

FluidTac Quick Start Guide

1 Introduction

FluidTac is a high-resolution compact visual-tactile sensor designed to detect water flow velocity and direction in underwater environments. Below is a brief overview of the FluidTac fabrication process.

The required materials are listed in the table below. For certain special items, we've provided purchase links at the end where they can be bought on Taobao.

Component	Specification	Quantity
Casing	Light-curing(JLC Black)	Several
Camera	Raspberry Camera Module 3	1
Development board	Raspberry Zero2w	1
Potting compound	7018 AB Waterproof sealant	A*1 B*2
Expanded Mirror	120-degree wide-angle lens ^[1]	1
IMU	JY901S ^[2]	1
Acrylic sheet	r20 mm	1
lithium battery	1000mAh	1
Fill light	Homemade	1
Metal Shaft	r1*12mm	8
Ceramic bearings	2*5*2.5mm ^[3]	8
Passive Propeller	Light-curing(9600)	8
Waterproof sealant	Black epoxy resin ^[4]	2
Label	Light-curing(9600)	8
Spray painting	Red	1

All items are arranged on the table as shown in the figure below.



2 Base fabrication

This section describes how to install and construct the camera mount. It does not cover waterproofing design.

The camera base is made using photopolymerization with JLC Black material. The base model file can be found in the attachment. Four screw holes are pre-drilled at the base's bottom for securing the camera to the base. The assembly tutorial is provided below.

- 1) Connect the camera to the ribbon cable. The base has a pre-drilled hole for the ribbon cable to pass through. Thread the ribbon cable through the base and secure the camera to the base with screws.
- 2) Due to differing temperature and humidity levels between the above-water and underwater environments, condensation will form on the lens when it is sealed and submerged. Therefore, we need to place a desiccant inside the base. Place the desiccant into the designated compartment within the base, then secure the lid and seal it with super glue.
- 3) Next, attach the field extender to its corresponding field extender mount and insert the entire assembly into the base.
- 4) Finally, attach the acrylic sheet to the base and seal it with epoxy resin waterproof adhesive.

The base after completing this step is shown in the figure below.



3 Lighting Kit Production

The lighting kit is designed to provide illumination for cameras in dark underwater environments. Since placing the light source inside the base would cause reflections, we need to position it externally. This requires us to make it waterproof.

The circuit board for the fill light module is designed in-house to better accommodate our sensor dimensions and required illumination levels.



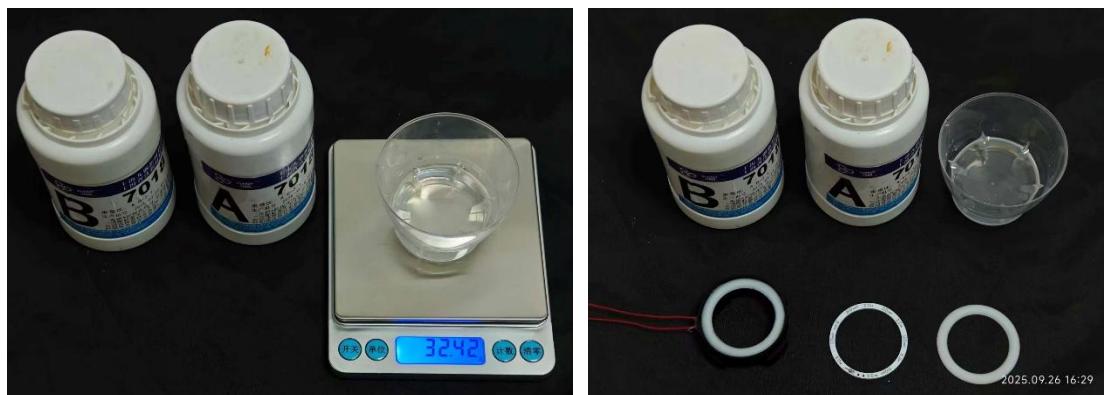
We designed a ring array of six parallel LED lights and applied copper plating. The surface-mount technology (SMT) process uses 0603 components. Since the lithium battery's rated voltage of 3.7V exceeds the operating voltage of our LEDs, we designed a series of resistors to resolve this. The electronic components used are listed in the table below:

Component	Specification	Quantity
LED	0603 White	6
Resistor	0603 50Ω	6

The installation distribution tutorial is as follows:

- 1) Solder the chip resistors and chip LEDs onto the PCB using low-temperature solder paste, then connect two wires to them.
- 2) Place the finished light ring inside the photopolymerized printed housing made from JLC Black material. Note that the wires must be routed through the housing. Since potting compound will be applied next, seal the wire exit points with a hot glue gun to prevent leakage.
- 3) Use an electronic scale to weigh out a specific amount of potting compound, then mix them together in a 2:1 ratio until thoroughly blended. Leave undisturbed for 24 hours to allow the potting compound to fully cure.
- 4) We designed a light-cured printed shell to cover the light ring, serving to homogenize the light source. The shell material is 9600, with a creamy white color.

