LTE

Universal tester of laser range finders

Fig. 1. Photo of LTE test station

Basic information:
LTE test station enables expanded tests of laser range finders at laboratory conditions without necessity of frequent costly and time consuming field tests. The station enables measurement of design parameters, final performance parameters and also checking boresight errors. The first group includes such parameters like pulse energy, pulse peak power, pulse time width, pulse frequency, beam divergence, receiver sensitivity. The second group includes accuracy of distance measurement, distance discrimination, and extinction ratio (ER). Boresight errors are understood as angles between optical axis of three blocks: transmitter, receiver and aiming channel.

LTE test station can be treated as an universal test station suitable for both manufacturers, maintenance/repairing workshops and final users of laser range finders.

Final performance tests are often done at field conditions when tested LRF shoots directly to a reference target (Lambertian type target of known reflectance) located at maximal operational distance of the tested device or when LRF shoots to a target located at short distance but through an optical medium of regulated attenuation. In both cases the field tests are time consuming and test results are sensitive to atmospheric conditions. Next, field tests give valuable information that something is wrong with tested LRF but do no deliver information what is wrong. In this situation a station capable to carry out measurement of both performance parameters and design parameters at laboratory conditions is very useful for both final users and manufacturers of LRFs.

How it works
In general LTE station imitates real field tests. The station simulates a square target of regulated angular size located at regulated distance and seen through a medium of regulated attenuation. The user can see image of the target and shoots to it like to a real target. In detail, LTE station measures parameters of optical pulse (pulses) emitted by transmitter of tested LRF and generates with some temporal delay optical pulse of regulated properties directed into receiver of tested LRF. A long series of parameters of both transmitter and receiver can be measured during such tests. Boresight errors of LRF can be checked, too.

Types of tested LRFs
From the point of optics the laser range finders can be divided onto several groups:

1. Dual channel LRFs with integrated sight (two separate optical channels (receiver and transmitter) and aiming system integrated with transmitter or receiver. The channels are located at very short distance from one to another. The aiming device can be optical sight, VIS-NIR camera, or night vision device.
2. Dual channel LRFs with a sight as a separate optical channel but located at very short distance to transmitter or receiver.
3. Dual channel LRFs with an external sight located at significant distance from receiver or transmitter.
4. Single channel LRFs built using using a single coaxial optics channel (receiver is integrated with transmitter and sometimes also with an aiming device into one optical system)
5. Dual channel LRFs built using an external thermal imager as a sight.

LTE station in basic version enables testing type 1-2 devices that represent at least 98% of all LRFs offered on market. LTE can be also delivered optional version that can be used for testing all types of laser range finders.

How is built?

LTE station can be treated as a system that combine three sub-systems: 1)image projector of square target of variable angular size, 2) meter of optical pulses emitted by transmitter of tested LRFs, 3)triggered generator of optical pulses of regulated intensity and time delay. However, from optical point of view LTE station is built as a set of two symmetrical optical channels of optics aperture is shape of non-full circle. One of the channels works as a meter of optical pulses emitted by transmitter when the second channel works as a triggered generator of optical pulses. These functions of the channels can be inverted. It is expected that during tests optics of LTE station at least partially overlaps optics of tested LRF.

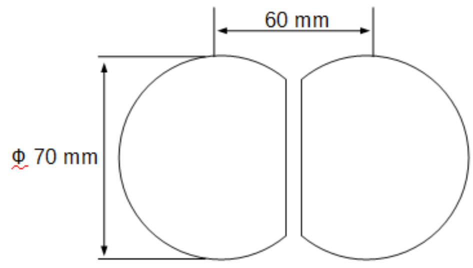

Fig. 2. Optical aperture of LTE station

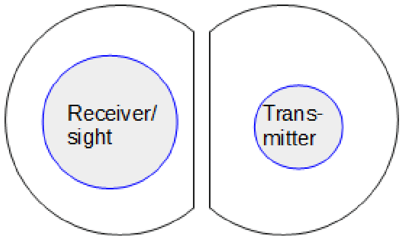

Fig. 3. Optics of LTE test station fully overlaps optics of LRF

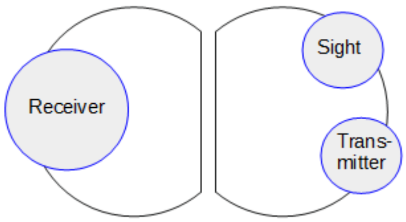

Fig. 4. Optics of LTE station partially overlaps optics of LRF

Technical specifications

Tab. 1. Technical parameters of LTE test station

Parameter	**Value**
Types of tested LRF	Optimized for testing dual channel LRFs with internal aiming channel or external aiming channel located at short distance from receiver/transmitter channels. Other types optional.
Spectral wavelength of tested LRFs	910 nm, 1060 nm, 1540 nm, 1550 nm, 1570 nm (other wavelengths optional)
Optics of LTE test station	Two non-full circles of 70 mm diameter
Location of LRF relative to test station	Step regulation, seven values: 0.25; 0.5; 0.75; 1.0; 1.5; 2.0; 4.0 mrad
Optical detector type	ultrafast, calibrated InGaAs photodiode
Central wavelength of pulsed light sources	905nm, 1060 nm, 1540 nm, 1550 nm, 1570 nm (the sources are to be manually exchanged)
PC	typical modern laptop, Windows 7 operating system
PC communication	USB 2.0
Working temperature	+5ºC to 35ºC
Storage temperature	-5ºC to 50ºC
Humidity	up to 95% (non condensing)
Dimensions	(H x L x W) 350 mm x 1500 mm x 445 mm (base module + platform)
Mass	59 kg (base module + platform) + 10 kg additional parts + PC

