

Design of an Optical Localization and Communication Sensor for Mobile Robots

Semester Project: Midterm Presentation
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Photograph by A. Crespi



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

GOALS



- Design a system that uses **modulated optical signals** to determine the distance and direction of a modulated transmitter
- Decode low bandwidth data sent over the optical channel (e.g. 8 bit ID)
- Study the possibility of using the same sensor for obstacle sensing (by adding some transmitter at its side)



Photograph by A. Crespi

CONSTRAINTS

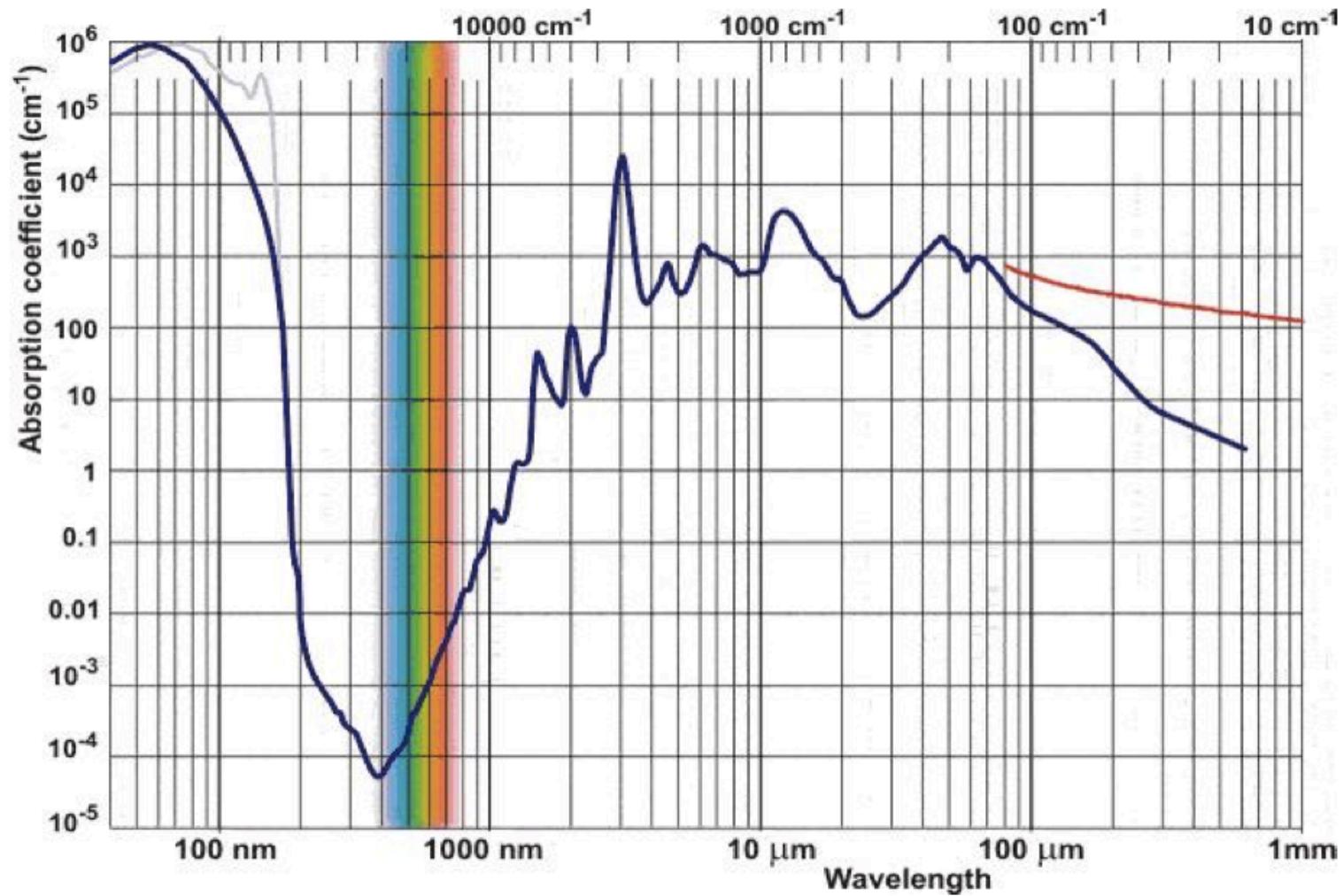


- Receiver powered by 3.3V or 5V available on robot
- Use as few components as possible
 - small space
 - lightweight
- Receiver should be waterproof
- Range of 5m in air and 1m in water (in normal light conditions)
 - study the possibility of using visible light instead of IR, for better performance in water

