# Leica DISTO™ measuring principle

Explained in simple terms

## Two types of length measurement

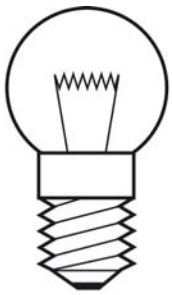
See a lightning flash and start counting the seconds. If you get to 15, divide by three – and you know that the storm is still five kilometres away. This measuring principle, which is also used by laser devices, is known as the “running time procedure”.

The speed of light is much higher than that of sound, and the times involved are extremely short where distances are limited. It thus follows that short distances of just a few metres cannot be measured with any great accuracy using the running time procedure.

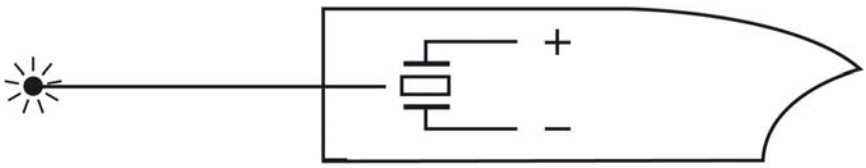
Leica DISTO™ devices therefore operate on the phase-shift principle, and are especially accurate over short distances – as you would indeed expect from a device known popularly as a “laser rule”. A wave on a lake, for example, is measured from crest to crest. If the wind pushes such a wave against a jetty, we can see how a new wave runs back into the water. A comparison of the crests of the incoming and outgoing waves illustrates the phase-shift principle.

## A wave of light

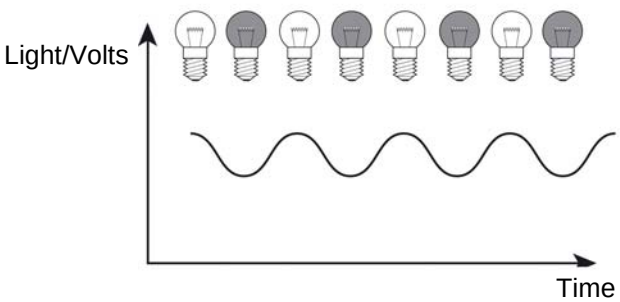
We must start off with a wave. But how can we create one out of light?

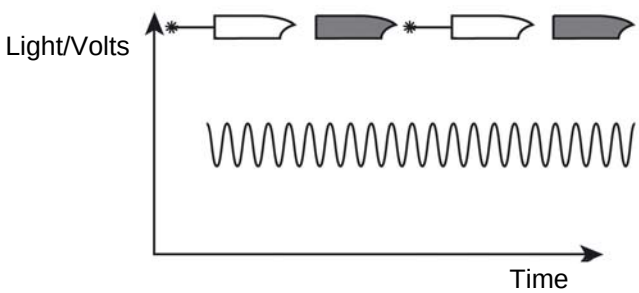


50 times a second




200 000 000 times a second

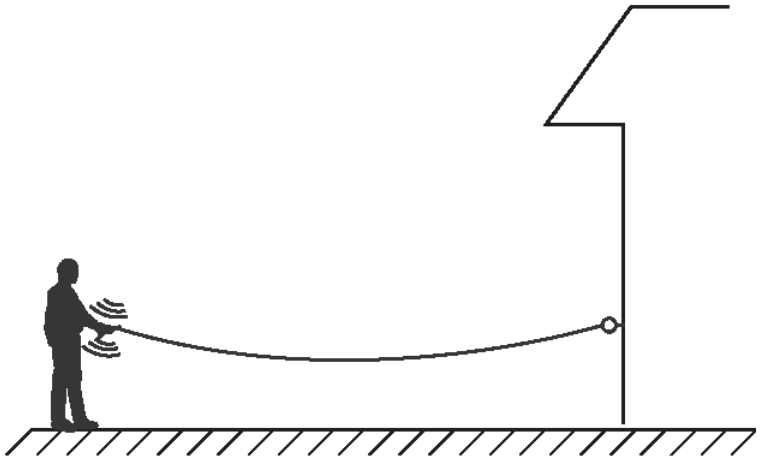


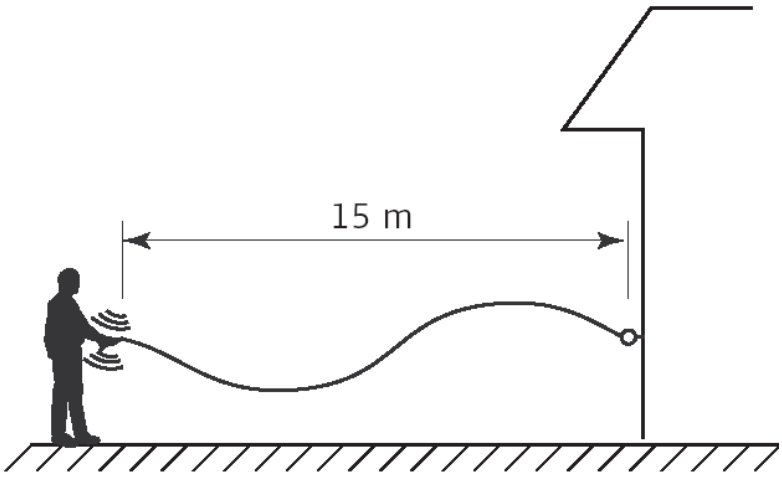
The light actually goes on and off 50 times per second, as we use an AC power supply to light up the bulb. The Leica DISTO™ is fitted not with a bulb, but with a semiconductor diode, which emits a guided laser beam. This light is switched on and off 200 million times per second with “alternating current”. We use these millions of waves (on the same principle as the water lapping against the bank of the lake) to measure the distance concerned.