After assembly, connect the wires to the lithium battery and switch, then attach the lighting module to the base.

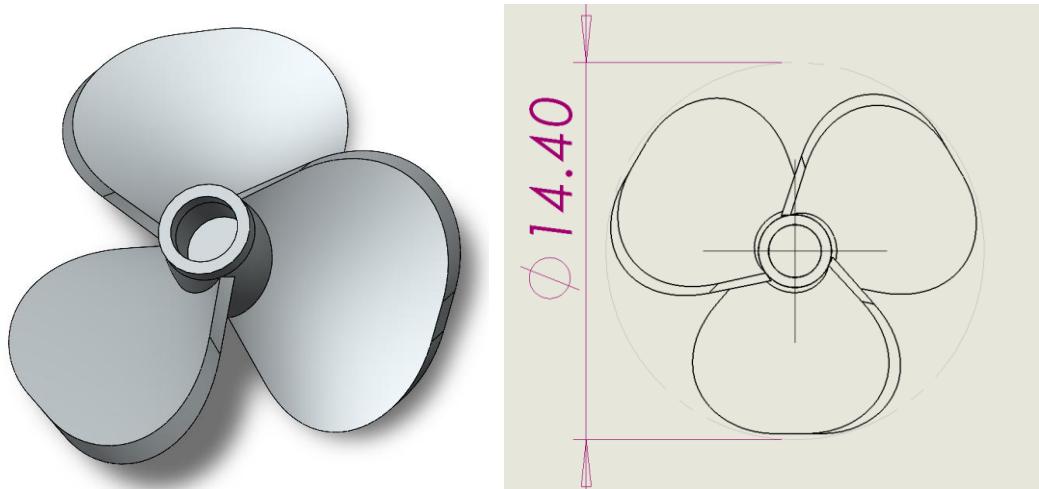


4 Fabrication of Passive Propeller Array

The passive propeller array consists of a series of units. Each unit comprises a passive propeller, a ceramic bearing, a metal shaft, and a label. These units are assembled onto a housing. Both the label and the casing are made from photopolymer materials, specifically 9600.

Passive propellers require sensing minute water currents, so we designed a propeller structure with a large water-facing surface area and low hydraulic resistance.

Simultaneously, we employed ceramic bearings to minimize the unit's starting torque and counteract potential underwater corrosion.



The materials required for constructing a passive propeller array are shown in the figure below. We will introduce the specific production process.



- 1) Assemble the passive propeller, metal shaft, and ceramic bearings in sequence. Due to the interference fit, no additional adhesive is required to secure them.
- 2) Next, install the assembled unit into the housing and test whether its rotational performance is consistent. The housing and bearing also feature an interference fit, eliminating the need for additional adhesive. If no issues are found, proceed to create the label.
- 3) The printed labels are conical in shape. We designed a mold for producing these labels based on their dimensions, as shown in the figure above. Each label placement area features a triangular hole. Labels can be inserted into the mold, with the exposed triangular sections representing the areas requiring spray painting.
- 4) Next, we invert the mold and apply bright red spray paint. After spraying, allow it to rest for a period of time before removing the label. This yields a label featuring a triangular emblem on the reverse side. Assemble the label onto the metal shaft.

We have now completed the entire sensor assembly. The array's appearance and the sensor's appearance when illuminated are shown in the figure.



Appendix

- [1] <https://e.tb.cn/h.SkFwh7e242t7kOM?tk=wgdcf3i7HYp> HU108
- [2] <https://e.tb.cn/h.SPbM1dePJWvCAI0?tk=J9Okf3QbfxE> CZ057
- [3] <https://e.tb.cn/h.SPbM1dBIUMIBvsV?tk=eUpQf3QbfC4> HU591
- [4] <https://e.tb.cn/h.SPHRTvvmuKfHNmp?tk=DCs1f3QbfCP> CZ356