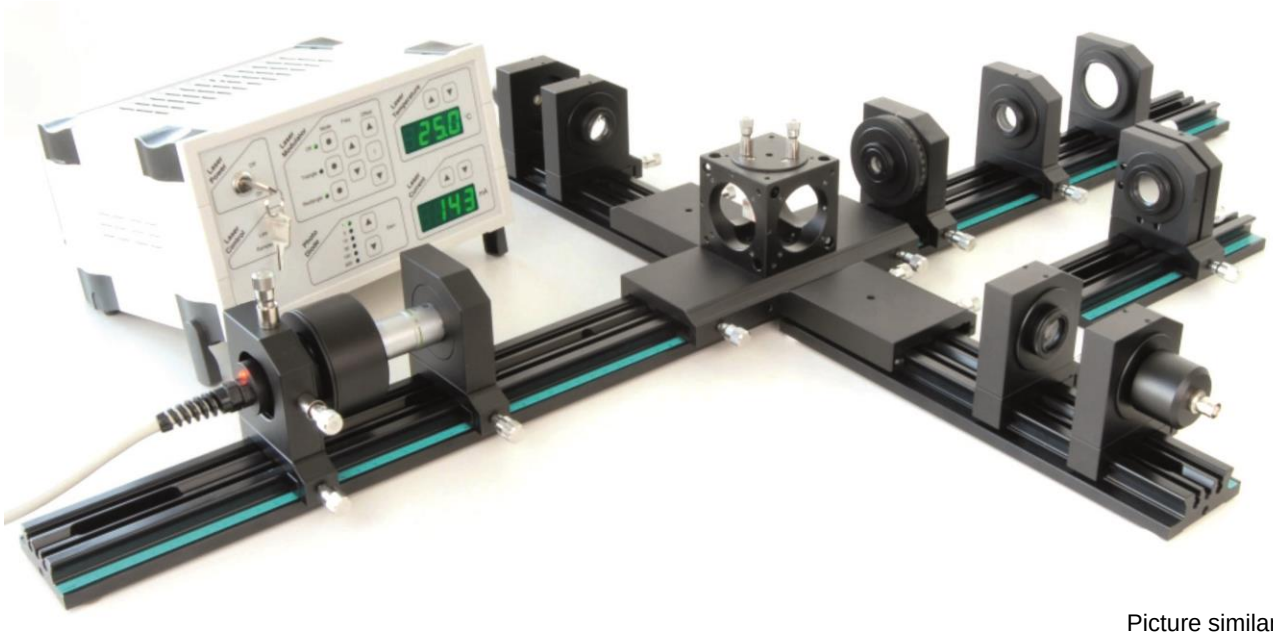
Laser Range Finder (CA-1340)



Picture similar

This educational kit shows the basics of distance measurement with pulsed lasers. The application, also known as LIDAR (**LI**ght **D**etection **A**nd **R**anging), works like RADAR (**RA**dio **D**etection **A**nd **R**anging), but uses light instead of radio waves. The LIDAR system sends light to a target which scatters or reflects the light back towards the LIDAR system. Hereby the pulse energy and the focusablilty as well as the amount of scattered/reflected light define the maximum detection range. On the other hand, the temporal laser pulse width limits the resolution of the measurement system.

After assembling the range finder kit, distance measurements can be performed. The pulsed laser module sends short and intensive pulses towards the provided corner cube reflector or an object of interest. An optical diode divides the laser pulse in a reference and an object pulse, respectively. The reference pulse is sent directly to a photo detector which generates the trigger signal for starting the measurement. After scattered back from the target, the object pulse is guided to the signal detector by the optical diode. The time of flight of the backscattered laser pulses determine the distance of the measured object. The pulse temporal width reaches below 5 ns and distances of less than 40 cm can still be measured in the laboratory environment. High peak power and low beam divergence allows the measurement of targets in distances of up to a hundred meters, still with a standard InGaAs detector. Since the laser module emits at 1535 nm, the laser radiation lays in the eye safe wavelength range.

This educational kit requires a two channel 100 MHz oscilloscope (optionally available).

