TRAL

System for testing discrete optical detectors



Fig. 1. TRAL station

1 What is TRAL?

TRAL test station is a station for testing discrete optical detectors (or small linear array) sensitive in any band of wide spectral range from about 400nm to about 14000 nm (VIS/NIR/SWIR/MWIR/ LWIR). It is also optionally possible to test UV detectors. All main types of infrared detectors can be tested: photon detectors, thermal detectors, or pyroelectric detectors etc.

TRAL enables measurement of a set of critical parameters:

- 1. responsivity,
- 2. normalized detectivity D* (valid for MWIR/LWIR detectors),
- 3. quantum efficiency (valid for VIS/NIR/SWIR detectors).

at variable wavelength. Therefore all these parameters can be measured as two dimensional functions of wavelength variable. Relative spectral sensitivity function can be measured, too.

2 How TRAL works?

TRAL station irradiates the tested detector using variable wavelength, variable intensity radiation. Analysis of electrical signal at output of tested IR detector enables determination of parameters of tested detector.

From design point of view TRAL is a modular systems built from a series of blocks:

- 1. set of two exchangeable radiation sources:HB halogen light source (for VIS-SWIR range), BB1200 miniaturized high temperature blackbody (for MWIR-LWIR range),
- 2. broadband image projector/integrator BIPRO (different versions available depending on maximal wavelenght)
- 3. OM25 optical modulator for chopping incoming optical radiation,
- 4. RW-EF rotary wheel with set of edge filters (different configurations depending on spectral band)
- 5. RW-AT rotary wheel with set of OA attenuators
- 6. Light probe LP (measurement of light intensity of light source)
- 7. MGM250 multi-grating monochromator
- 8. Set of positioning adapters (optimized for typical mechanical cases of optical detectors)
- 9. Set of electronic amplifiers (different types depending on type of tested detectors)
- 10. DICO digital scope
- 11. laptop
- 12. test/control software
- 13. set of reference detectors (different configurations depending on spectral band).

The blocks 1-7 create a variable wavelenght/intensity radiation source that irradiates tested detector. Blocks 8-12 create a system for analysis of electronic signal generated by tested detector capable to determine parameters of tested detector.



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3 Why TRAL is special?

Testing discrete optical detectors at variable wavelenght selected by monochromators looks easy. The monochromators are spectral systems invented over 100 hundred years ago and offered by many manufacturers. It is easy to use monochromator as a system that transmit optical light at variable wavelngth used for relative measurements like measurement of transmission of optical windows. However, it is surprisingly difficult to built a system capable to measure accurately absolute values of radiometric parameters of optical detectors at variable wavelenght (especially at MWIR/LWIR band). Accurate measurement of parameters of optical detectors is possible only after taking into account complex physical phenomenon that infleunce work of light sources, modulators, attenuators, monochromators, electronic amplifiers and mastering calculation of such parameters. Due to high requirements on know how there are only several manufacturers of systems for testing optical detectors. TRAL belong to a small elite group of test systems capable to do accurate testing of discrete optical detectors.

4 TRAL features

TRAL is characterized by unique features:

- 1. Universal test station capable to test all main types of infrared detectors (all spectral bands: VIS, NIR, SWIR, MWIR, LWIR and optionally UV).
- 2. Special multi grating monochroamtor is used (no need to change monochroamator when changing spectral band).
- 3. PC controlled test station. Important blocks like monochromator, light source/blackbody, modulator, acquisition system are controlled from PC.
- 4. High dynamic of regulation of output irradiance (detector dynamic can be tested)
- 5. User friendly software to support semi automatic measurement of parameters of optical detectors.

5 Versions

TRAL test stations are modular test systems that can be delivered in form of different versions of different test capabilities and price. Two letter code shown in Tab.1 is used to describe TRAL versions. The columns 1-2 present what letters are to be chosen to define precisely required version of ST test system.

Code	1		2
	Spectral range[nm]	Test capabilities	Detector type
А	2000-6000	relative spectral responsivity	Photovoltaic
В	600-6000	absolute spectral responsivity (measurement at regulated wavelength)	Photovoltaic/photoconductive
С	2000-14000	additional parameters: 1)normalized detectivity D* (MWIR/LWIR detectors), 2)quantum efficiency (VIS/NIR/SWIR de- tectors).	Photovoltaic/photoconductive/py- roelectric/thermal
D	600-14000		
E	400-2400		
F	customized		

Tab. 2. Definitions of the code used to describe versions of TRAL test system

Example: TRAL-ABA test station means the TRAL test station of the following features:

- 1) testing infrared detectors sensitive in spectral band 2000nm to 6000nm,
- 2) measurement of absolute spectral responsivity at regulated wavelength,
- 3) type of tested detectors: photovoltaic (optimization of amplifier).

		Version 3.1	
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