LTE

Station for testing laser range finders/designators

Fig. 1. Photo of LTE test station

1 Basic information

Final performance tests of laser range finders 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 (especially the first method). 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.

LTE test station enables expanded tests of laser range finders/designators at laboratory conditions without necessity of frequent costly and time consuming field tests (it is still recommended to do some 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, extinction ratio (ER), and operational range. 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/designators.

2 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.

3 Testing laser designators

The LTE station can be also used for testing laser designators. The latter devices can be typically treated as high power transmitter of design very similar to transmitters used by LRFs. The same parameters used to characterize transmitters of LRF are used also for characterization of laser designators. Therefore next section shall concentrate on testing LRFs.

4 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 third optical channel located at short distance to transmitter or receiver.

3. Dual channel LRFs with an external sight located at significant distance from receiver or transmitter.
4. Dual channel LRFs built using an external thermal imager as a sight.
5. 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)

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 in optional version that can be used for testing all types of laser range finders.

5 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 (see Fig. 3-4).

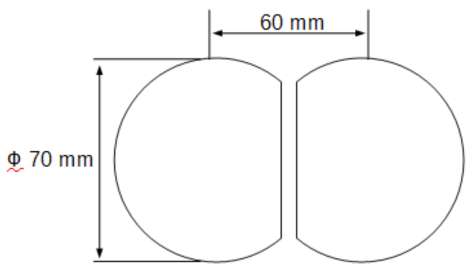


Fig. 2. Optical aperture of LTE station

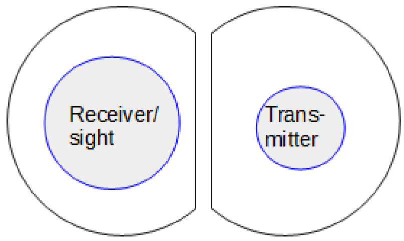


Fig. 3. Optics of LTE test station fully overlaps optics of LRF

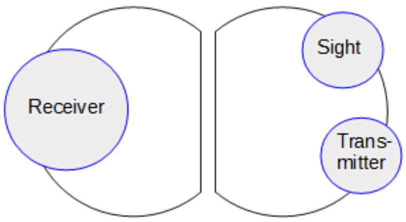


Fig. 4. Optics of LTE station partially overlaps optics of LRF

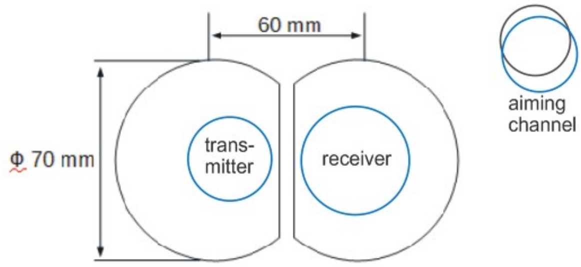
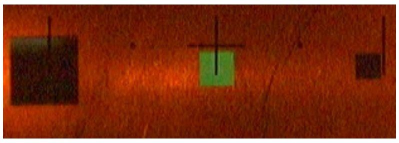


Fig. 5. Case of optional LTE station with additional third aiming channel

Typical LTE station having two channel optics as shown above is a perfect solution when testing LRFs of type 1-2 (dual channel LRFs with integrated sight or dual channel LRFs with a sight as a separate optical channel located at very short distance to transmitter or receiver). In rare cases of testing LRF of type 3-4 (dual channel LRFs with an external sight located at significant distance from receiver or transmitter or dual channel LRFs built using an external thermal imager as a sight). Inframet can offer LTE having additional third aiming channel that can be fixed by the user at a series of different positions (see Fig. 5). The third aiming channel of LTE station can be built using typical refractive optics (to cooperate with VIS-NIR camera/NVD used as sight in tested LRF) or using reflective optics (to cooperate with thermal imager used as sight in tested LRF).

In case of rare type 5 LRFs (coaxial optics LRFs) Inframet can deliver optional adapters that enable testing such LRFs using LTE station. However, customer is expected to deliver detail drawings of the LRF to be tested and have ability to control of both transmitter and receiver (case of manufacturer or integrator).