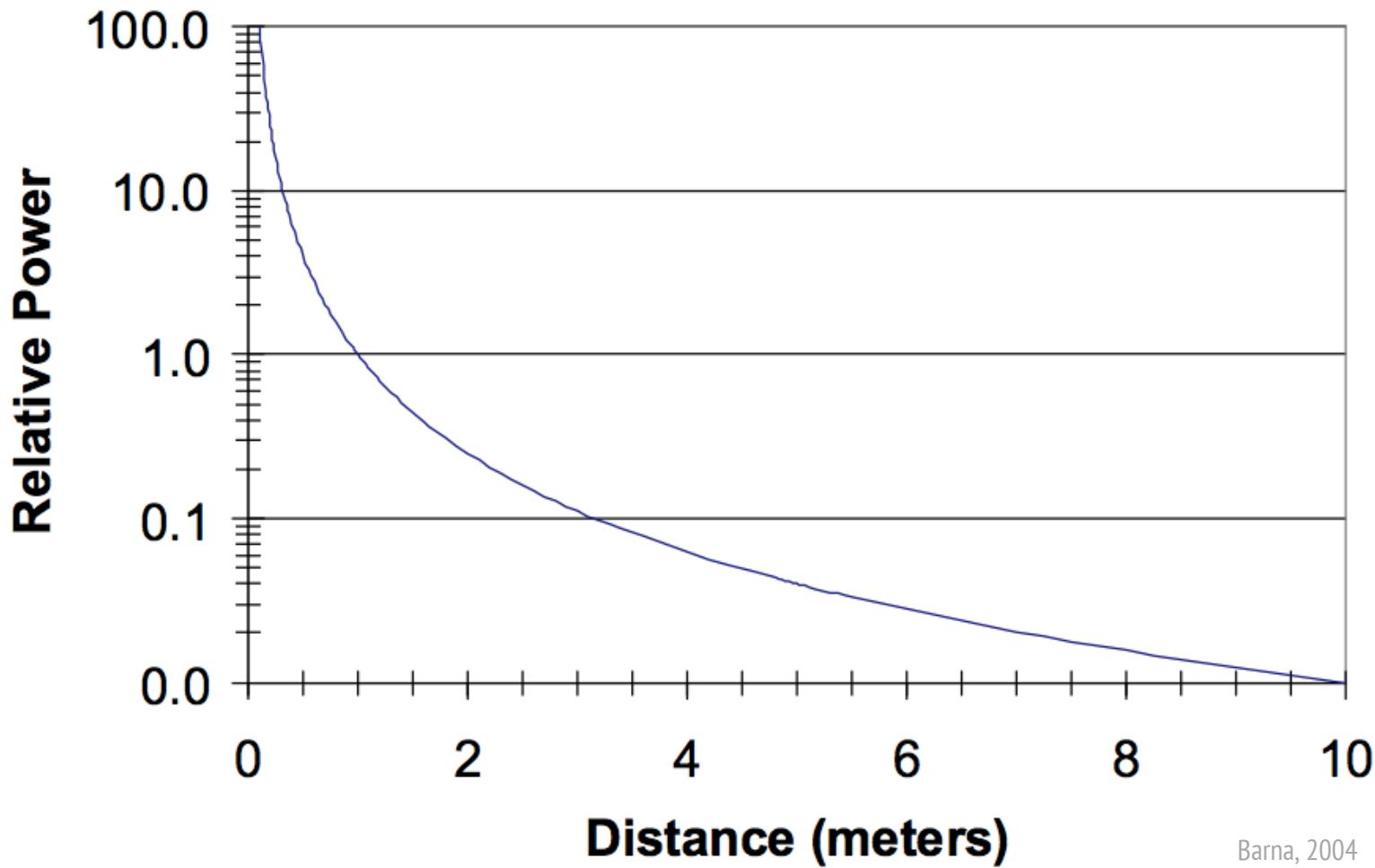


Photograph by A. Herzog

CONSIDERATIONS

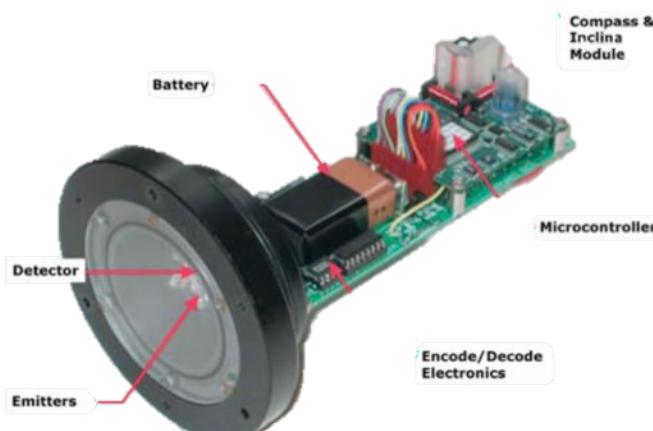


CONSIDERATIONS

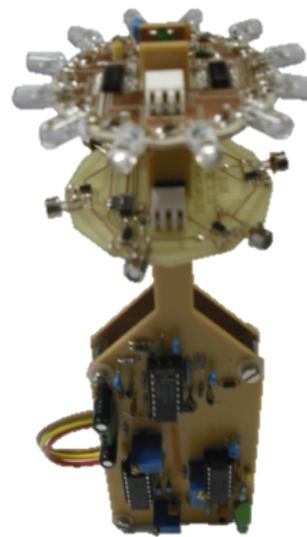


Barna, 2004

STATE OF THE ART



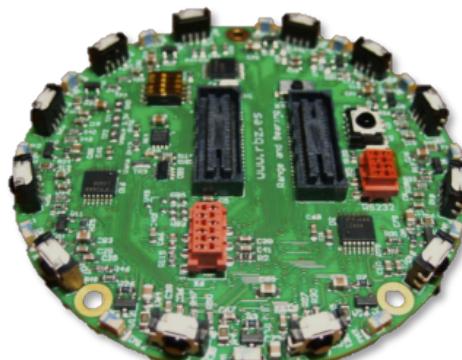
Tivey, 2004; WHOI



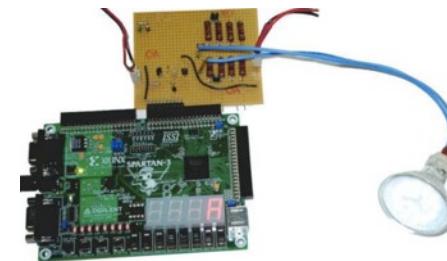
Anguita, 2010; Genova



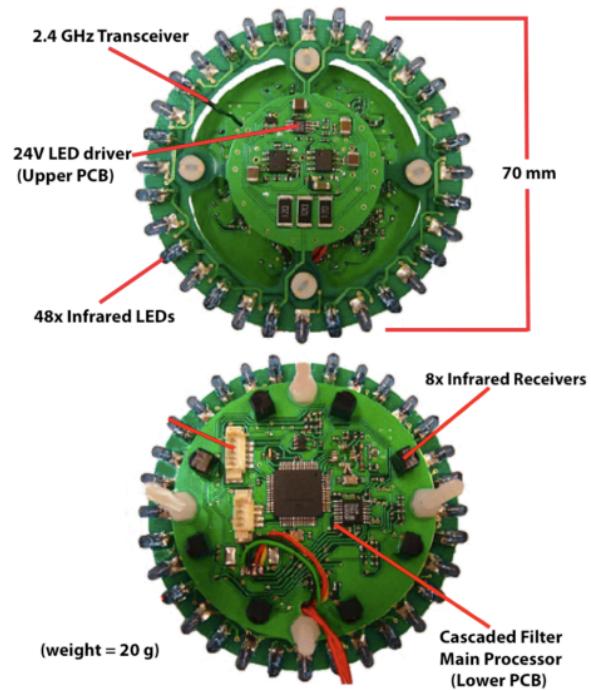
Kelly, 2004; USC