Educational Objectives of Investigation

- Pulsed Laser Module
- Light Echoes
- Time of Flight
- Optical Diode
- Beam Shaping and Bending
- LIDAR
- Velocity of Light
- InGaAs Photo Detector

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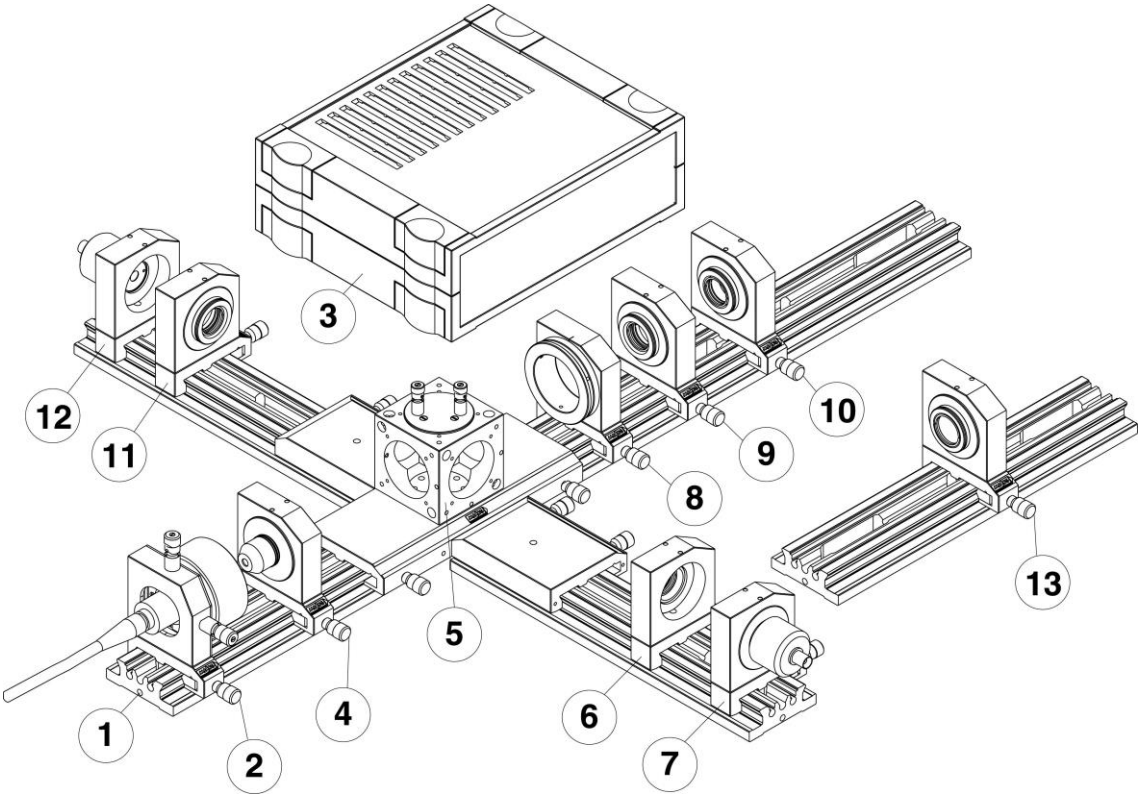
Setup and Components of the kit



1	Set of 5 flat rails with scale
2	Pulsed laser module in θ/φ adjustment holder
3	Pulse laser power supply PLPS 1000
4	Laser Beam shaping optics in holder
5	Polarizing laser beam splitter optics on cross piece
6	Imaging optics for start pulse detector
7	Detector for start pulse in holder
8	Quarter wave plate in rotation holder
9/10	Beam expander optics
11	Imaging optics for measurement pulse detector
12	Detector for measurement pulse in holder
13	Corner cube reflector for measurement of larger distances
14	Optionally available: Two-channel oscilloscope 100 MHz
15	IR detector card 800 nm – 1600 nm (not shown)
16	2 BNC cables with BNC T pieces and 50 Ω shunts (not shown)
17	User manual (not shown)

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Ordering Information

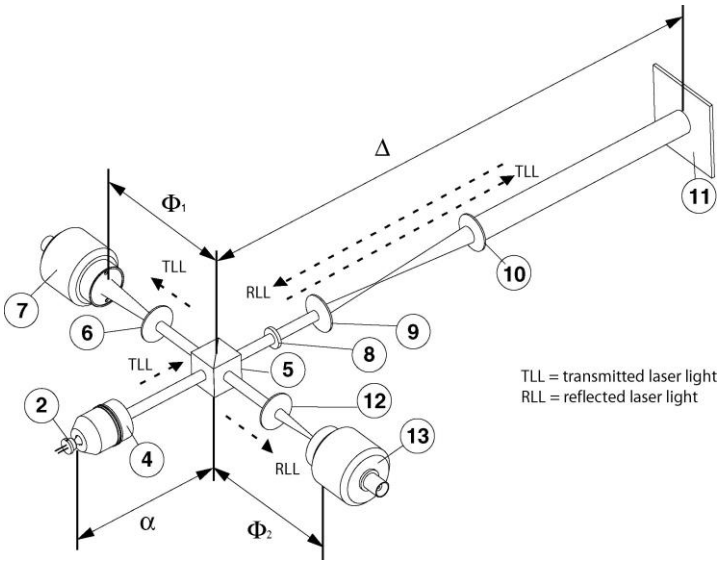
For ordering the Laser Range Finder kit (CA-1340)

use ordering number: 490091340

Measurements and Handling

Some of the possible measurements are presented in the following list:

