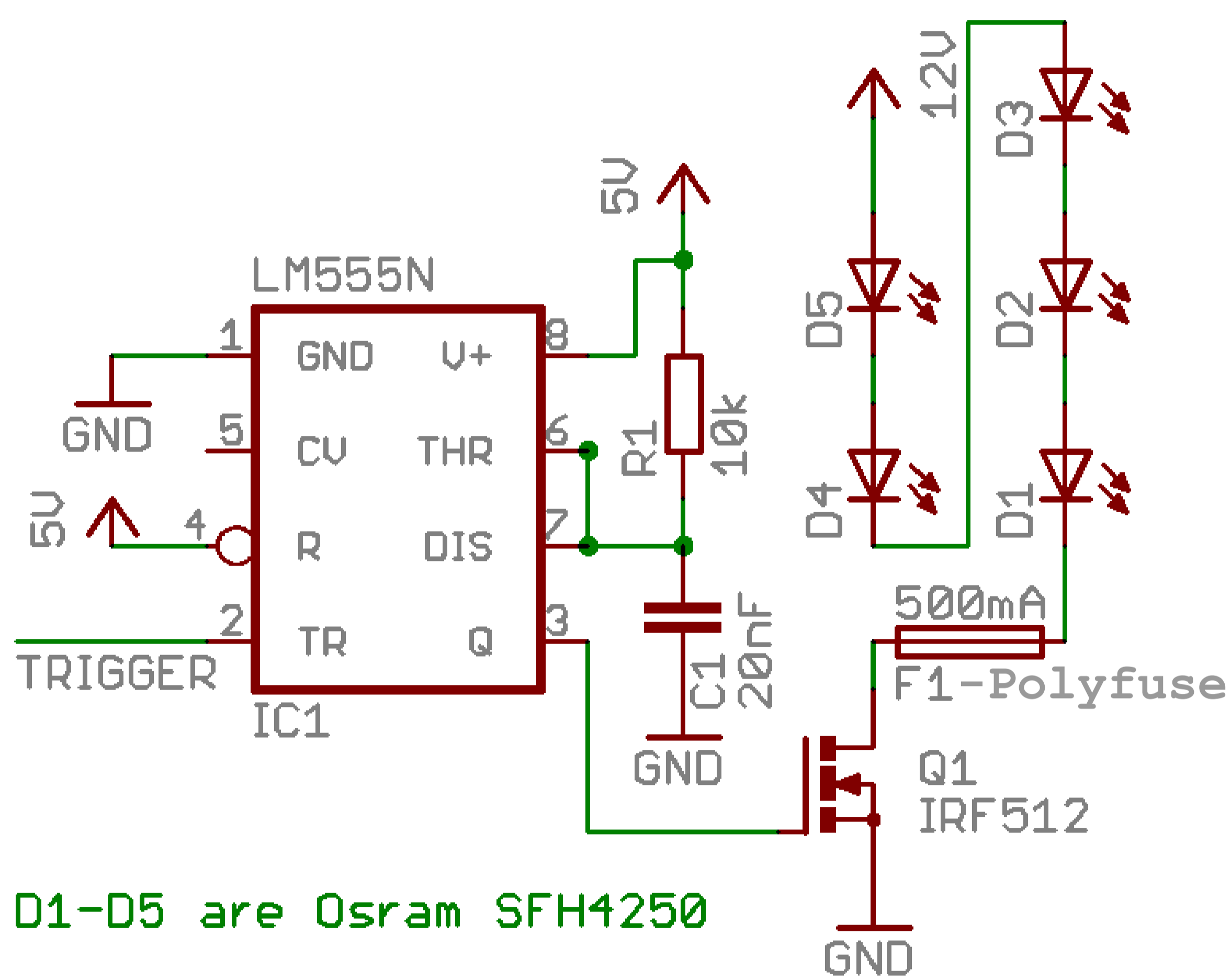


# A Short Guide to Modulated Light

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**Motivation & Problem.** Infrared sensing is often highly sensitive to ambient light, as many naturally occurring and artificial IR sources exist (e.g. sun, fluorescent lights..). When the LEDs which illuminate the relevant parts of the scene are pulsed and synchronized to the camera, the amount of ambient light hitting the sensor is significantly reduced, thereby increasing contrast. While this method is widely used in the computer vision community, an easily applicable reference doesn't seem to exist. We aim to provide such a reference with this paper.