Gutiérrez, 2008; ETSI



Hernandez, 2006; CEDINT

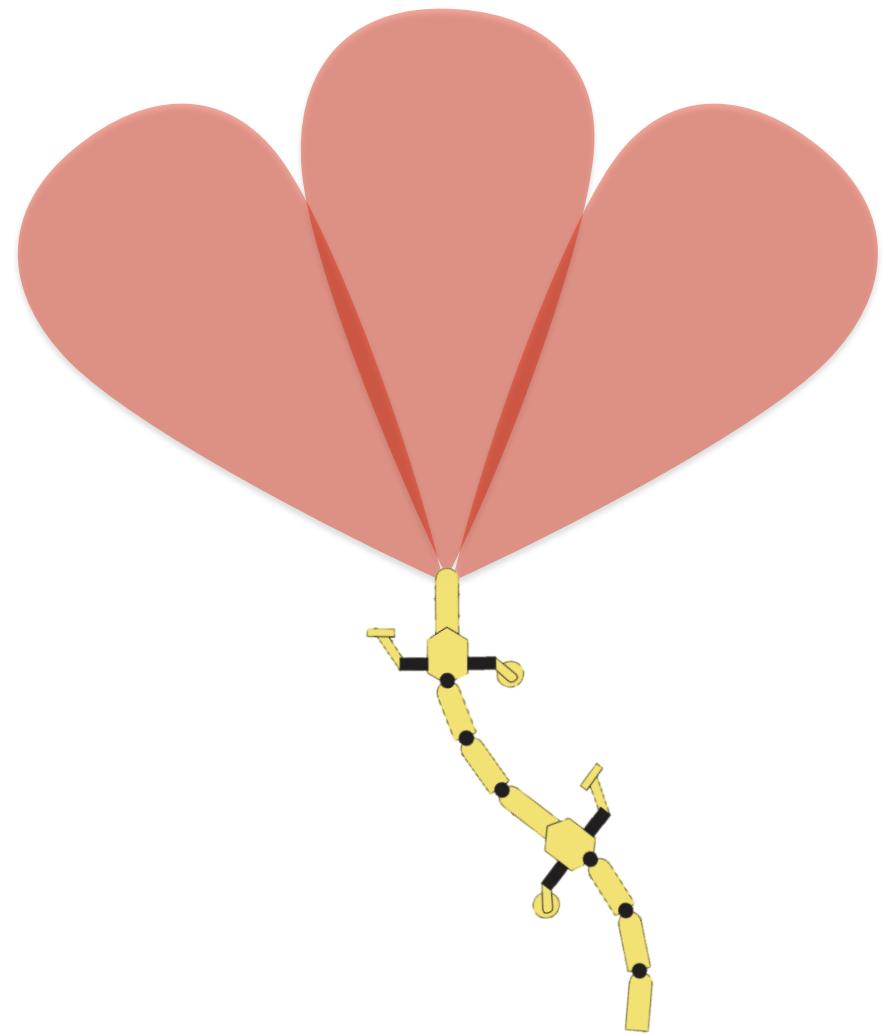


Roberts, 2009; EPFL

DESIGN



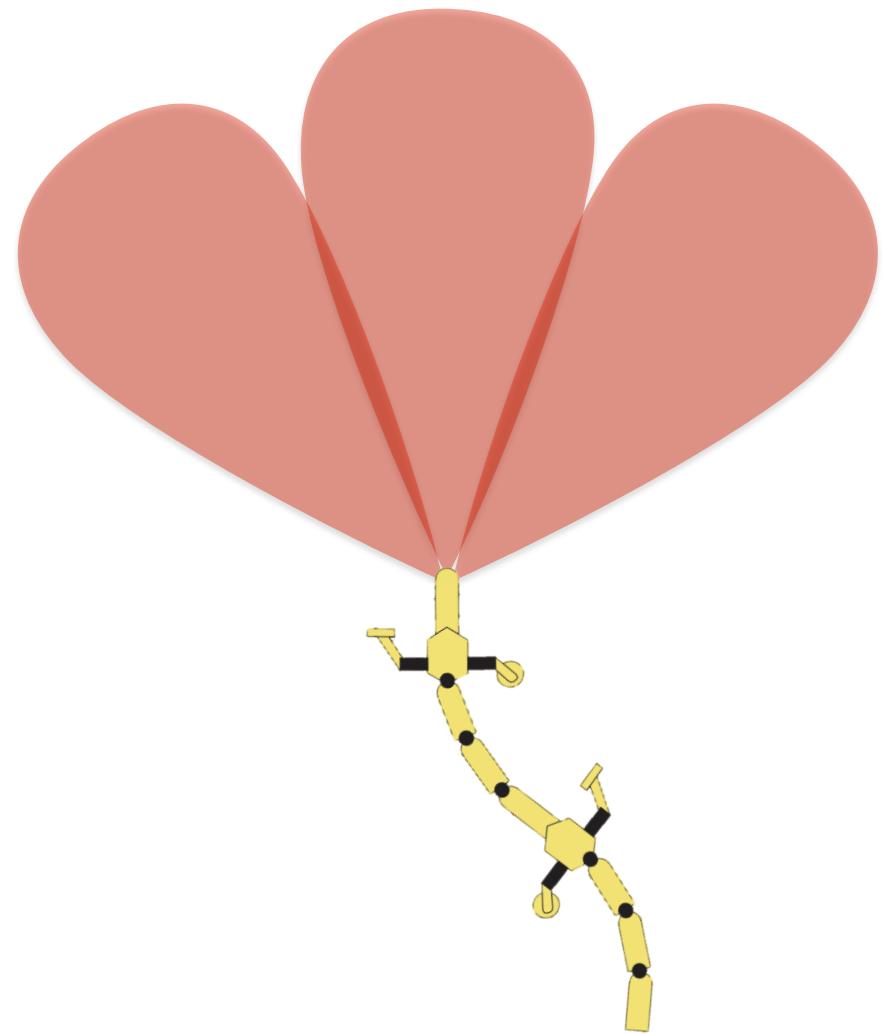
- Detector array



DESIGN

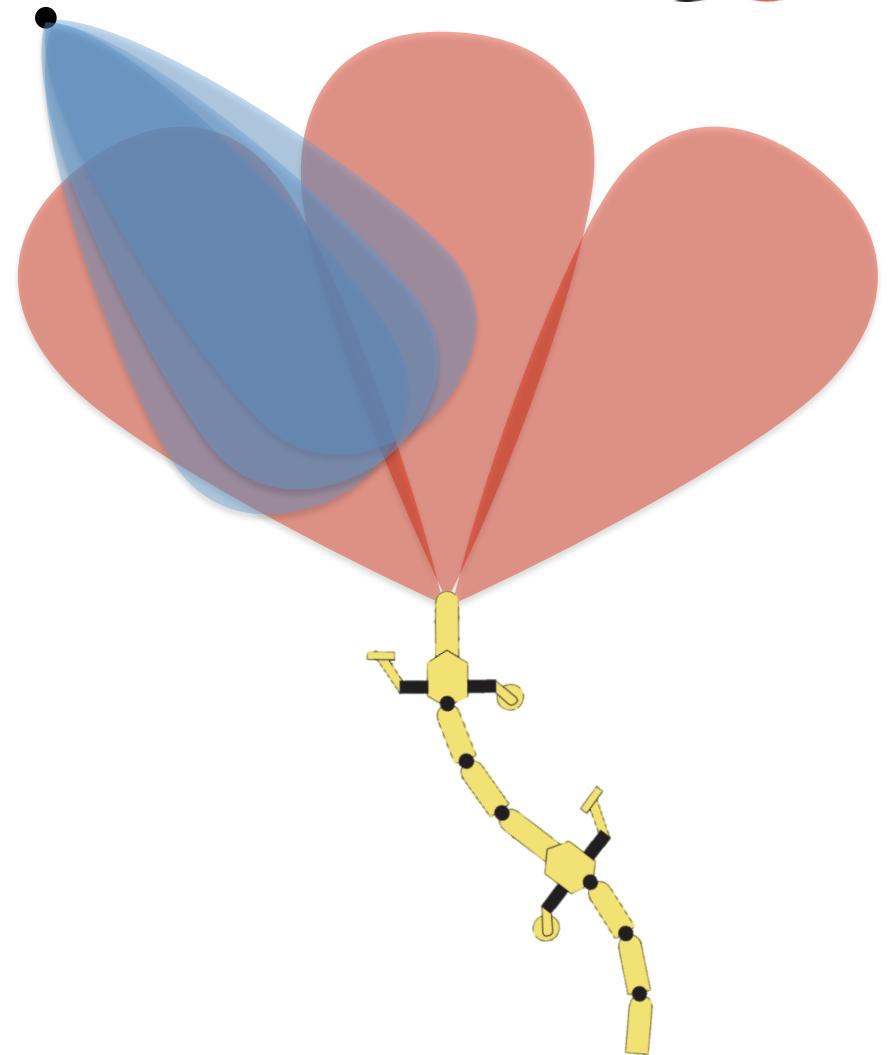


- Detector array
- Modulated signals (10 kHz carrier)



DESIGN

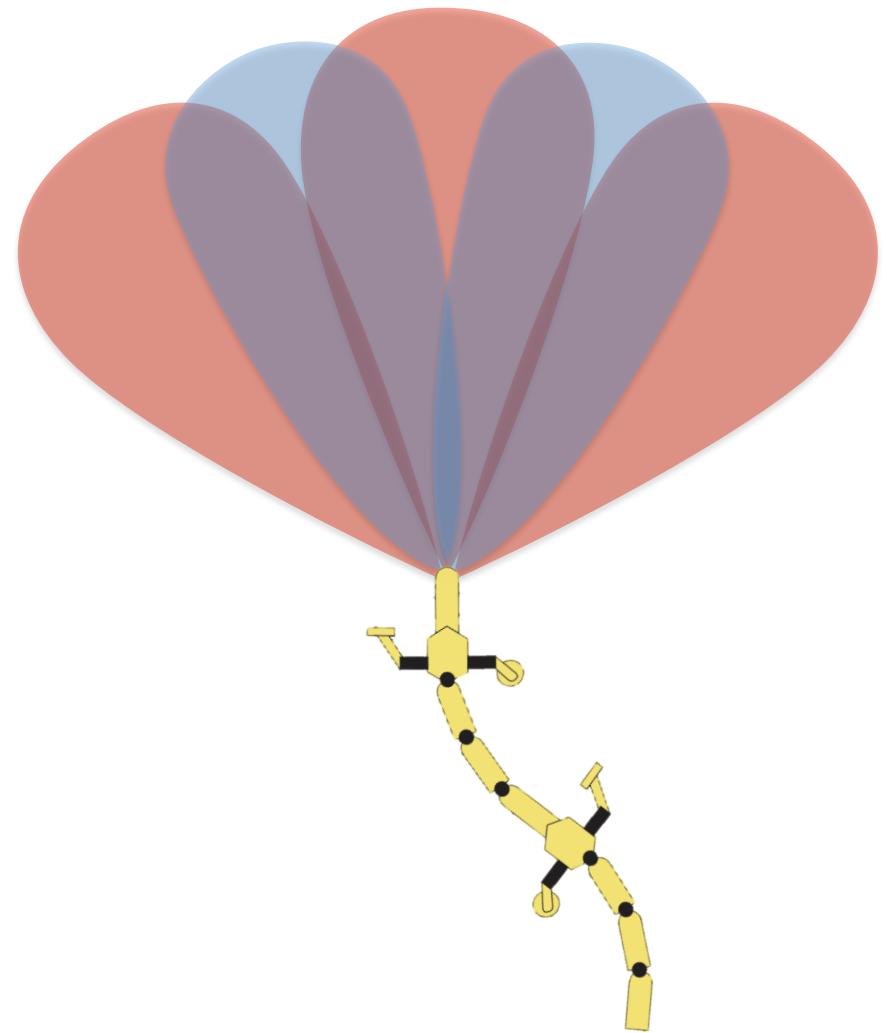
- Detector array
- Modulated signals (10 kHz carrier)
 - Active beacon



