B 105 Fish Eyes Experiments **Draft 1.1**
PAN, June 6th, 2016

1. Introduction

The Baby Duck should hear and view Mama Duck by any angle. Here we show a first approach:

- Hearing: Ultrasound FSK 40 kHz distance monitoring, omnidirectional possible if both Mama and Baby are equipped with omnidirectional Speakers and Mics.

- Viewing: IR 940 nm, Modulation 15.6 kHz, Mama equipped with 6 x 60 Deg LED, Baby with two „Fish Eyes“ at +/- 60 Deg, viewing angle +/- 150 Degree

2. Environment

The Duck Family system should swim outdoors at the pool of the „Swiss Museum of Transportation, Lucerne, Switzerland“

We noticed the following disturbing environmental effects:

- Wind and thermal turbulence affects the ultrasonic wave front. With face to face aligned speaker and mic the distance measuring accuracy amounts to about +/- 5 mm

- Sun Light will saturate the IR-Diode: A Near Infra Red (NIR) Filter is needed to attenuate the visible light at full sun shine.
However, an interference filter such as the NIR Filter 940DF20 operates fine only for incident light angles of max- +/-15 Degree, see chapter 5 below
We shall tray later the Long Pass Filter 830 nm by Edmond, D12.5x3.

3. Optical Experiments

3.1. Test Setup

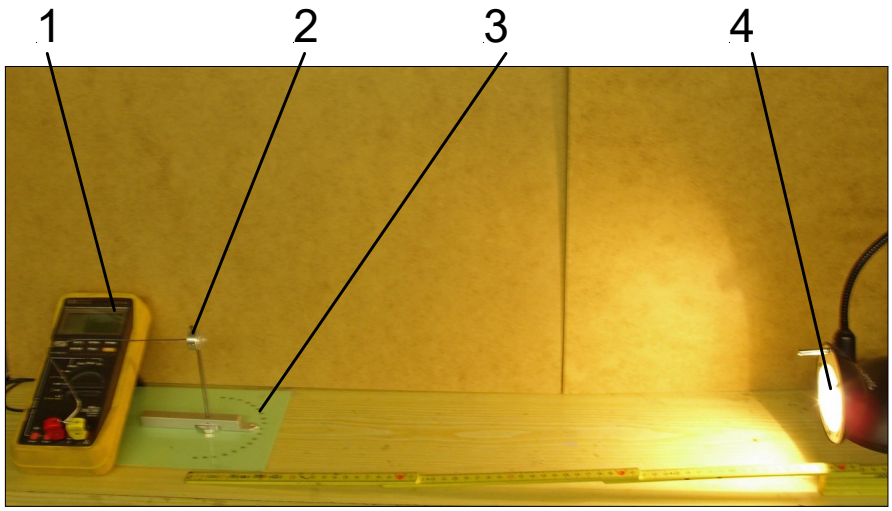


Fig. 1: Test Setup

1: DVM HP940A

2: Fish Eye with DUT Lens

3: Turn Table +/-90 Degree

4: Light Source Halogen 20 W

Distance: 0.6 Meter

3.2. Experimental Lens and Light Guides, nominal 8 mm diameter

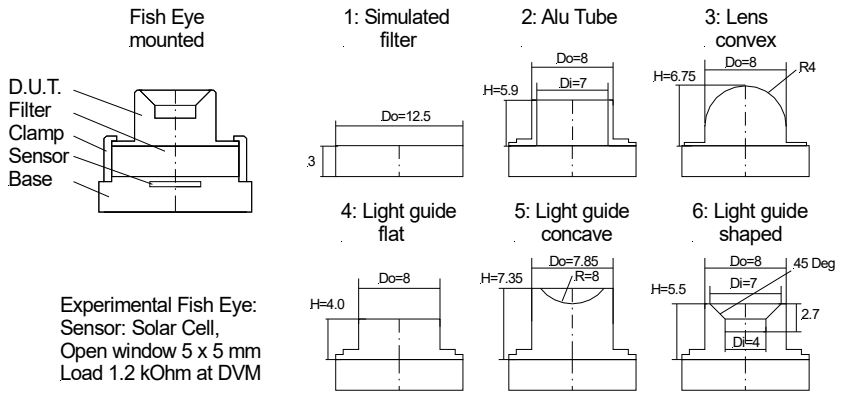


Fig.2: Experimental Lens and Light Guides

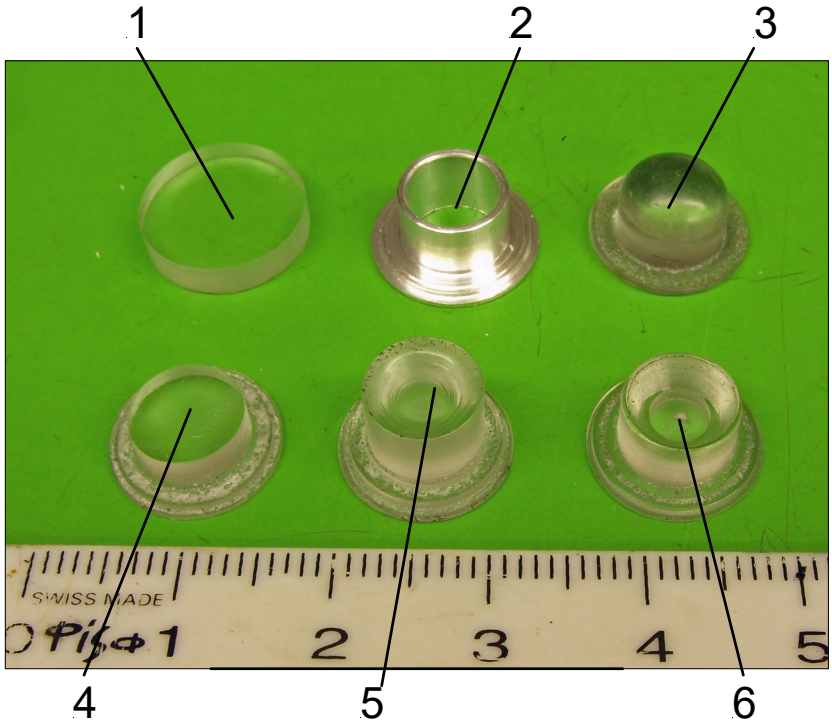


Fig. 3:
Experimental Lens and Light Guides

1: Filter
2: Al Tub
3: Lens convex
4: Light Guide flat
5: Light Guide concave
6: Light Guide shaped