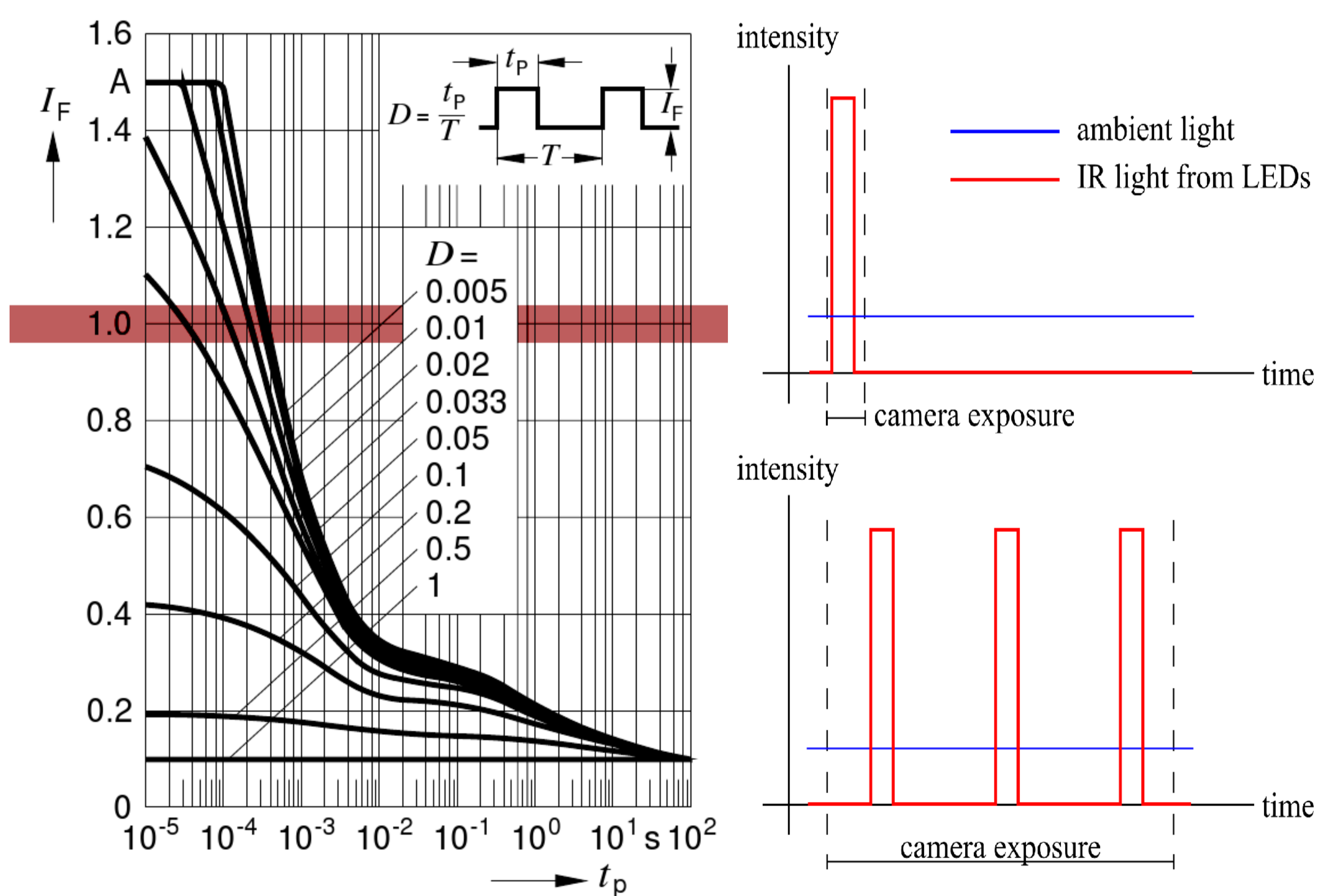
## Circuit Example: Mark I



## Camera & Circuit Tips

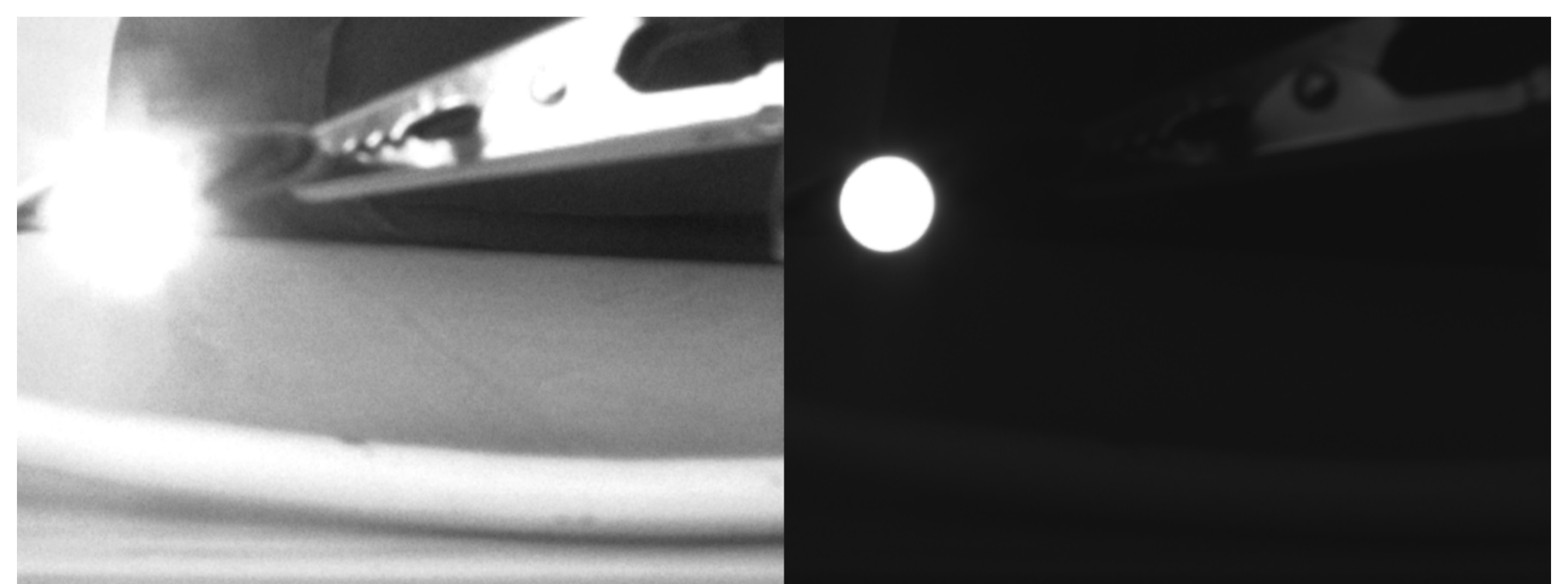
- Webcams (rolling shutter) do not work
- start of integration different for each line
- industrial-grade cameras (usually DC1394-based) recommended
- short integration times  $\leq 1$  ms must be supported
- *important*: disable auto exposure control!
- note: some cameras permit precise control of trigger pulse
- possible to connect FET directly
- *important*: camera trigger pulse must be at start of frame!
- alternative controller ICs: ATtiny12, Atmega8
- more complex, but also more versatile
- don't forget to add a fuse - use *lower* rating than pulse current
- will immediately blow in case of continuous current
- use polyfuses for better maintainability - thanks to Steve Hodges for the suggestion!

## Pulse Width Selection



- example from datasheet: Osram SFH4250
- recommended pulse current: 1.0 A (highlighted)
- $T = t_p / D$  must match camera frame rate
- select rightmost curve where  $T < 1/f$
- intersection with 1.0 A:  $t_p \sim 300 \mu\text{s}$ ,  $D = 0.02$ ,  $T = 15$  ms
- sufficient for 60 Hz framerate ( $T < 1/60 \text{ Hz} = 16.6$  ms)

## Results



- LED viewed head-on by camera
- left image: normal mode
  - LED continuously pulsed
  - integration time 1/fps (full frame)
  - LED values: 255, background values: 160
  - contrast: 1 : 1.6
- right image: pulsed mode
  - single pulse of 200  $\mu\text{s}$  per frame
  - integration time 200  $\mu\text{s}$
  - LED values: 255, background values: 20
  - contrast 1 : 12.8
- *contrast increase by factor 8 !*