DESIGN



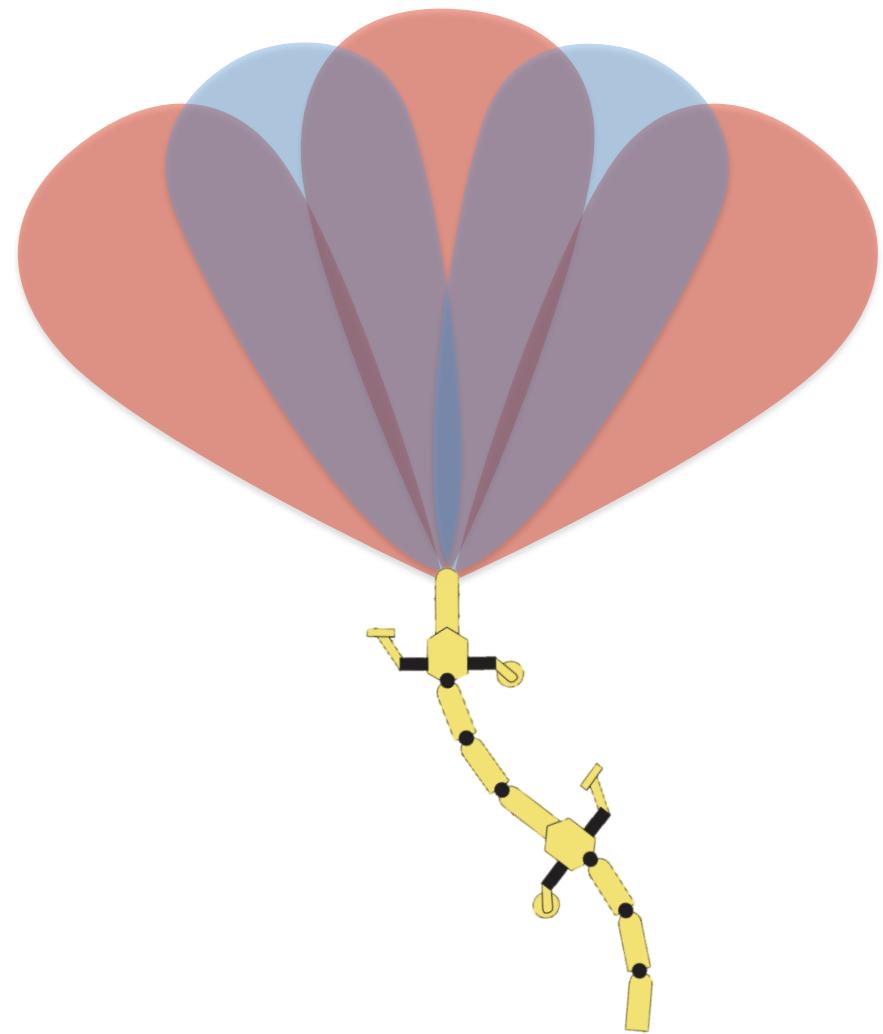
- Detector array
- Modulated signals (10 kHz carrier)
 - Active beacon
 - Onboard transmitter



DESIGN



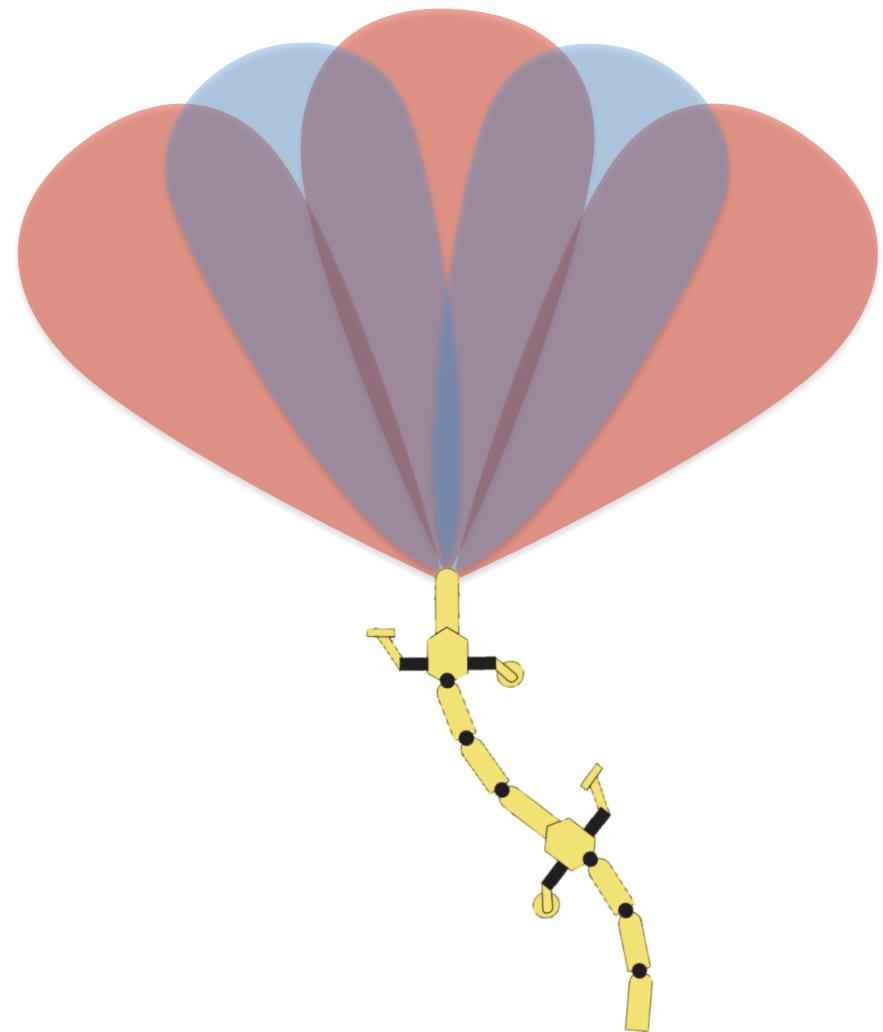
- Detector array
- Modulated signals (10 kHz carrier)
 - Active beacon
 - Onboard transmitter
- Transmit data over optical channel (PWM, PPM, OOK)



DESIGN



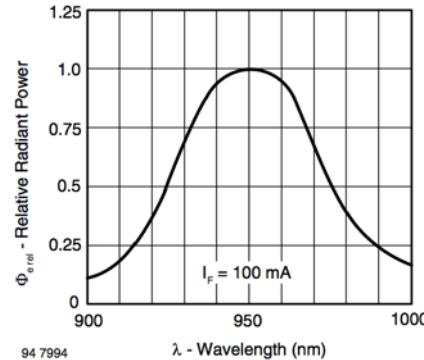
- Detector array
- Modulated signals (10 kHz carrier)
 - Active beacon
 - Onboard transmitter
- Transmit data over optical channel (PWM, PPM, OOK)
- Works with visible or infrared light



