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.

Why and how to test?

Laser range finders are important electro-optical devices used widely in defense/security/industrial applications. Ability to measure accurately distance in specified operational range of LRFs is considered as very important. At the same time performance of LRFs depends on a set of parameters that can deteriorate in short time. Therefore testing LRF is needed to assure that this device will produce proper distance measurement result in required distance zone.

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 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 can give 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 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 that indicates simulated distance A long series of parameters of both transmitter and receiver can be measured during such tests. Boresight errors of LRF can be checked, too.

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Features

1. Test concept: variable distance, variable signal electronic simulation
2. Measurement of parameters of pulses emitted laser transmitters, simulation of variable distance targets, simulation of multiply targets, regulation of pulses of variable amplitude,
3. Ultra expanded test range: pulse energy, pulse peak power, pulse time width, pulse repetition frequency, missing pulse, pulse coding, distance measurement accuracy (test for both single target or multiply targets), distance discrimination, receiver sensitivity, extinction ratio ER
4. Checking of boresight errors and divergence angle.
5. Ability to test both monopulse LRFs and multipulse LRFs
6. LRFs working at all typical wavelengths can be tested: 905/910 nm, 1060nm, 1540nm, 1550nm, 1570nm.
7. Ability to simulate six targets of different angular size (from 0.25 mrad to 4 mrad).
8. Fully computerized test system. Distance target-LRF, target size, system attenuation can be controlled from PC. The incoming pulses are digitally recorded and analyzed.
9. LTE simulates real field tests conditions. User sees a small target and shoots to it. Distance measurement indication only when laser beams hits the target.
10. Ability to test laser range finder equipped with night vision channel.
11. Enables testing typical dual channel LRFs with internal aiming channel or external aiming channel located close to receiver/transmitter. Other types of LRFs can be optionally tested, too.

Requirements on tested LRFs

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

A) Dual channel LRFs with integrated aiming (two separate optical channels and aiming system integrated with transmitter or receiver. The channels are located at very short distance from one to another.
B) Three channel LRFs having channels at short distance from each other. Aiming device is a separate optical channel.
C) Dual channel LRFs with additional aiming channels (optical sight/video camera) located at significant distance from LRF optics,
D) Single channel LRFs built using using coaxial optics solution (receiver is integrated with transmitter (and sometimes also with a video camera as aiming device) in one optical system)
E) LRFs using an external thermal imager as an aiming device.

Typical LTE test station is built using two separate optical channels. Diameter of optics in both optical channels is 70mm. It is typically required that optics of the LTE station should at least partially overlap the optics of the tested LRF (Fig.2). It means that situation shown in Fig 2a is preferable but situation shown in Fig.2 is still acceptable.

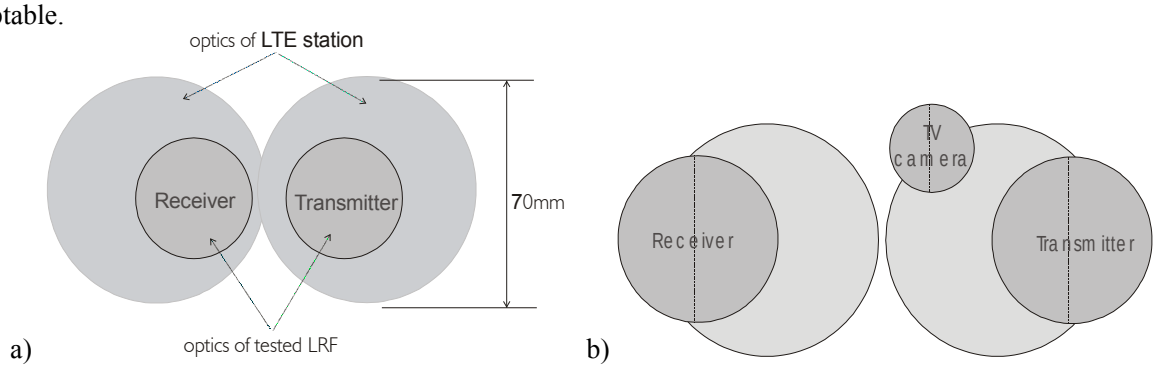

Fig. 2. Optics of tested LRF relative to optics of LTE test station a)optics of LTE test station fully overlaps optics of LTE test station overlaps only partially optics of tested LRF

Design of LTE station is optimized for testing of LRFs from groups A and B. Such LRFs represent at least 99% of all hi-tech LRFs.
LRFs from group C can be optionally tested using a special version of LTE station with third additional channel.
LRFs from group D can be optionally tested using a special version equipped with additional adapters. Detail information about active aperture of coaxial optics is needed.
LRFs from group E cannot be tested at all because optics of LTE station is non transparent for thermal imagers. A test station of different optical designed can be delivered.

