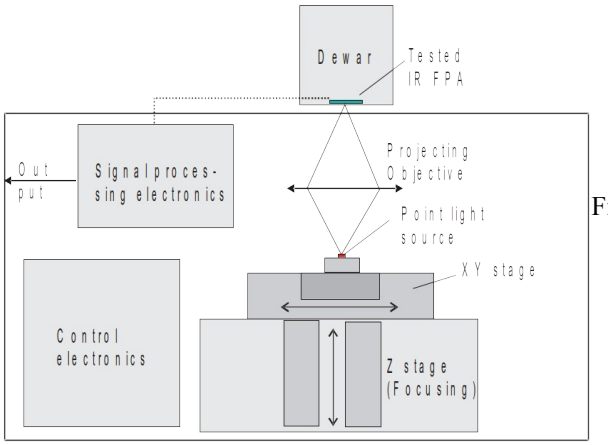
SPOT

Station for measuring spatial responsivity of IR FPA sensors



. 1. Block diagram of SPOT test station

Fig

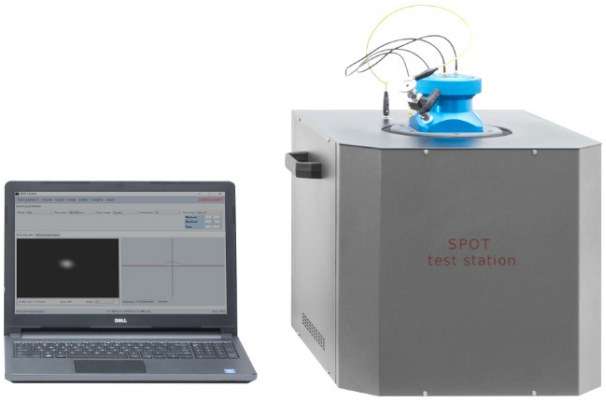


Fig. 2. Photo of Spot test station

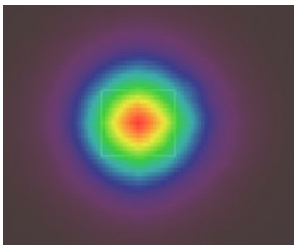


Fig. 3. 2D plot of Spatial Responsivity Function

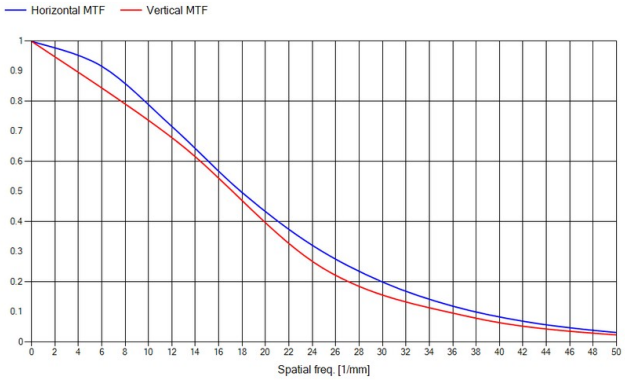


Fig. 4. MTF graph of tested MWIR FPA sensor

1 Basic information

Modulation Transfer Function (MTF) and cross-talk are two very important parameters of IR FPA imaging sensors that depend on a series of design parameters of IR wafer used to manufacture FPA sensor. Precision measurement of these parameters enables design optimization and can lead to development of FPA sensors of ultra small cross-talk and very good MTF. Precision measurement of spatial responsivity distribution function (indirect measurement of MTF and cross talk) is possible only if two conditions are fulfilled. First, measurement is done using scanning light spot projector capable to project light spot of size significantly below size of typical pixel of IR FPA sensor. The latter condition is a big challenge in situation when pixels of modern IR FPA can be equal or below 10µm even in case of perfect optics limited only by diffraction effect. Second, measurement is carried out before integration with readout electronics because the latter device influences measurement results in way that is difficult to predict.