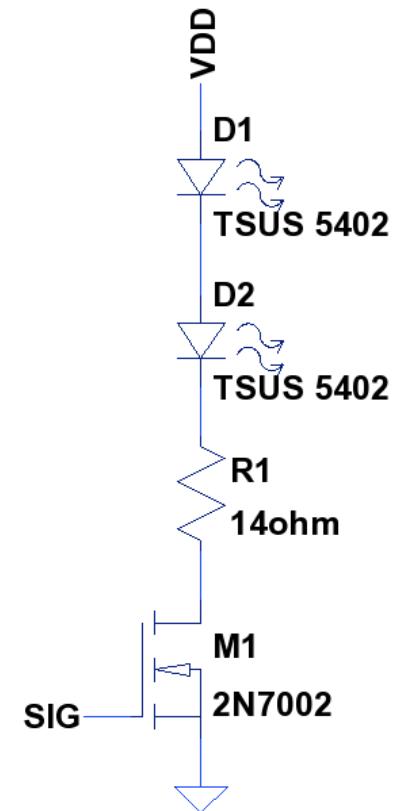
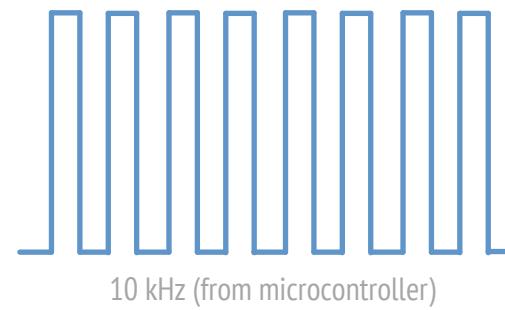
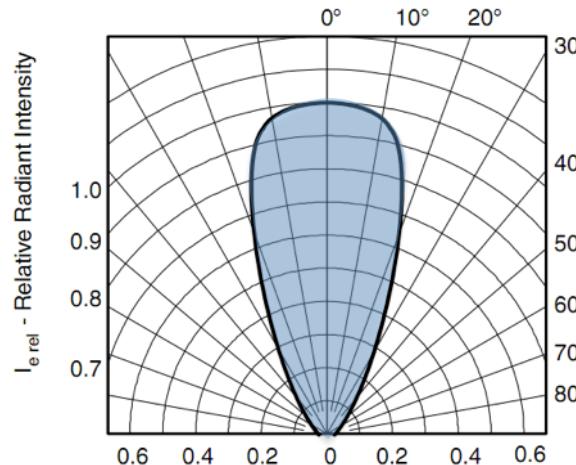
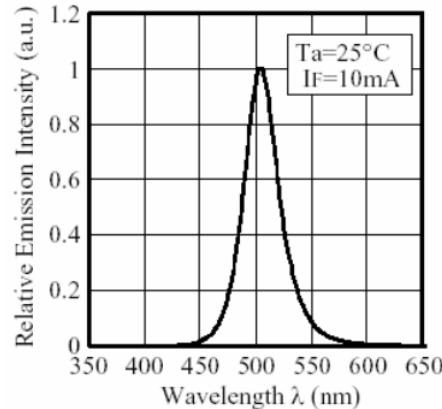


TRANSMITTER

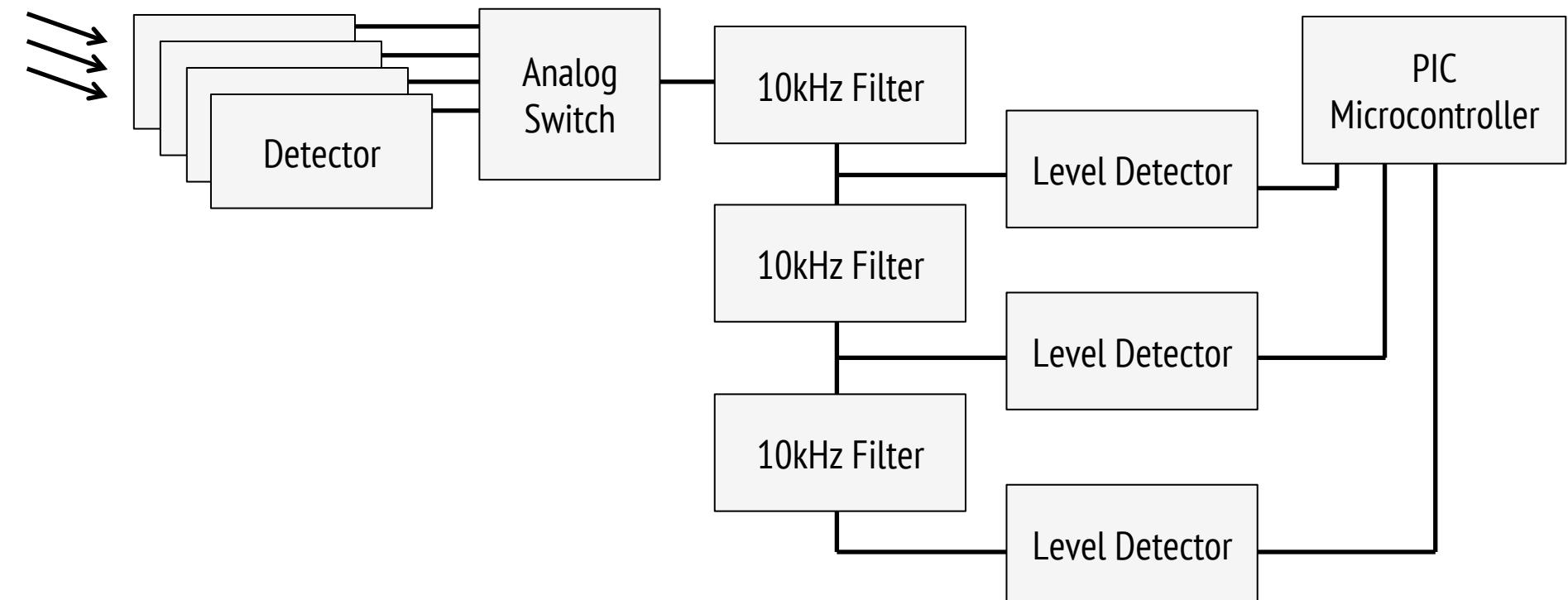
- Modulated 10 kHz carrier
- Infrared source: TSUS 5402