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Technical parameters

Parameter	Value
Types of tested LRF	Both mono-pulse LRF and multi-pulse LRFs can be tested. Optimized for testing dual channel LRFs with integrated aiming and three channel LRFs having channels at short distance from each other. 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 circles of 70 mm diameter
Location of LRF relative to test station	LTE optics must overlap at least 50% of optics of tested LRF
Regulation of target size	Step regulation, six values: 0.25; 0.5; 0.75; 1.0; 1.5; 2.0; 4.0 mrad
List of measured parameters	pulse energy, pulse peak power, pulse time width, pulse repetition frequency, missing pulses, pulse coding, distance measurement accuracy (test for both single target or multiply targets), distance discrimination, receiver sensitivity, extinction ratio
Optical detector type	ultrafast, calibrated InGaAs photodiode
Pulse energy range	10nJ to 200 mJ (option 500mJ)
Peak pulse power	1W to 10 MW
Pulse width	4-600ns (option 2-800ns)
Resolution of pulse width measurement	±1ns
Pulse Repetition Frequency	from 0.1 Hz to 20kHz
Simulated distance	At least from 200m to 40 km (can be extended up to 98km)
Resolution of simulated distance	2 m
Number of simulated reflections of single shot	up to 3 (can be increased up to 6)
Missing pulses	Yes
Coding	Yes (customer is expected to define type of coding used)
Central wavelength of pulsed light sources	905nm, 1060 nm, 1540 nm, 1550 nm, 1570 nm (the sources are to be manually exchanged)
Receiver sensitivity tests	Yes
Absolute receiver sensitivity range	At least 0.1 nW/cm² to 1μW/cm²(depends on wavelength)
Divergence angle	Rough measurement using six step targets
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
PC	typical modern laptop, Windows 7 operating system
Software	Set of computer programs: Pulse Browser, LE Control, MET Control. Pulse Browser: to support acquisition and analysis of temporal profiles of pulses emitted by laser transmitter LE Control: to enable PC control of attenuators and target sliders working in electronic mode MET Control: program to enable control of pulse generator module (distance simulation in electronic mode)
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

Options:

Several options are offered:

1. Third optical channel to enable testing dual channel LRFs with additional external aiming channel (optical sight/video camera) located at significant distance from LRF optics,
2. Additional adapters to enable testing single channel LRFs built using using coaxial optics solution
3. Additional mechanical platform for tested LRFs to allow precision angular positioning of tested LRF
4. Additional camera to replace human operator and increase accuracy of angular positioning of tested LRF.

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 not cheap but still they are not very expensive. Having a set of optical energy meter and a high speed oscilloscope at price level about 5000 Eur 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 e values of pulse energy and pulse width but what 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 not only to measure two mentioned above parameters but capable to:

1. Measure a long set of design parameters of LRFs: pulse energy, pulse peak power, pulse time width, pulse repetition frequency, missing pulses, pulse coding, distance measurement accuracy (test for both single target or multiply targets), distance discrimination, receiver sensitivity,
2. Measure final quality parameters like extinction ratio (directly related to operational range)
3. Simulate targets of different angular sizes,
4. Simulate case of multiply reflection targets
5. To check angular divergence of the emitted beam
6. To check aligning of the laser emitter with aiming device or other reference optical axis,
7. To check aligning of the laser receiver with aiming device or other reference optical axis.

LTE is not a simple meter of a single parameter of LRFs. It is an ultra advanced computerized test system capable to measure all design parameters of LRFs, final quality parameters and 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 worldwide.

Version 7.1

CONTACT:

Tel: +48 604061817 Fax: +48 22 3987244 Email: info@inframet.com