DT systems

Testers of thermal imagers

Fig. 1. Photo of three DT test systems (DT 2500, DT 1500, DT 100)

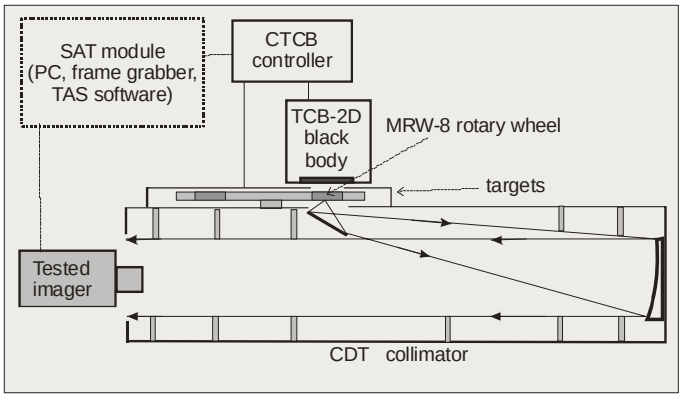

Fig. 2. Block diagram of the DT series test system

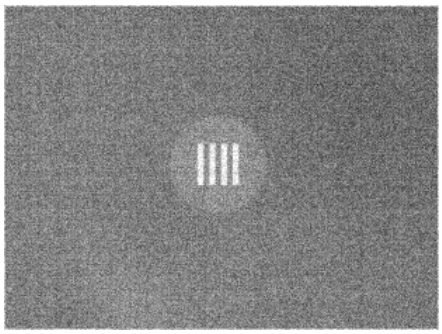

Fig. 3. Images of a 4-bar target plate (generated by DT 1500 system seen by thermal imager imager of FOV= 8 deg)

BASIC INFORMATION:

The DT series test systems are specialized test systems optimized for task of extensive testing of surveillance thermal imagers at laboratory/depot conditions. The systems can be also optionally used for basic testing of TV cameras, boresighting of thermal imagers with a reference optical/mechanical axis of TV cameras, basic testing of IR objectives.

The DT series system is a variable target measuring system that uses a series of different targets to project their images to a tested thermal imager. The tested imager generates distorted copies of the projected images. Quality of the images generated by the imager is evaluated directly by humans or by software and its important characteristics are measured.

The DT set consists of CDT collimator, TCB-2D blackbody, CTCB controller, MRW-8 motorized rotary wheel, a series of targets, :PC, frame grabber, CTCB Control software, TAS-T software and some optional modules). DT systems are offered in form of a long series of different version of different test capabilities. Collimator code and combinations of eight digits are used to compose codes that describe different available versions of DT test system. DT-1500- 11111111 describe basic version of DT 1500 test system based on CDT 1500 collimator.

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1 Versions of DT systems

DT test systems are basically modular test systems. The DT series systems can be delivered in form of different versions of different configurations and of different test capabilities.
The basic division of DT series system is based on output aperture of the collimators. The aperture is calculated as the system number divided by 10 (see Tab. 1).

Tab. 1. Division of DT series systems based on the collimator aperture

System code	Collimator output aperture
DT 1500	150 mm
DT 2000	200 mm
DT 2500	250 mm
DT 3000	300 mm
DT 1000	100 mm

Possible application areas of the DT series test systems are listed below:

- DT 1500 - testing short/medium/long range thermal imagers of optical apertures below 150 mm
- DT 2000 - medium/long range thermal imagers of optical apertures below 200 mm
- DT 2500 - testing long range thermal imagers of large optical apertures below 250 mm
- DT 3000 - testing long range thermal imagers of very large optical apertures below 300 mm
- DT 100 – testing short range imagers of aperture below 100mm.

Collimator aperture is only one of a series of technical parameters that should be determined to optimize DT system for required applications. We need also to determine:

a) Test capabilities
b) Hardware version (standard or extra hardware modules: collimator, blackbody, rotary wheel),
c) Acceptable electronic image formats of tested imagers
d) Optional capabilities for testing TV cameras
e) Boresighting capabilities
f) Simulated distance
g) Optional software for evaluation support of test results
h) Optional tests of IR objectives (modulation transfer function MTF, effective focal length EFL, relative transmittance)

Therefore combinations of additional eight digits plus collimator aperture code are used to compose precise codes that describe different available versions of DT test system. Definition of codes are shown in Tab.2. The columns a-h present what digits are to be chosen to define precisely required version of DT test system.
Example: DT 1500 -2111-2121 means DT 1500 test system of 150mm aperture and of the following features a)Typical test capabilities, b)standard collimator/blackbody, c)that accepts only analog video electronic standard, d) having no capabilities for testing TV cameras, e)able to carry out boresighting to a reference optical axis, f)capable to simulate only infinity target, g)having Simterm as optional software, h)no ability to test optical objectives.