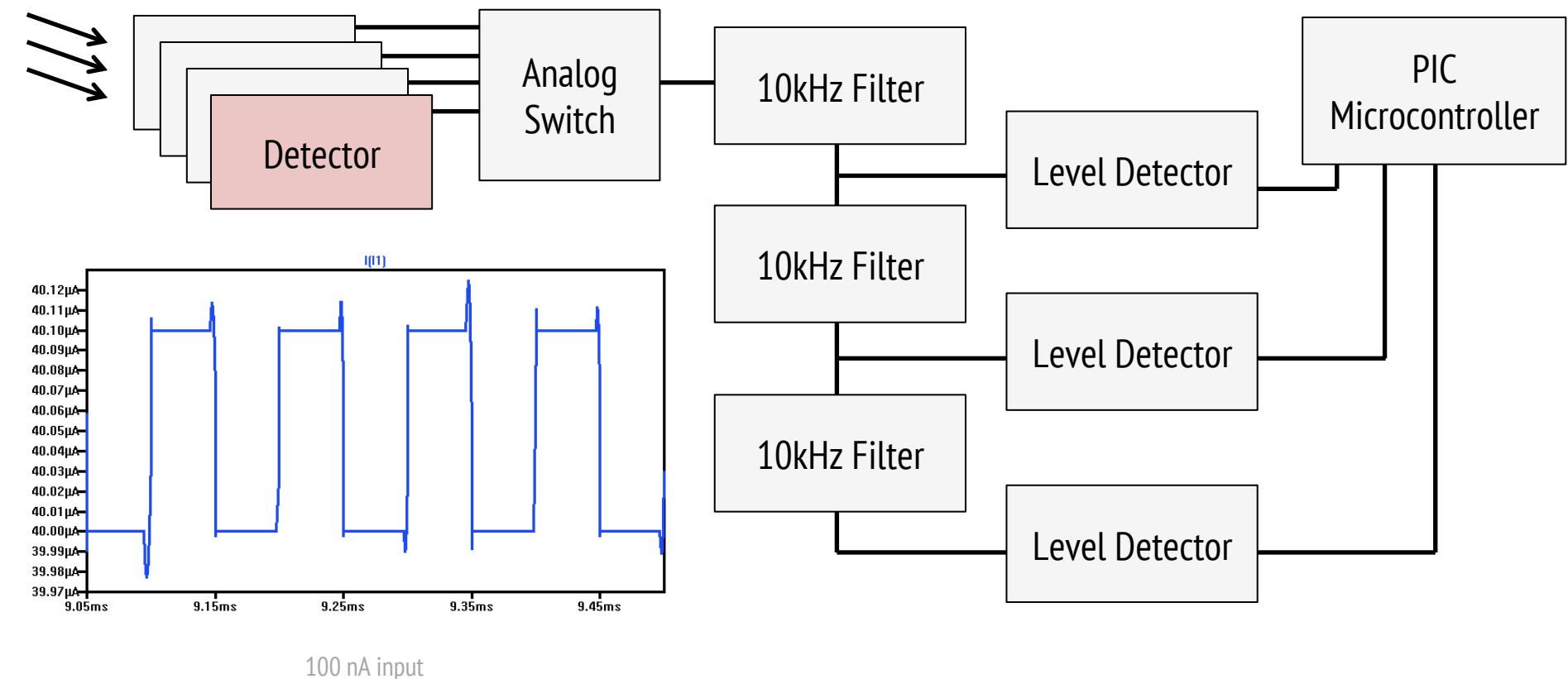
- Cyan light source: L5-BG1G



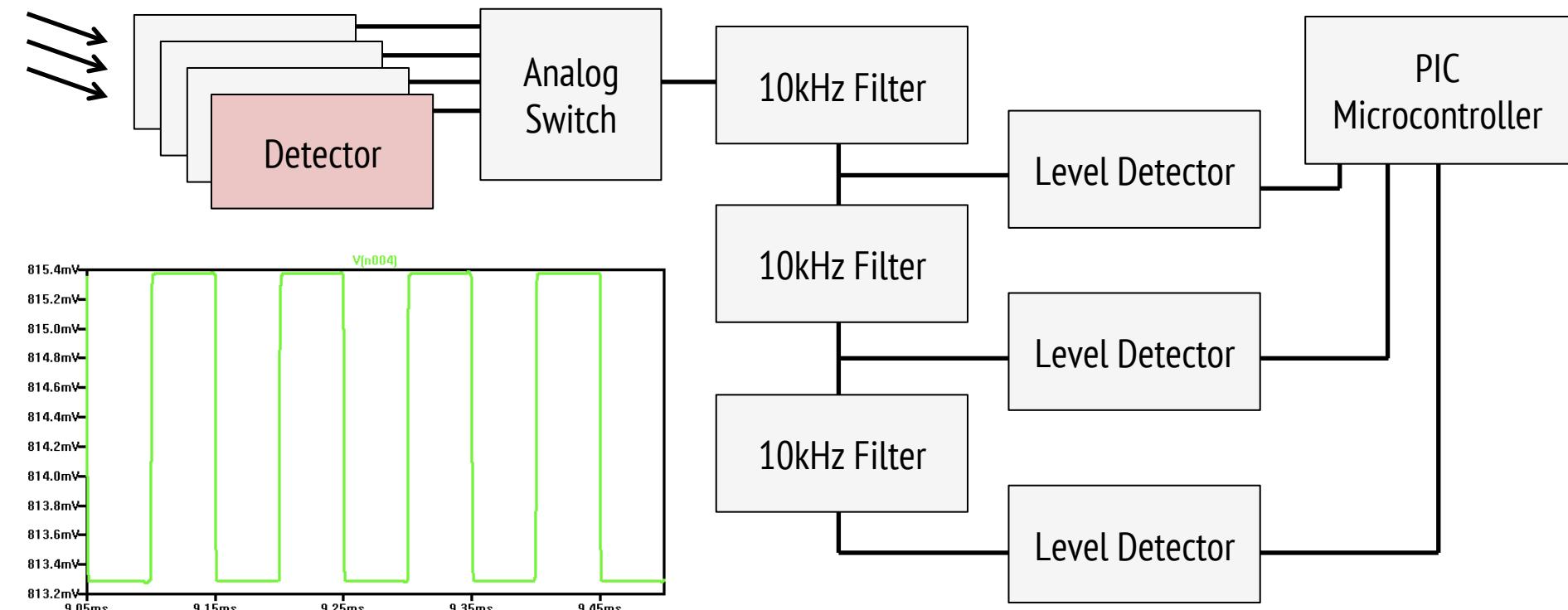
RECIEVER



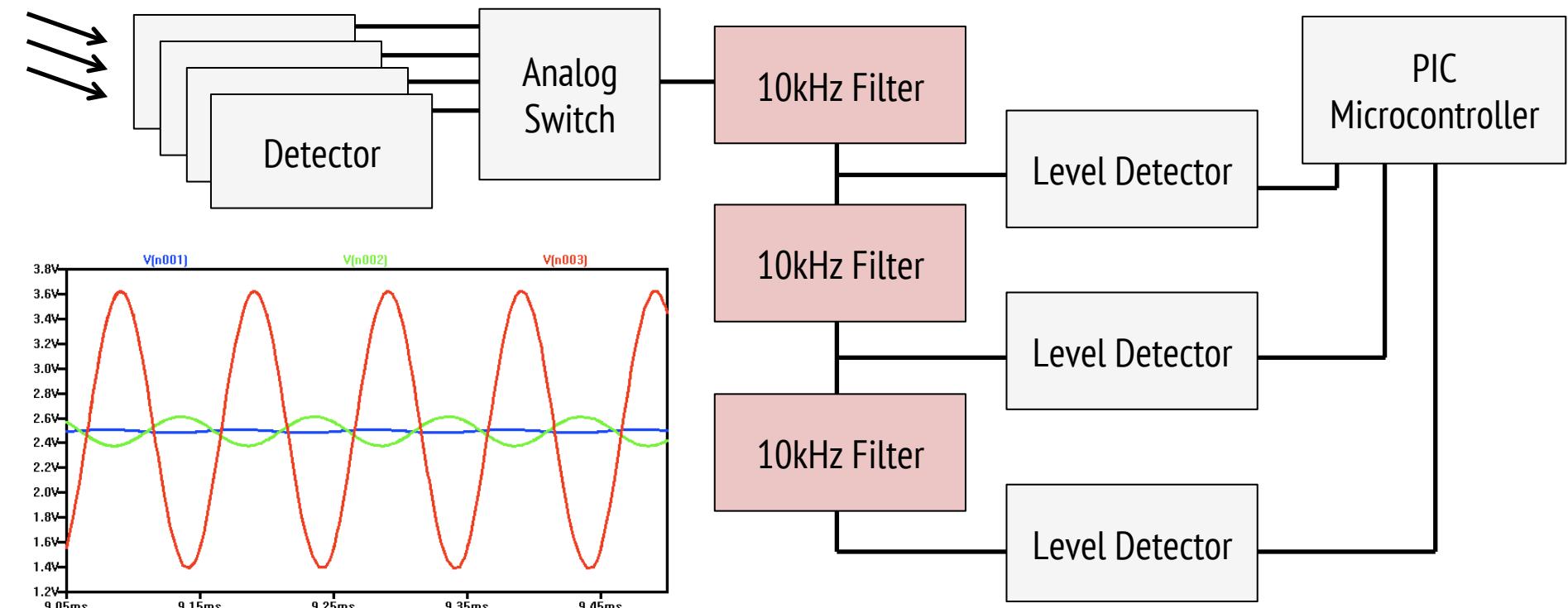
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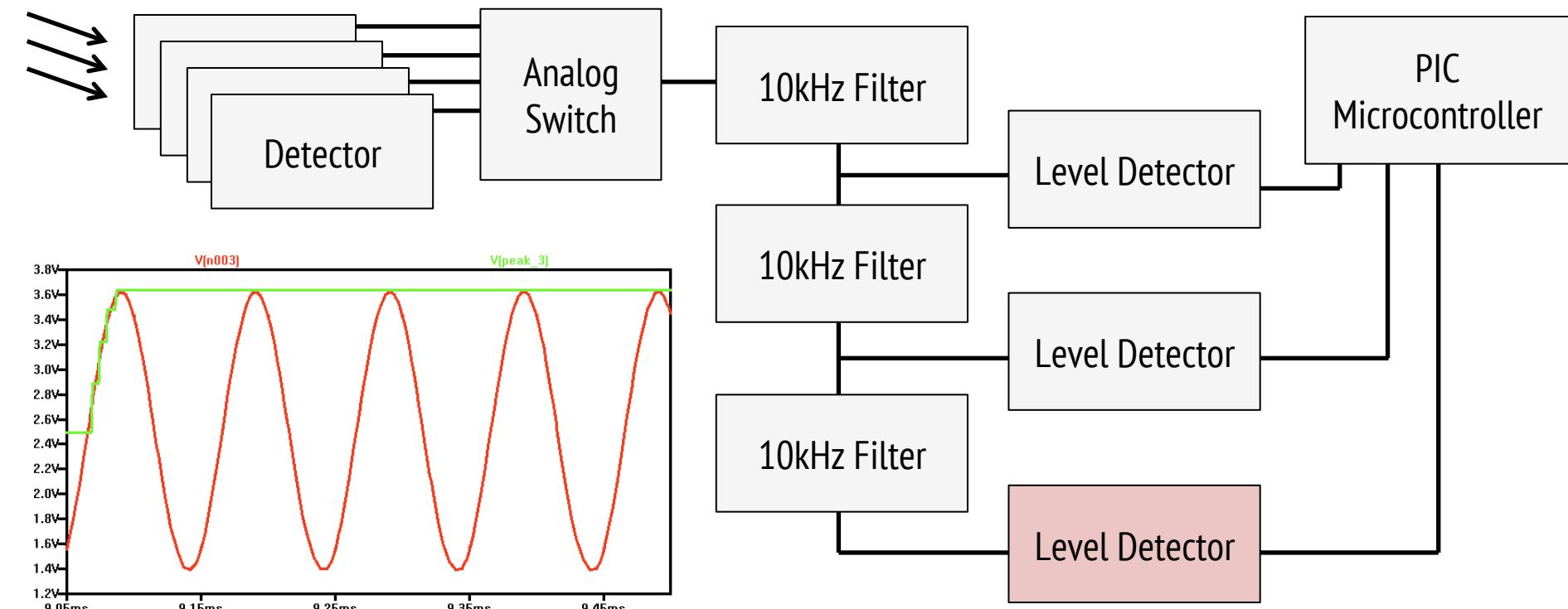