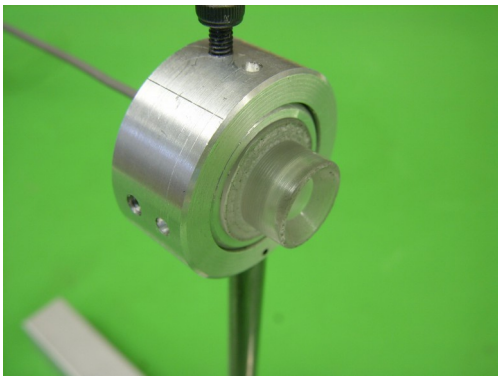


Fig. 4: Mounted Fish Eye

Fig. 5: Masked Solar cell, filter, clamps

3.3.Experimental Results

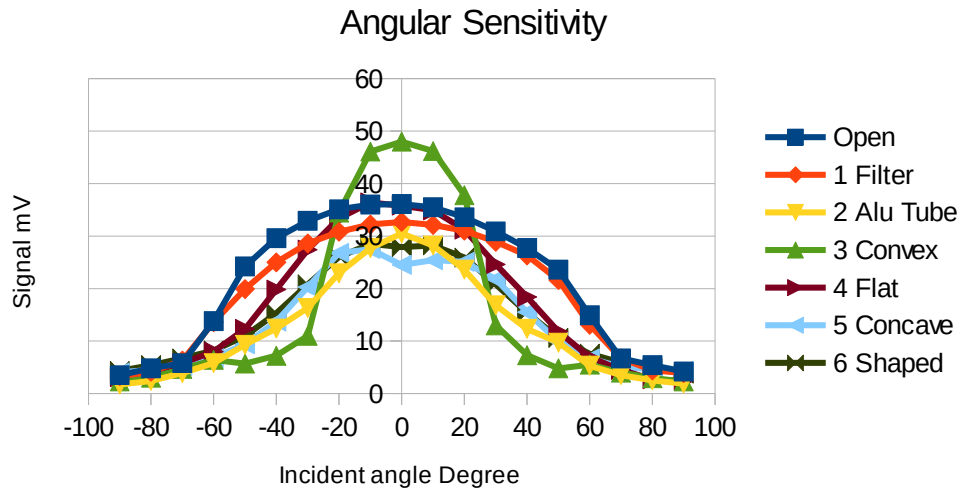


Fig. 6:
All experimental results

Comment to Nr. 5: concave shape not perfect and 0.5 mm out of center

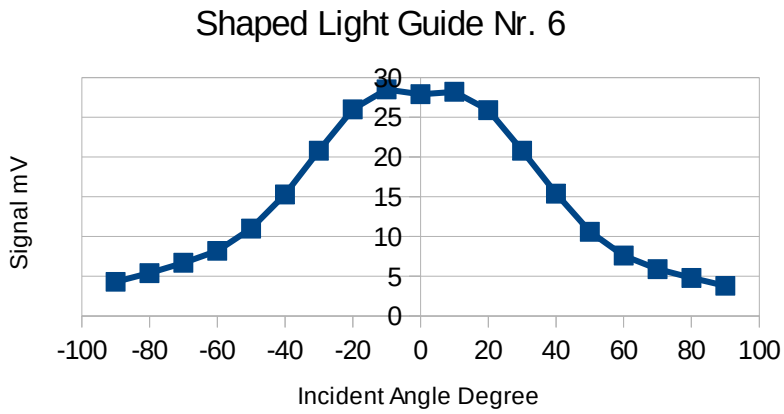


Fig. 7:
Best experimental result with Type 6 Shaped Light Guide, signals up to +/- 80 Deg.

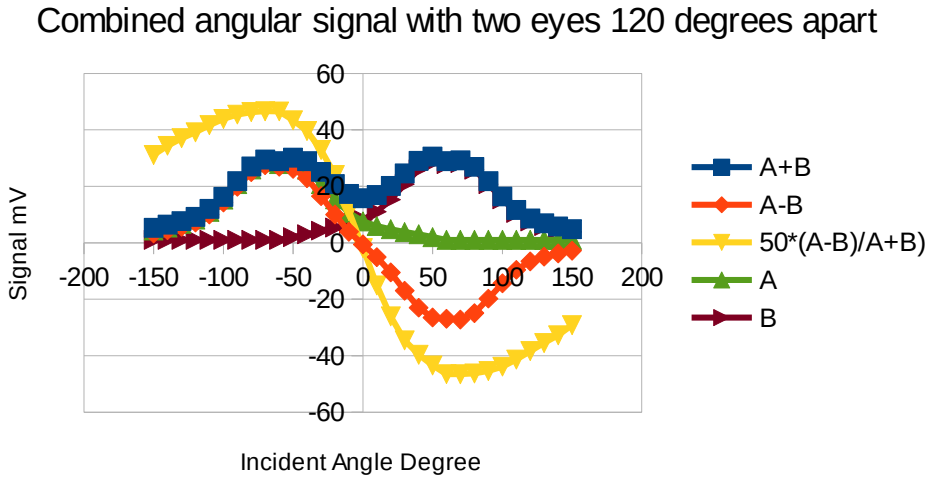


Fig. 8
Calculated Values with two Fish Eyes Type 6
Direction Signal ok +/-150 Deg.

Division not needed in our circuit, since sampling is done at constant A+B level.