SPOT is a test station that enables precision direct measurement of spatial responsivity of IR FPA sensors and indirect measurement of MTF and cross-talk of IR FPA sensors before integration with read out electronics. The measurement is done by analysis of a signal generated by a single active pixel of FPA sensor (bonded directly using ultra thin golden wire) irradiated using a scanning projector that generates high intensity light spot as low as 8 µm. This extremely small light spot has been achieved by using special customized image projector based on aberration free optics and spot light source that operates at short wavelength range (typically 1.3 µm, optional: 1.55 µm) of low diffraction blurring. Great majority of IR FPA sensors are sensitive to some degree to this wavelength. Even very low relative spectral sensitivity of tested IR FPA sensor at level over 0.01 is enough due to high power light source used in SPOT station.

SPOT station has been successfully used be several big manufacturers of cooled MWIR FPA sensors to improve manufacturing technology. The station has been originally developed for a manufacturers of MWIR FPAs but can be also used to test SWIR/LWIR sensors as long as they have some sensitivity to its light source.

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2 Features

- Control of: a) 3D coordinates of light spot, b)light intensity,
- Measurement and deconvolution of output signal from the active pixel of tested FPA sensor,
- Measurement of Spatial Responsivity Function of IR FPA sensor,
- Calculation of MTF and crosstalk of tested IR FPA,
- Fully computerized system,
- Software can show optimal focusing.

3 Blocks

SPOT is built from three main modules:

1. SPOT base block
2. Laptop
3. Spot Control program

4 Warnings

SPOT is a potentially very valuable tool for RD projects on improvement on MWIR sensor technology. However, there are several warnings.

1. Relative spectral sensitivity of tested IR FPA sensor at 1.3um should be over 0.01. It occurs for great majority of MWIR IR FPA sensors are inherently sensitive to this wavelength even if having coating optimized only for MWIR band. The only known exception is IR FPA sensor having germanium filter that is totally not translucent at wavelengths below 1.8um.
2. Customer is responsible to deliver IR FPA sensor integrated with his electronics capable to generate output electronic signal from the active pixel. Both analog or digital formats of the output signal are acceptable but Inframet must be informed in advance.
3. IR FPA sensor to be tested is typically cooled sensor integrated with a dewar. The latter module is also to be delivered by customer. However, technically it is possible to do testing non cooled sensors, too.
4. Distance from input mechanical plane of dewar (front wall with window) to sensor plane should be below 10mm (option: higher value)
5. Specifications of window in dewar (material, dimensions, flatness, coating) must be approved by Inframet. Customer should deliver to Inframet technical drawings of dewar and sensor.
6. It is preferable if customer could send sample discrete MWIR detector (or sample IFPA sensor) to Inframet to verify sensitivity at 1.3um and check cooperation of SPOT acquisition electronics with customer preamplifier/sensor.
7. Inframet prefers vertical configuration of dewar when sensor is at bottom of dewar but horizontal configuration is still acceptable.

5 Technical specifications

Parameter	Value
	Sensor
Tested sensors	sensors having at least low sensitivity to light at 1.3 um (option: at 1.5 um)-all SWIR senors, great majority of MWIR sensor and some LWIR sensors
Accessories	Customer is responsible to deliver sensor in dewar and having active pixel bonded to preamplifier preferable dewar having floor window
Pixel size of tested sensor	Typically > 8um, Option < 8 um
Required responsivity at 1.3 um	>0.01 A/W (contact Inframet is responsivity below this level)
Distance from input mechanical plane of dewar (wall with window) to sensor plane	<10 (can be optionally increased)

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Specifications window in dewar	must be approved by Inframet
Dewar configuration	preferable vertical (horizontal option)
Light spot projector	
Max power of light spot	At least 2 mW
Light spot diameter	< 6 um at 70% of light power
Dynamic of regulation of light power	At least 100 times
Optics	F1.5 diffraction limited
Control	From PC via USB
Scanning system	
XY scanning area	At least 10x10 mm
Scanning resolution	rough movement – 2.5 um; precision movement: 0.5 um
Focusing range	10 mm
Focusing resolution	0.5 um
Control	From PC via USB
Other parameters	
Working temperature of SPOT station	+5ºC to 35ºC
Storage temperature	-5ºC to 55ºC
Working humidity	Up to 85%
Storage humidity	Up to 90%

**specifications are subject to change without prior notice*

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