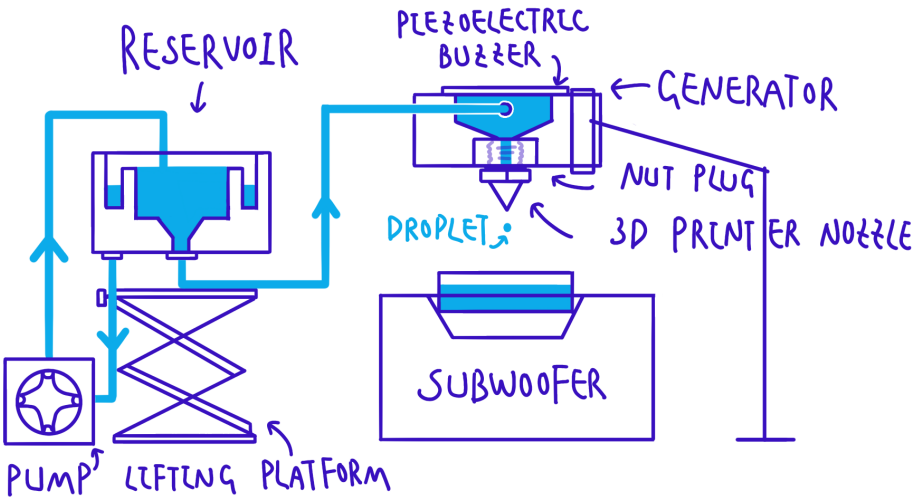


**Figure 1.** Schematic of droplet generator assembly

### *3.2. Priming the System*

(i) Fill system with silicone oil:
- Start pump to slowly fill reservoir
- Invert generator below reservoir
- Continue until oil overflows into generator square slot

(ii) Insert nut cap tightly into square slot

(iii) Wait until oil emerges from nozzle

(iv) Return generator to upright position on tripod

### *3.3. Final Adjustments*

(i) Level generator using tripod

(ii) Adjust height until oil forms concave meniscus at nozzle

(iii) Connect signal generator and amplifier to piezoelectric buzzer

## 4. Operation Tips

- Place container under nozzle during height adjustments
- Cover reservoir when not in use to prevent contamination
- Maintain equal nozzle and reservoir liquid levels
- Use 5Hz 50Vpp square wave input (see Harris paper for details)

## 5. Expected Results

When properly assembled and adjusted:

- Generator should produce consistently sized droplets
- Droplet size can be measured using ImageJ

### Final Notes

Enjoy experimenting! For questions, please contact: lymphy@smail.nju.edu.cn