4. Integration into Baby Head

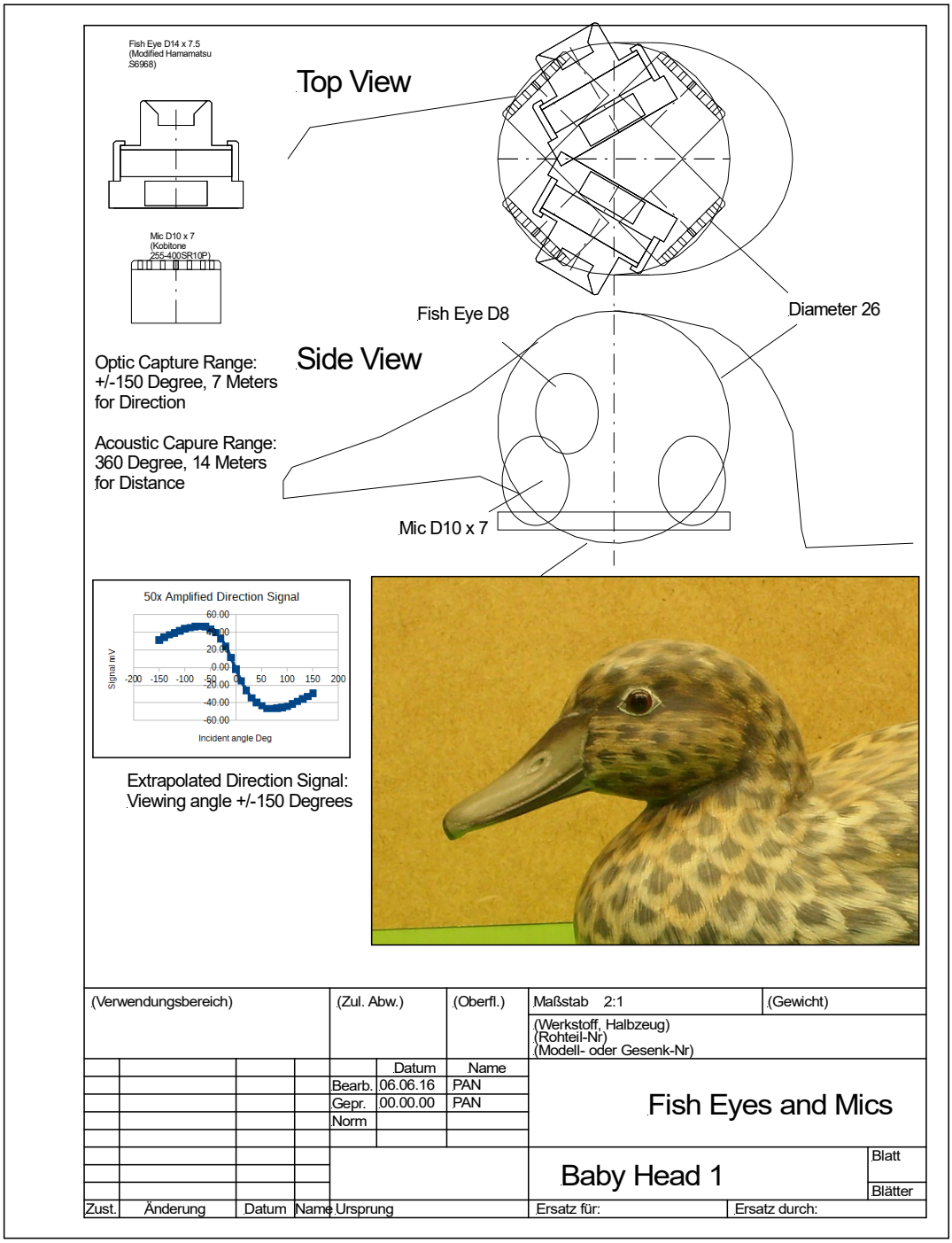
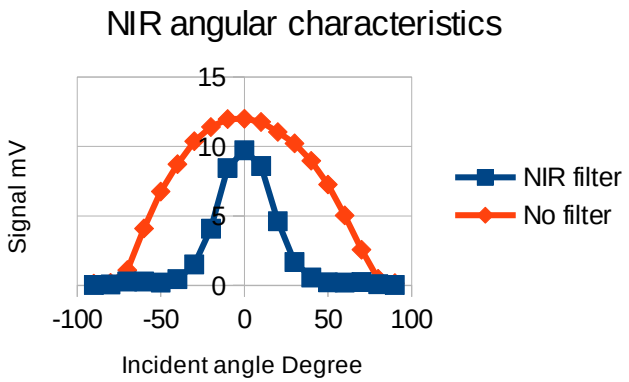