Aiming of tested LRF to a target simualted by LTE station is easy. Human operator of tested LRF can see several targets where active target is indicated by different color or light intensity. Task of the operator is to align tested LRF in a way when aiming mark (typically cross) of the LRF is on the center of the active target simulated by the LTE station. Size of the active target simualted by LTE station can vary (step regulation



typically from 0.25mrad to 4 mrad).	Fig. 6. Image of targets projected by LTE station

6 Technical specifications

Tab. 1. Basic data 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 of tested LRFs optional.
Optics of LTE test station	Two non-full circles of 70 mm diameter (optional third aiming channel). Optics of tested LRFs must at least partially overlap on LTE optics.
Spectral wavelength of tested LRFs	910 nm, 1060 nm, 1540 nm, 1550 nm, 1570 nm (other wavelengths optional)
Distance to simulated target	Regulated at least 100m to 40 km with resolution of 2m
Size of simulated reflecting target	Seven targets: 0.25;0.5;0.75;1.0;1.5; 2.0; 4.0 mrad (step regulation)
Number of simulated reflections (echos)	At least three echos with regulated distance difference: 50 m – 6 000 m with resolution 2 meters
PC type	typical modern laptop, Windows 7/10 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 settings 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 (distance simulation)
BOR program	Support acquisition of images from cameras

Tab. 3. Test capabilities of LTE test station

No	Parameter	Measurement range	Measurement uncertainty
		Transmitter parameters	
1	Pulse energy	10nJ to 200 mJ	10%
2	Pulse time width	4-600ns	5% or 1ns
3	Pulse peak power	1W to 10 MW	10%
4	Pulse Repetition Frequency	0.1 Hz to 20kHz	2%
5	Pulse coding	Yes (customer is expected to define type of coding used)	

6	Missing pulse	Yes	
7	*Divergence Angle	1) 0.25 to 4mrad (variable target mode) 2)0.25 to 1mrad (moving target mode)	1) difference in size of targets 0.25; 0.5;0.75;1.0;1.5; 2.0; 4.0 mrad 2) 25% (multiply shots needed)
		Receiver parameters	
1	Sensitivity	At least 0.1 nW/cm² to 1µW/cm²(depends on wavelength)	10%
		Performance parameters	
1	Distance measurement accuracy	At least 100 m – 40 000 m	Uncertainty: 1.5m Resolution: 1 m
2	Distance discrimination	Up to three echos with regulated distance difference: 50 m – 6 000 m	Uncertainty: 2m Resolution 1 m
3	Relative Extinction Ratio	At least 0.1 dB – 60 dB (for target at 500m distance)	1dB
4	Absolute Extinction Ratio	At least 100 dB -160 dB	1dB
5	Operational range	At least 500m to 40km	Calculation based on theoretical model
		Boresight paramers	
1	Boresight of transmitter relative to aiming sight	*0.25 mrad – half of FOV of LRF	20% or 0.1mrad
2	Boresight of transmitter relative to receiver	*0.25 mrad – 2 mrad	20% or 0.1mrad

*Optional precision mechanical platform and camera to replace human are needed (options 1-2)

Attention:
LTE can enable measurement boresight errors. However, it should be noted that the station is optimized only for fast basic checking how well LRF is aligned by shooting LRFs at several angular positions and analysis of results. Measurements of boresight errors in ranges listed in Table 3 require a series of shots and tests are time consuming. The same can be said about measurement of divergence angle of LRF. Measurement is done by shooting LRFs at several targets of different angular size.

Therefore if fast accurate measurements of boresight errors and divergence angle are needed (for example manufacturing line) Inframet recommends other test stations: LUNI station or LJT120 station.

7 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 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
5. Additional adapters to enable testing single channel LRFs built using using coaxial optics solution
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: Number 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.

8 List of blocks

LTE station is a modular station built from following blocks:

1. LTE18 base station
2. EFA external filter adapter
3. Set of optical filters / attenuators
4. OR optical receiver
5. MS transmitter
6. Set of pulse light sources (910, 1060, 1540, 1550, 1570 nm)
7. LS collimator
8. Laptop with accessories (power supply, mouse, drivers, battery integrated, mouse pad)
9. Set of cables for LTE base module (power cable, USB cable)
10. AC protection board
11. LTE Control program
12. Pulse Browser program
13. MET program
14. BOR program

Optional blocks

15. XNAS mechanical platform for tested LRF
16. HEC camera
17. FTP fused target projector (combines functions of RPT reference target projector and TTP thermal target projector)
18. Set of coaxial adapters
19. Electrical triggering module ETM (integrated with LTE base station)
20. Optical triggering module OTM
21. AT720 optical table

9 Why LTE station?

Some important parameters of laser range finders/designators 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 series of design parameters of LRFs
2. Measure performance parameters like distance measurement accuracy, distance discrimination or to measure 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. It can be said that LTE has no rival on international markets if a potential customer is looking for an advanced universal test station capable to measure all important design and performance parameters of LRFs in order to support R/D, production and maintenance of LRFs.

Version 8.5

CONTACT:

Tel: +48 22 6668780 Fax: +48 22 3987244 Email: sales@inframet.com