**How many wave crests can fit into a given space?**

This principle is best illustrated by a simple example. We hang a length of rope from an object such as a house wall and stand holding the other end at a distance of about 15 metres from the wall (i.e. the distance that we wish to measure).

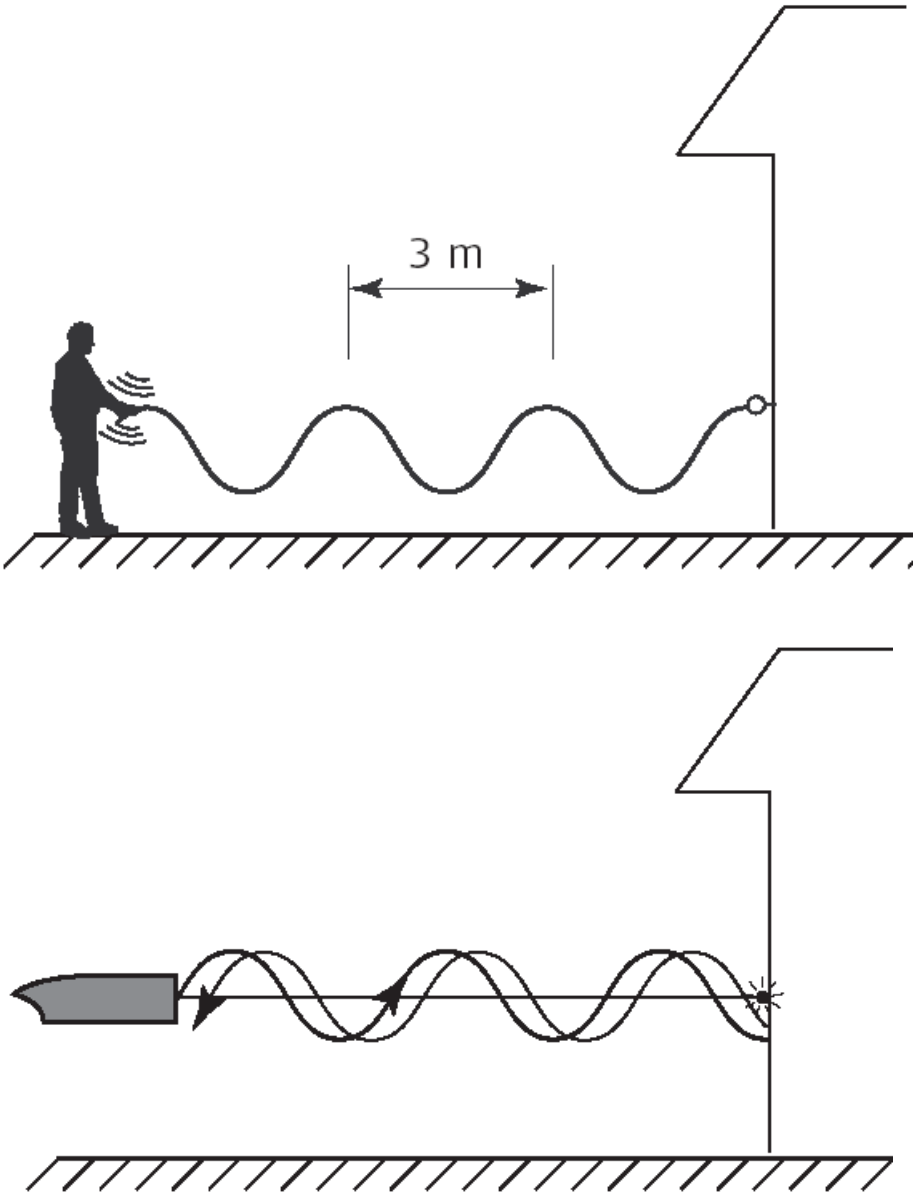


We then raise and lower the rope with regular up-and-down arm movements. The rope begins to oscillate and forms waves (like water):




A slowing of the arm movement causes the size of the wave to increase, until the 15 metres available is filled with a single wave.

An increase in the speed of the up-and-down arm movement decreases the size of the waves (e.g. to three metres each). The same distance to the house wall is now occupied by various waves.




This is exactly how the Leica DISTO™ works. A laser beam is used to emit various different waves simultaneously. With a frequency of 200 million waves (their speed regulated by the equivalent of the arm movements in the above example), it is possible to be accurate to the millimetre, while lower frequencies determine the higher fractions of a metre and the lowest frequency measures the number of metres. As the crests and troughs of a laser wave are, unlike the oscillating length of rope, invisible to the naked eye, we have to resort to some technological trickery – which brings us back to the example of waves lapping against a jetty: the difference between the incoming and outgoing waves of light (i.e. the phase shift) can be measured by means of sophisticated electronics, allowing the distance to be determined to the nearest millimetre.

**As you can see, where distance measurement is concerned,**
**quite a lot goes on behind the scenes.**