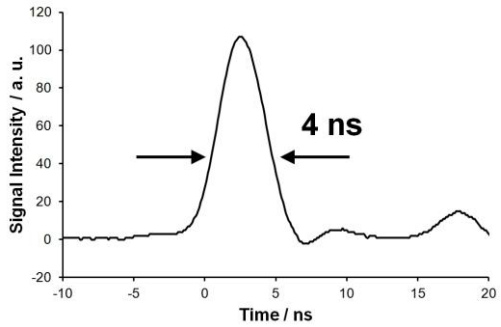
- **Setting up a Range Measurement System with an optical diode**



The collimated laser beam (2/4) is divided in two beams by the optical diode consisting of the polarizing beam splitter (5) in combination with the λ/4 quarter wave plate (8). The reference beam is expanded (6) and guided to the reference photo detector (7), the object beam back scattered from the target (11) is guided to the signal photo detector (13). A beam expander (9/10) widens the laser beam for better collimation.

Setting up the system and aligning of all of its elements are trained.

- **Pulse width of q-switched laser module**



The laser in use is a q-switched laser module with a pulse width of less than 5 ns. With an oscilloscope of 100 MHz or better, the pulse width can be displayed and measured on the oscilloscope screen. It must be taken care, not to saturate the detector. Otherwise the measured pulse width is too large.

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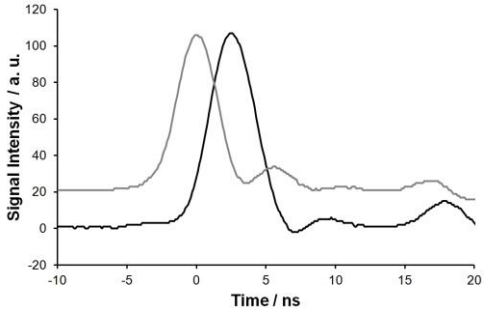
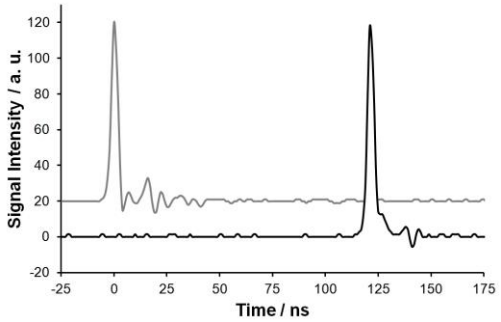
- **Resolution of range sensing**



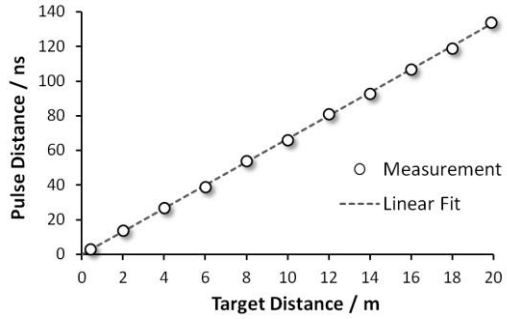
With a pulse width of less than 5 ns, target distances of as short as 40 cm can easily be resolved. Especially for such short distances it must be taken care, not to saturate the measurement detector. A saturated signal may show a pulse elongated by several hundreds of nanoseconds. In the example on the left picture the pulse distance is 2,3 ns which corresponds to a target distance of 35 cm.

- **Long distance measurements**



Due to the high peak power and low beam divergence of the laser module, measurements of several tens of meters can be performed. In the example on the left picture the pulse distance is 120 ns which correspond to a target distance of 18 m.

- **Evaluation of speed of light**



A measurement of time of flight values for a series of distances can be performed. The slope of a linear fit of the data points is related to the speed of light. If big bodies of transparent materials are available, the index of refraction of these materials can be determined (note: the laser emits in the infrared range).

- **Possible extension**

The kit can be used for a measurement of the length of a glass fiber. A suited fiber and mechanics for coupling laser light in the fiber is offered by eLas and can be ordered optionally.

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