Fig. 9: Fish Eyes and Mics

5. Filters for attenuating sun light

5.1. NIR Filter



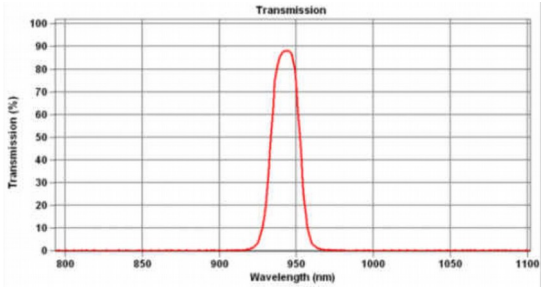


Fig. 10; NIR Filter: 940DF20, 11.5x 2.3mm
Angle of half sensitivity about +/- 15 Deg. only!

Tested with IR-LED SFH 4233, at distance of 60 mm and 60 mA

See theory by PD Hans Zogg

5.2. Long Pass Filter

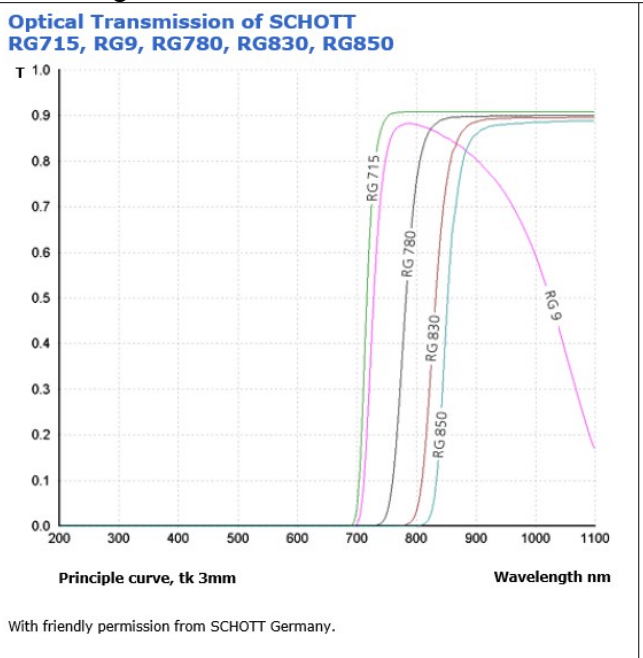


Fig. 11: LP-Filter RG830, 12.5 x 3 mm

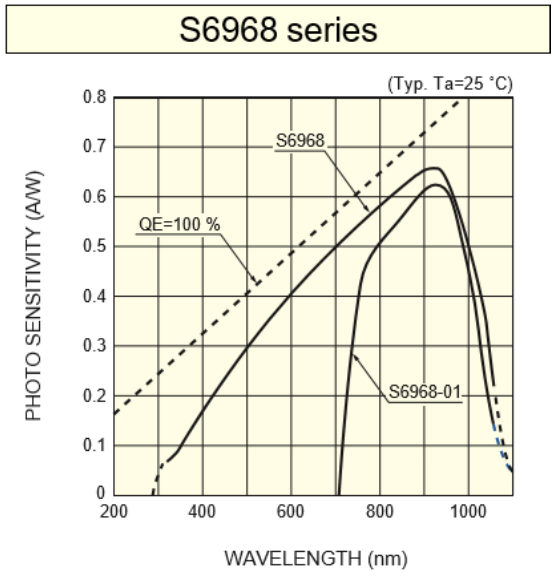


Fig. 12: Sensitivity IR-Diode S6968-01

The IR Diode S6968-01 comes with a LP Filter 700 nm, perhaps this is already sufficient to attenuate direct sunlight.