The DT system in its basic version DT-X – 1111-1111 (X – collimator code) is built from the following modules CDT X-SR collimator (standard resolution), TCB-2D blackbody (typical version), CTCB controller, MRW-8 motorized rotary wheel, set of six 4-bar targets, PC. In case of more advanced version the structure of DT system is to be changed by adding some modules or replacement of the modules mentioned earlier. Detail description of these changes is presented in Tab.3.

Tab. 2. Definitions of the eight digit code (ABCD-EFGH) used to describe versions of DT test system

	A	B	C	D	E	F	G	H
Code	**Test capabilities**	**Collimator/ blackbody**	**Acceptable electronic image formats**	**TV camera test capability**	**Boresight**	**Simulated distance**	**Optional software**	**Tests of IR objectives**
1	Basic: MRTD	standard	Analog video (PAL or NTSC), FireWire, USB 2.0	No	Only reference optical point*	Only infinity	No	No
2	Typical: MRTD, MTF, SiTF, NETD, FPN, non uniformity, distortion, FOV	Extra	Additionally: CameraLink or GigE, or LVDS	Measurement of resolution at regulated illuminance conditions	Boresighting to reference optical axis	Regulated from 200m to infinity	Simterm	Yes. Only LWIR range.
3	Expanded: as in A2 but also: AutoMRTD, MDTD, PVF, SRF, ATF, NPSD, 3D noise,			Measurement of resolution, MTF, Distortion, FOV, Sensitivity, SNR, NEI, FPN, Non Uniformity, Resposivity function	Boresighting to reference mechanical axis		Mosot	Yes. LWIR, MWIR,
4	As in point A3 but additional targets or custom designed targets			As in D3 but additionally MRC, 3D Noise, Number of bad pixels and bad pixel localisation	Boresighting to reference optical axis and to reference mechanical axis		Mosot and Simterm	Yes. LWIR, MWIR, SWIR

* – the alignment target creates a reference point in the image generated by tested thermal imager but no other means for boresighting to a reference optical axis or mechanical axis are provided

Tab. 3. Structure of DT test systems for advanced options

Option	Description
A2	additional targets: edge target and alignment target; standard frame grabber (analog video, FireWire, USB 2.0), TCB Control software, TAS-T/S software – option recommended for typical range of tests of thermal imagers
A3	As option A2 but additionally: a set of six pinhole targets; more expanded TAS-T/E software
A3	As in A3 but additionally a set of three silhouette targets (tank, ship, aircraft) and optionally any of IR targets presented at Inframet website (multi 4-bar target, triangle targets, slit targets, square targets, cross targets etc
B2	CDT collimator, TCB blackbody and MRW-8 wheel are delivered in Extra version: collimator (HR high resolution version, improved baffling, low reflectivity coating); blackbody (improved temporal stability –HS version), rotary wheel (improved repeatability –HR version) – this option is recommended when long range imagers of ultra high spatial resolution and temperature resolution are to be tested (frequency range for MRTD measurement > 10 lp/mrad; NETD<20 mK)
C2	Additional frame grabber optimized to cooperate with imagers generating video images in one of following formats: CameraLink or GigE or LVDS is added – this option is recommended if tested imagers

	generate images of resolution /or frame rate higher than resolution/ frame rate of TV video image (resolution max 720x576; max frame rate: 30). Option needed in case of some thermal imagers mostly still under development.
D2	Secondary flat mirror in CDT collimator is coated using protected silver instead of typical protective gold coating. This option is recommended if the test system is to be used not only for testing thermal imagers but also for testing TV cameras. The disadvantage of silver coating is its shorter life time in comparison to gold coating, particularly in humid climate. Please note that in both cases Inframet is not using cheap flat mirrors with aluminium coating having inferior transmittance. Additional visible light source MAL series and 100% contrast USAF 1951 target. Simulated illuminance range: 0.1lx to 5 klx; color temperature 2850K, continuous manual regulation. .
D3	As D2 but an edge target, FOV/distortion target and TAS-V/S software
D4	As D3 but additionally set of five variable contrast USAF 1951 targets and TAS-V is offered in expanded version TAS-V/E.
E2	Module in TAS-T software capable to analyse images generated by tested thermal imager and TV camera and to determine aligning error.
E3	BRH camera and set of three mechanical adapters. BOR software that enable easy and accurate boresighting of optical axis of the tested thermal imager with a reference mechanical axis.
F2	Motorized FS stage (with ROB controller) for control of focusing of the CDT collimator
G2	Simter 3.0 computer simulator – program that enables realistic simulation of real market thermal imagers
G3	Mosot 1.2 computer program- enables calculation of detection, recognition and identification ranges of some targets according to recommendations of NATO standards
G4	Both Simter and Mosot programs are included
H2	Additional modules to enable measurement: MTF (on axis, off axis), effective focal length, relative transmittance) or LWIR objectives MMS scanning stage, EG-LW light source, CEG controller, IA-L image analyzer, EO1 mechanical stage, LIR audit objective, TAS-O software
H3	Additional modules to enable measurement: MTF (on axis, off axis), effective focal length, relative transmittance) of LWIR objectives and MWIR objectives: MMS scanning stage, EG-ML light source, CEG controller, IA-ML image analyzer, EO1 mechanical stage, MLIR audit objective, TAS-O software
H4	Additional modules to enable measurement: MTF (on axis, off axis), effective focal length, relative transmittance) of LWIR objectives , MWIR objectives and SWIR objectives: MMS scanning stage, EG-ML light source, CEG controller, IA-ML image analyzer, EO1 mechanical stage, MLIR audit objective, TAS-O software NMS scanning stage, EG-SW light source, CEG controller, SW target, IA-S image analyzer, EO2 mechanical stage, SIR audit objective, TAS-O software