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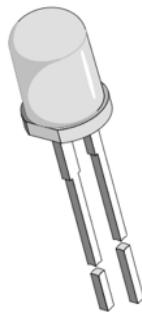
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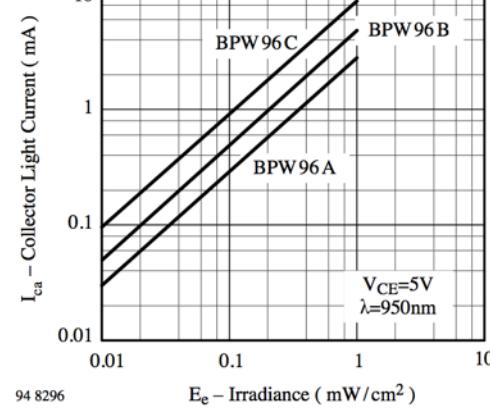
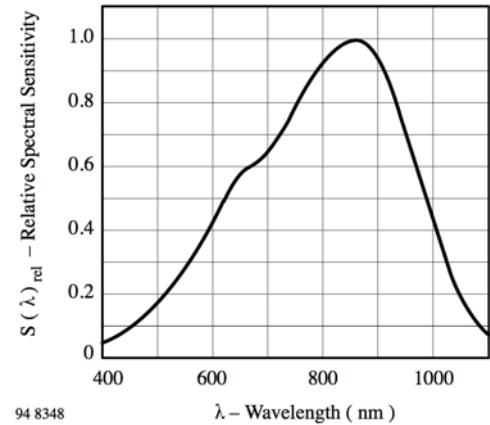
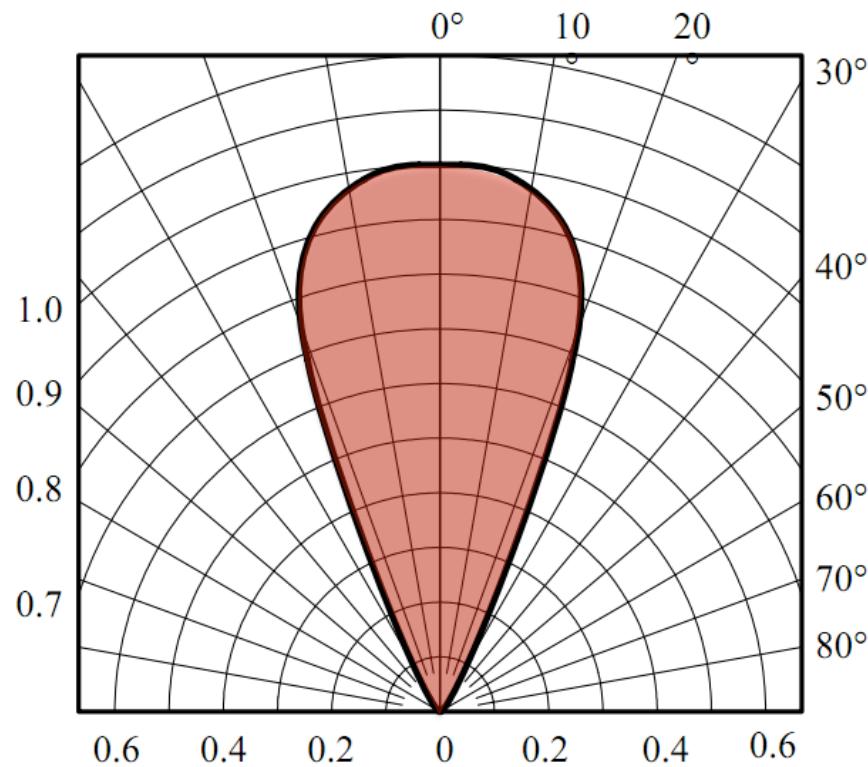
RECIEVER