6. Mechanical Test Setup

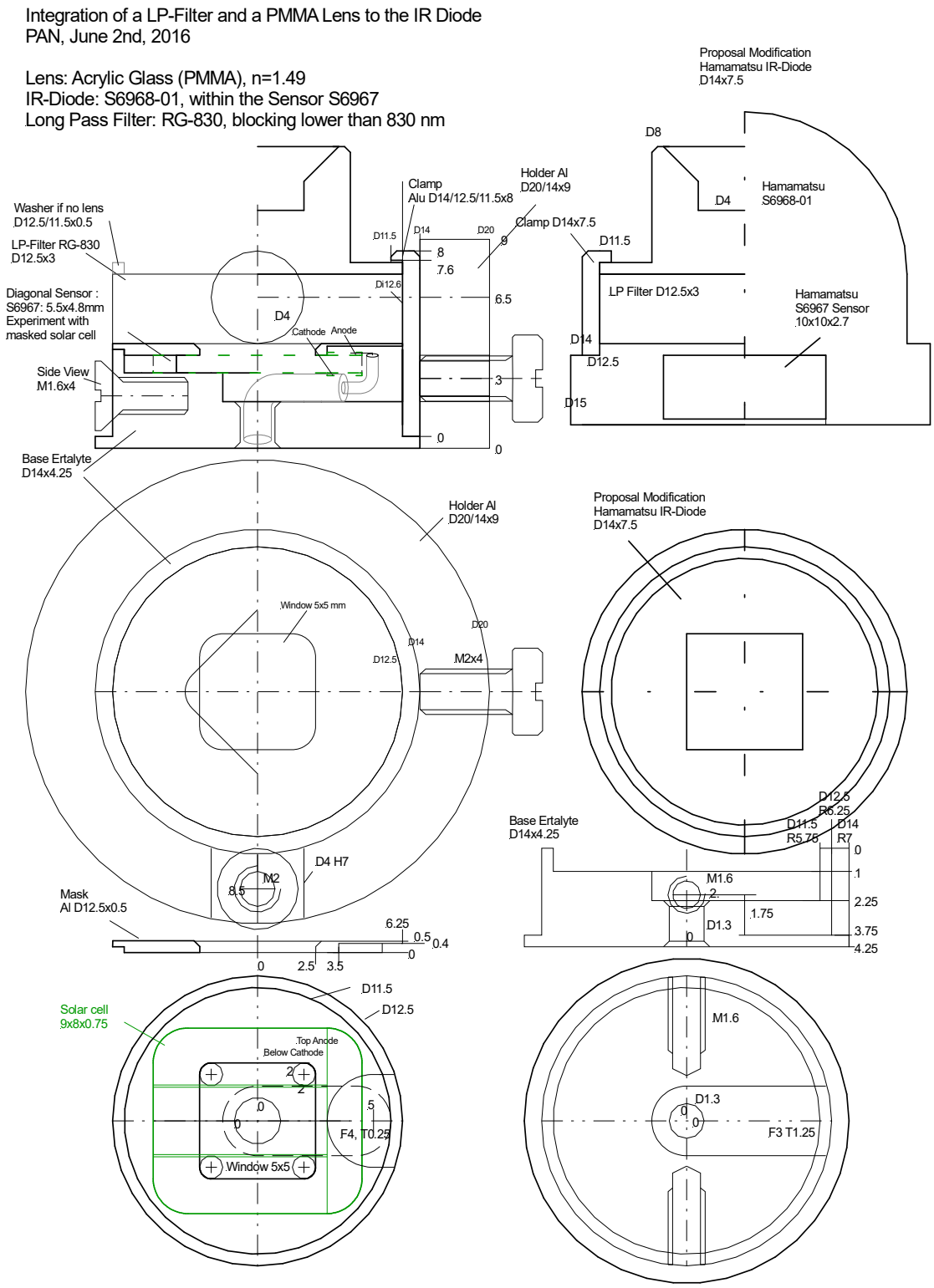


Fig. 13: Mechanical Test Setup

7. Appendix

Experiments with a cylinder concave lens showed a little bit improved data, but this fish eye looks no so nice.