SPECIFICATIONS

Blackbody

Model	TCB-2D
Modules	BB-2D head integrated with controller
Aperture	50× 50 mm
Differential temperature range	–25°C ÷ + 75 °C (at 25°C ambient temperature)
Absolute temperature range	0°C ÷ +100°C
Set point and resolution	1 mK
Emissivity	0.97±0.01 (0.98 at B2 option)
Temperature uniformity	< 0.01 °C at Δ T< 5° C
Response time	10°C step – <60s
Regulation stability	±0.002°C for ΔT=10°C ±0.001°C (at B2 option)
Computer control	RS-232 (USB)
Power supply	230/110VAC 50/60Hz
Operating temperature	+5°C ÷ +35 °C
Dimensions	head: 180× 205×185 mm; controller: 355× 90×205 mm
Mass	head: 10.9 kg; controller: 4.6 kg

Collimators

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Models	CDT 1000, CDT 1500, CDT2000, CDT 2500, CDT 30000, CDT 4000, CDT 5000
Collimator type	reflective, off-axis
Aperture	from 100mm to 300 mm (collimator code/10); option: 500mm
Focal length/resolution	CDT1000-1000mm CDT 1500 – 1500mm CDT 2000–2000mm CDT 2500SR – 2500 mm CDT 2500HR – 2000 mm CDT 3000SR – 3000 mm CDT 3000HR – 2000 mm CDT 4000SR – 4000 mm CDT 4000HR – 3000 mm
Spectral range	0.6-15 µm (0.4-15 µm – optional)
Spatial resolution	not less than 50 lp/mrad – SR version not less than 160 lp/mrad – HR version
Coating	Standard: aluminum – collimating mirror, gold-flat mirror Option: aluminum – collimating mirror, protected silver-flat mirror
Transmittance	0.92@3-5 µm, 0.94@8-14 µm
Field of view	CDT 1500 : 2.3° CDT 2000 : 1.7° CDT 2500SR : 1.4° CDT 2500HR : 1.7° CDT 3000SR – 1.1° CDT 3000HR : 1.7° CDT 1000 : 3.4°
Dimensions	From 310x 320x 1120 mm to 410x 420x 3130 mm
Mass	From 15 kg to 65 kg

Rotary wheel

Model	MRW-8
Number of holes for targets	8
Control type	motorized, digital
Wheel emissivity	0.97±0.01
Dimensions	380× 350×100 mm
Mass	5 kg

Targets

Model	M54
Diameter	54 mm (for wheel holes)r
Emissivity	0.97±0.01
Type	4-bar, pinhole, slit, edge, cross, multiple 4-bar, triangle, custom

SAT module parameters

SAT components	PC, frame grabber no 1, frame grabber no 2, TCB Control program, TAS-T computer program
PC	
Parameters	IBM compatible PC with Intel Pentium Dual Core E5400 or better processor with 17'' color monitor, 2GB RAM, >160GB hard disk, DVD writer (basically modern PC)
Operating system	Windows XP (option Windows 7)
Frame grabber	
Number of frame grabber	1 – standard version 2- optional version
Frame grabber no 1	Analog/digital video frame grabber Dynamic 8-bit SNR>256 Input signal formats - PAL, NTSC, Fire Wire, USB 2.0
Dynamic	8 bit analog frame grabber
Frame grabber no 2	High resolution, high speed digital frame grabber input signal formats: CameraLink (option: GigE or LVDS) please contact with detail requirements as CameraLink and LVDS formats are not fully standardized
TCB Control program	
Modes of work	a)blackbody/rotary wheel control, b)MRTD measurement support c) MDTD measurement support d)blackbody recalibration mode
TAS program	
Modes of work	Capture, Analysis, Viewer
Measurement tools for testing thermal cameras	MTF, SiTF, NETD, FPN, non-uniformity, distortion, FOV, Auto MRTD, SRF, ATF, PVF , NPSD, AutoMRTD, 3D Noise

**specifications are subject to change without prior notice*

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