Laser Range Finder

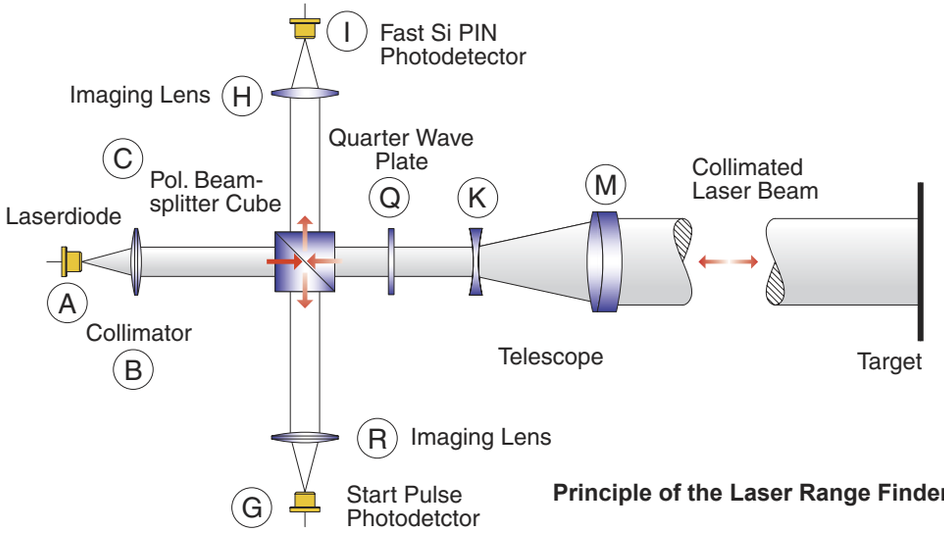
Topics:

- ✓ Laser Diode Pulsed and CW
- ✓ Lenses and Beam Shaping
- ✓ Beam Splitter
- ✓ Retro Reflectors
- ✓ Si PIN Photo Detector
- ✓ Light Echoes
- ✓ Time of Flight
- ✓ LIDAR

Laser range finding is one of the applications of light detection and ranging known as LIDAR. The principle of this technique is well known from the RADAR (Radio Wave Detection And Ranging). Instead of using radio waves, the LIDAR uses light as electromagnetic wave. Both techniques are based on the emission of a short pulse of electromagnetic radiation and the reception of back scattered signals from a target. The time t between the emission and reception of the pulse is measured and the distance d is calculated based on the velocity v of electromagnetic radiation. Using $v \approx 3 \times 10^8$ m/sec for the speed of light, the time interval t for a distance d of 10 m will be 60 nsec. The pulse duration must be modified to match the required resolution and distance. In this experiment, the shortest pulse duration is 75 nsec with a rise time of 10 nsec. When the laser pulse is launched, a photo detector is used to generate a start pulse signal which serves as trigger for the two channel oscilloscope. The trigger will be set to the falling edge of this pulse allowing the detection of distances also below 10 m. The second channel of the oscilloscope will be connected to the receiver photo detector. The power of the laser diode is limited to 30 mW for safety reasons and therefore a corner cube reflector is used as a target which is positioned to the object of interest. The controller of the diode laser can be operated in pulsed as well as in continuous mode. An external modulator can be applied to generate different pulse shapes. The capabilities of the controller also allows the characterisation of the laserdiode itself. The output power versus the injection current can be recorded and subsequently the modulation behaviour investigated. The figure above shows the complete arrangement of the Laser Range Finder set-up. With some modules this set-up can be upgraded for the „OTDR“ experiment. For this experiment, a two channel 100 MHz oscilloscope is required.

Principle of operation

Short light pulses are generated by means of a laserdiode (A) which is driven by a control unit. The divergent emission of the laser diode is collimated (B) and directed to the polarising beam splitter cube (C). The polarisation of the emission of the laserdiode is oriented for maximum transmission. A small amount of laser light is passed to the start pulse detector (G). For a low divergence on large distances the laser beam is expanded by the telescope consisting of the elements (K) and (M). The back reflected light from the triple reflector target (T) enters the telescope and has a different polarisation state and will therefore mainly be reflected at the polarising beam splitter cube (C). With the quarter wave plate (Q) the polarisation state can be influenced in such a way that almost the entire back reflected light is passed to the fast Si PIN Photo detector. The scattered light is focused by means of the imaging lens (H) onto the sensitive area of the photo detector. Since the rise time of the signal pulse is about 50-100 nsec and the back scattered light of several magnitudes less in intensity compared to the signal pulse, a high sensitive and fast photo detector with pre-amplifier is used.



Principle of the Laser Range Finder

Required Equipment

Cat. No.	Qty.	Description
02.0300	2	Profile rail OCM 650, 300 mm
02.0500	2	Profile rail OCM 650, 500 mm
02.2063	1	Mounting plate OCM 650 RMS threading
02.2126	2	Mounting plate OCM 650 for click 25
02.2132	1	Mounting plate OCM 650 for click 30
02.3022	1	XY-adjustment holder OCM 650
04.0010	1	Microscope objective x 10 with RMS thread
04.0040	1	Triple reflector mounted in click 30 mount
04.0050	2	Biconvex lens f=60 mm in click 25 mount
04.0302	1	Infrared display card 0.8-1.2 µm
04.0604	1	Beam splitter unit
05.0215	1	DIMO 820 OTDR (50 nsec)
07.0003	1	Set of 3 BNC connection leads
07.0102	1	PIN Si photo detector BPX 61 with housing
07.0202	1	PLDC-01 pulsed laser diode controller
09.0124	1	Coupling optics with microscope objective
09.0134	1	Quarter wave plate in rotational stage
09.0154	1	Telescope optics
10.0150	1	EXP 15 manual
Required Options:		
19.0140	1	Dual trace oscilloscope 100 MHz
Options:		
09.0159	1	Set of spare parts