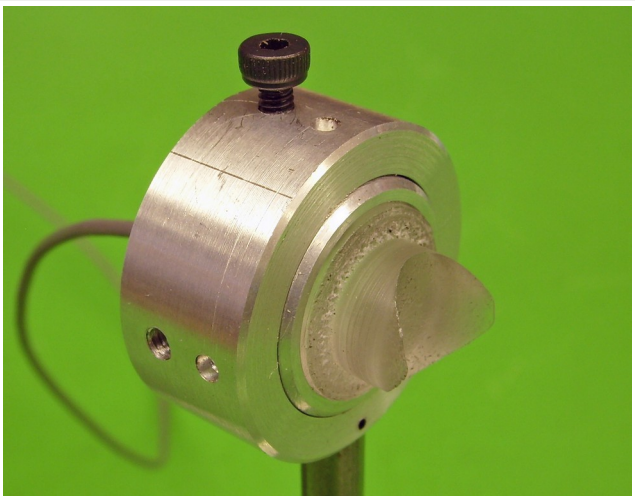


Fig. 14:
Cylinder concave Lens, R = 4
Works fine, but looks ugly!

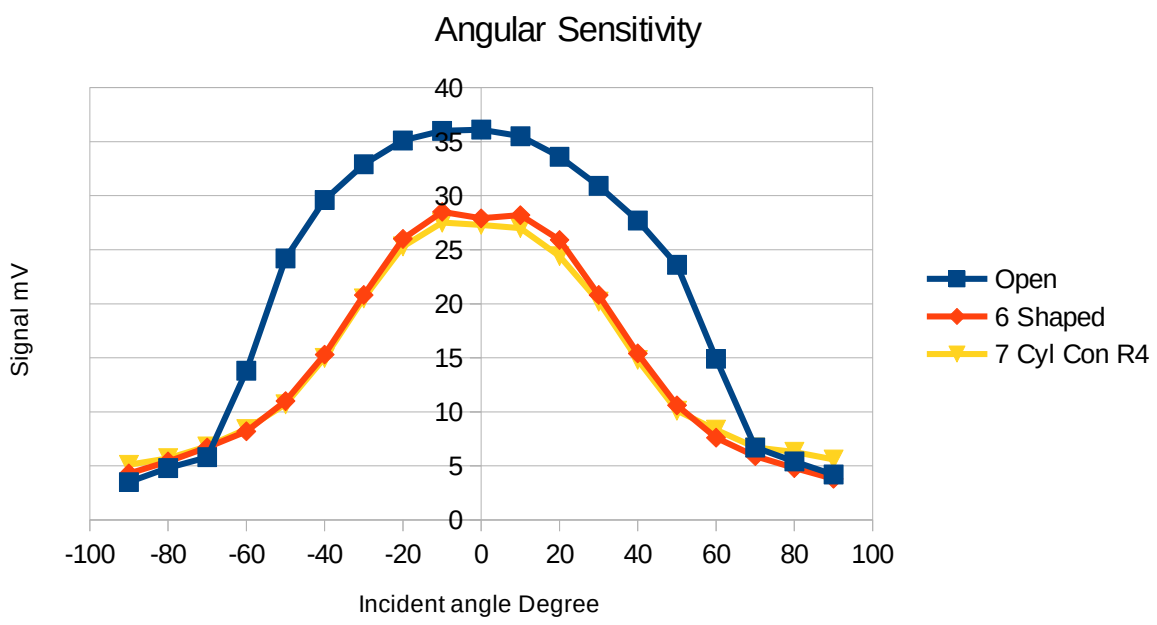


Fig. 15: Type 7 Cylinder Concave R4 shows a little bit better performance

Additional experiments with a mechanical improved type 5 with well manufactured concave R3.5 did not give better results compared with the original type 5!