DETECTOR



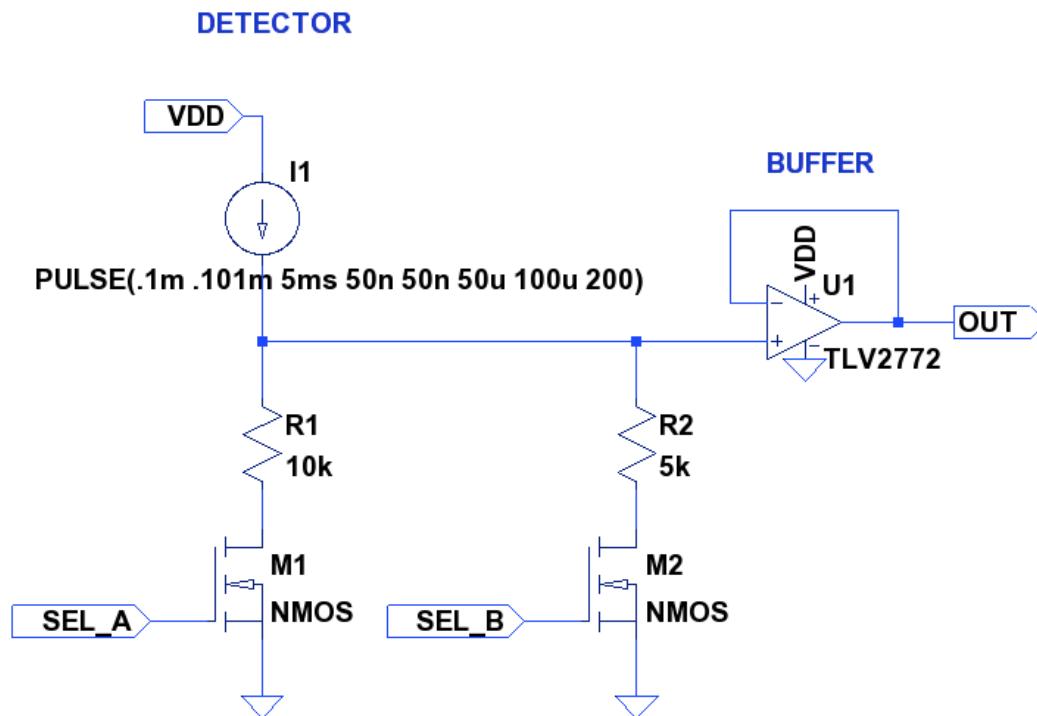
S_{rel} – Relative Sensitivity



DETECTOR



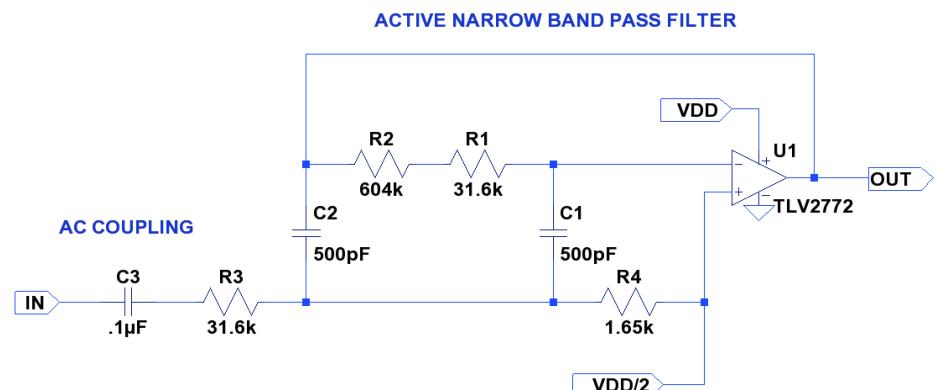
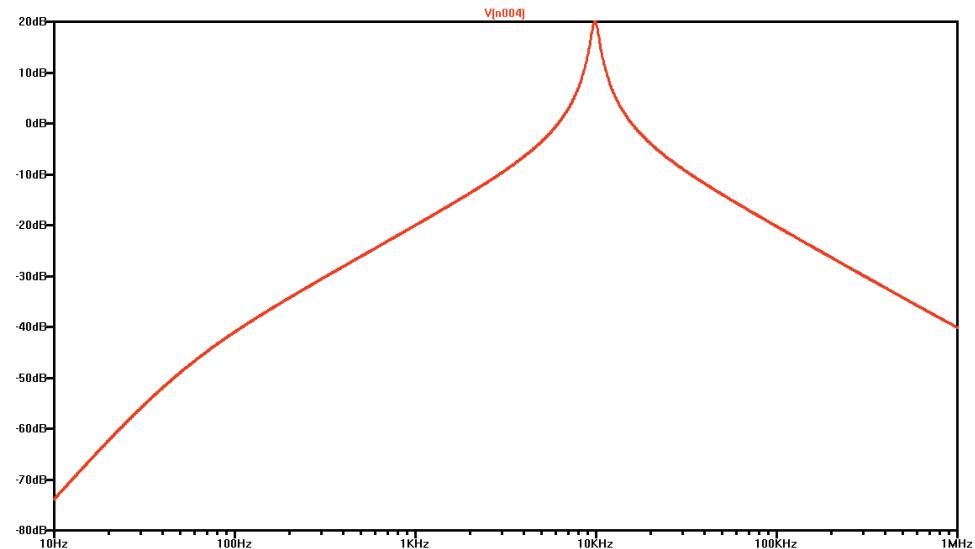
- Adjustable for different light conditions/sensitivity



FILTERS



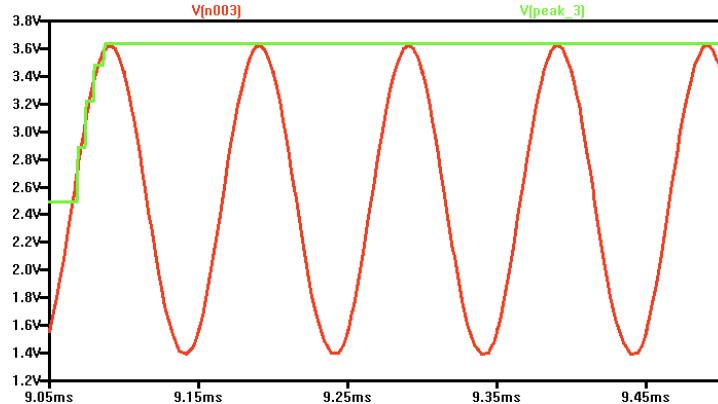
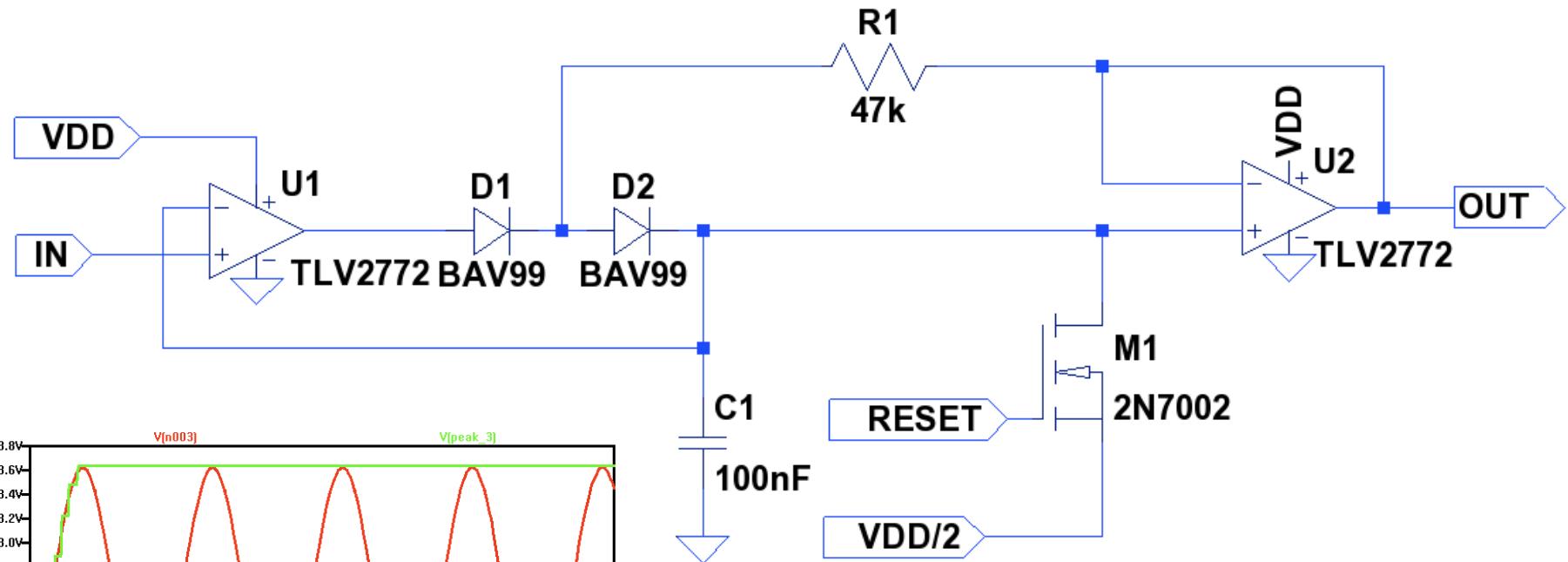
- Active, narrow band pass filters
 - modified Deliyannis filter
- Gain of 10 for selected frequency
- 3 cascaded stages
 - read signal strength from appropriate stage



LEVEL DETECTOR



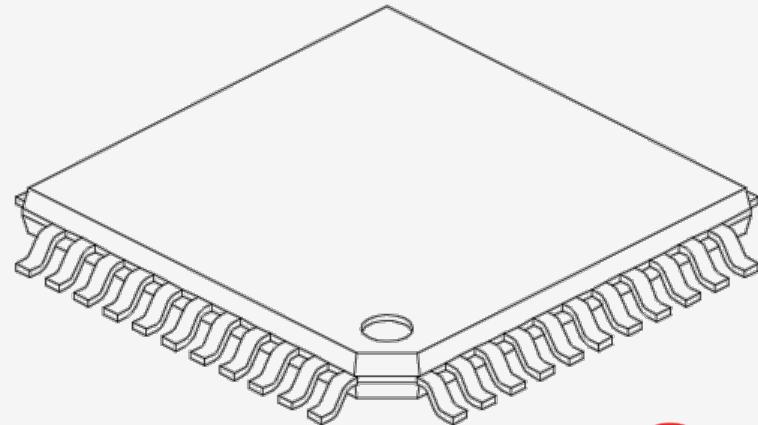
PEAK DETECTOR



MICROCONTROLLER



- Control low-level signals
- Analog-to-digital conversion
- Data processing
- Interface with robot



- PIC18F2580
 - 10 MIPS
 - 32 KB program memory
 - 100 ksps 10-bit ADC

NEXT STEPS



- Manufacture printed circuit board
- Program sensor firmware
- Calibration
- Testing
- Demo with salamander (head following an active sender)



QUESTIONS