Tab. 2. LTE test station software capabilities

Software	Description
LE Control	Program to enable PC control of LTE test station
Pulse Browser	Support acquisition and analysis of temporal profiles of pulses emitted by laser transmitter
MET Control	Program to enable control of pulse generator module
BOR program	Support acquisition of images from cameras

Tab. 3. Test capabilities of LTE test station

Parameter group	Parameters	Value
Pulse parameters	Pulse energy range	10nJ to 200 mJ (options 500mJ)
	Peak pulse power	1W to 10 MW
	Pulse width	4-600ns (options 2-800ns)
	Resolution of pulse width	±1ns
	Repetition period	from 0.1 Hz to 20kHz
Distance parameters	Simulated distance	At least 200m to 40 km (options to 98 km)
	Resolution of simulated distance	2 m
	Number of simulated reflections of single shot	up to 3 (options up to 6)
	Distance accuracy	Yes
	Distance discrimination	Yes
Receiver	Sensitivity	At least 0.1 nW/cm² to 1µW/cm²(depends on wavelength)
Divergence angle		Rough measurement using seven step targets
Boresight	Checking aligning of laser transmitter with internal optical sight/TV camera	Yes (it is checking how well LRF is aligned not measurement of absolute value)
	Aligning of the laser receiver with the laser transmitter	Yes (it is checking how well LRF is aligned not measurement of absolute value)
	Ability to test aligning of LRF with night vision sight	Yes
Range parameters	Extinction ratio	Yes
	Range	Yes
Pulse readings	Missing pulses	Yes
	Pulse coding	Yes (customer is expected to define type of coding used)

Options:

LTE station is optimized for testing dual channel LRFs with integrated or separate sight when optics of LTE stations can at least partially overlap optics of channels of tested LRF. Optional versions offer increase of test capabilities and additional useful functions. Eight additional options are offered:

1. Additional mechanical platform for tested LRFs to allow precision angular positioning of tested LRF
2. Additional HEC camera to replace human operator and increase accuracy of angular positioning of tested LRF.
3. Additional external aiming channel in form of RTP reference target projector to enable testing LRFs having an VIS-NIR aiming channel (optical sight, VIS-NIR camera) at some distance from LRF receiver/transmitter optics of LRF
4. Additional adapters to enable testing single channel LRFs built using using coaxial optics solution
5. Additional external aiming channel in form of TTP thermal target projector to enable testing LRFs having an thermal sight at some distance from LRF receiver/transmitter optics of LRF
6. Electrical triggering of emitter block in LTE station (enables distance simulation for receiver of tested LRF without necessity of shooting the transmitter)
7. Optical triggering of emitter block in LTE station (enables distance simulation for receiver of tested LRF when shooting the transmitter not aligned to receiver)
8. AT720 optical table optimized for LTE station.

Coding: Letter of interesting option should be added to the station code. LTE-124 means that LTE station with options 1,2 and 4 is to be delivered.

Why LTE station?

Some important parameters of laser range finders can be accurately measured using several typical measuring instruments: optical meters and high speed oscilloscopes. These measuring tools are relatively low cost. Having a set of optical energy meter and a high speed oscilloscope we can measure accurately pulse energy and pulse width of all laser range finders present on the market. However knowledge about pulse energy and pulse width is not enough to evaluate performance of laser range finders at real conditions. The final users of laser range finders are not specially interested in pulse energy and pulse width but is operational range and accuracy of their laser range finders at real life conditions. We must keep in mind that performance of LRF characterized by the same pulse energy can differ a lot. Therefore in order to evaluate fully laser range finders we need a test station capable to:

1. Measure a long set of design parameters of LRFs
2. Measure performance parameters like extinction ratio (directly related to operational range)
3. Simulate targets of different angular sizes,
4. To check angular divergence of the emitted beam
5. To check aligning of the laser emitter with aiming device or other reference optical axis,
6. To check aligning of the laser receiver with aiming device or other reference optical axis.

All these tasks can be fulfilled by LTE station. It is an ultra advanced computerized test system capable to measure all design parameters of LRFs, performance parameters and to do also checking of boresight errors. It is a mature product manufactured by Inframet since 2010 year and used worldwide by a series of manufacturers, maintenance centers or scientific laboratories.

Version 8.1

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