

# LS-SAL

## Multi channel broadband VIS-SWIR light source

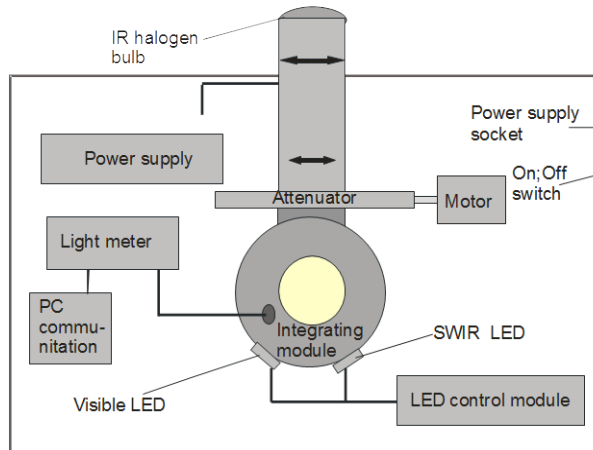


Fig. 1. Block diagram of LS-SAL calibrated light source



Fig. 2. Photos of LS-SAL calibrated light source a)front view, b)back view

### BASIC INFORMATION:

The LS-SAL light source is a multi-channel calibrated light source developed for realistic simulation of light conditions from dark, moonless nights to ultra bright days in VIS-SWIR spectral band. Design of this light source is optimized for use in systems for testing VIS-SWIR cameras (color VIS cameras, monochrome VIS-NIR cameras, SWIR cameras, VIS-SWIR cameras) working in spectral band from about 400nm to about 2000nm and used for long/medium range surveillance applications.

The LS-SAL source can work in five different modes: 1)halogen bulb of 2856K color temperature in most of VIS-SWIR band, 2) white broadband LED of color temperature over 5000K spectrum in visible range, 3)mixed mode when both halogen and white broadband LED are active at regulated ratio of halogen/LED light intensity, 4) calibrated monochromatic 1550nm high source, 5)calibrated SWIR light source. Next, LS-SAL source is equipped by a set of spectral filters that can be used to select desired spectral band when working in halogen mode. These advanced simulation capabilities make LS-SAL light source an unique solution on international market.

LS-SAL can be treated as modification of popular LS-DAL light source. Modifications: special coating of internal integrating sphere for expanded VIS-SWIR spectral band, no UV light source, additional monochromatic 1550nm mode, additional SWIR band only mode.

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### HOW IT WORKS :

The LS-SAL source is an integrated switchable light emitter that is built using three different light sources: 1)IR halogen lamp of approximate 2856K color temperature spectrum from visible to SWIR band, 2) white broadband LED of color temperature over 5000K. These lamps can work as independent blocks or in mixed mode. Next, LS-SAL source is equipped by a set of spectral filters that makes possible to modify spectrum of halogen/LED source.

Intensity of the halogen bulb is regulated using an opto-mechanical attenuator that changes light intensity but does not change light color temperature (light spectrum). Intensity of the LED sources is regulated electronically using advanced electronic regulation/stabilization system.

### MODES OF WORK:

LS-SAL can work in five modes:

1. Halogen bulb – no filter: broadband light source from 400nm to 2100nm (color temperature equals to 2856K in spectral band from 400nm to 1700nm and non greybody spectrum up to 2100nm). Light source is calibrated in  $\text{cd/m}^2$  units.
2. White LED: visible light source of color temperature over 5000K. Light source is calibrated in  $\text{cd/m}^2$  units.
3. Mixed mode: halogen and LED. Spectrum of emitted light depends on proportion of regulated halogen intensity to LED intensity. Light source is calibrated in  $\text{cd/m}^2$  units.
4. Halogen bulb – 1550nm filter: monochromatic light source that emits light at 1550nm wavelength. Light source is calibrated in  $\text{W/sr m}^2$  units.
5. Halogen bulb – SWIR only filter: broadband light source that emits light from about 900nm to about 2100nm (color temperature equals to 2856K in spectral band from 400nm to 1300nm). Light source is calibrated in  $\text{W/sr m}^2$  units.

*Attention: Number of modes of LS-SAL source can be increased by adding new spectral filters.*

### FEATURES:

- Extremely wide dynamic range ( $10^9$ ) and continuous regulation of light intensity enables simulation of both ultra bright day conditions and ultra night conditions). There is on the market no light source that could simulate light conditions in so wide range. Some competitors claim that their light sources offer regulation from 0 lx but this level is achieved by switching off the light source not by true precision regulation.
- Ability to regulate spectrum of emitted light in order to simulate conditions at different regions caused by different spectrum of light that illuminate scenery of interest and different spectral reflectance of such scenery. There is on the market no light source that could enables similar spectrum regulation.
- Fully computerized design. Light intensity and mode of work can be controlled from PC.
- Compact design optimized for use in systems for testing VIS-SWIR cameras.
- Open policy of Inframet on recalibration. Inframet delivers information that enables users of LS-SAL light sources to recalibrate these light sources.
- LS-DAL source is optimized for use in image projectors in systems for testing VIS-SWIR cameras. These image projectors (collimators) require from the light source Lambertian emission of light only in narrow angle (typically below  $10^\circ$ ). Therefore LS-SAL light source behave like a fully Lambertian source at emission angles up to  $15^\circ$ .

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### SPECIFICATIONS

Parameter	Value
	<i>Performance parameters</i>
Light source diameter	40 mm
Basic modes of work:	1) halogen bulb - no filter 2) visible broadband LED 3) mixed (halogen and LED) 4) halogen bulb with 1550nm narrow band filter 5) halogen bulb with only SWIR filter
Temporal stability	<1% (all modes)
	<i>Halogen bulb-no filter</i>
Type of light source	halogen bulb as a polychromatic source of light of color temperature about 2856K up to about 1300nm and non greybody spectrum up to 2100nm
Spectral band	From about 400nm to about 2200nm
Regulation type	continuous
Regulation method	opto-mechanical attenuator
Luminance range	At least $10\mu\text{cd}/\text{m}^2$ - $1000\text{ cd}/\text{m}^2$
Regulation resolution	$10\mu\text{cd}/\text{m}^2$ (at low intensity range)
Stabilization time	<90 sec
	<i>Visible LED mode</i>
Light source	white LED
Color temperature	>5000K
Spectral band	0.4-0.72 $\mu\text{m}$ .
Regulation method	Electronic regulation
Luminance range	At least $0.02\text{cd}/\text{m}^2$ - $5000\text{ cd}/\text{m}^2$
Regulation resolution	$0.01\text{ cd}/\text{m}^2$
Stabilization time	<30 sec
	<i>Mixed mode</i>
Light source	halogen bulb and white LED
Spectrum of emitted light	depends on proportion of regulated halogen intensity to LED intensity (example spectrum in Fig.3c)
Regulation method	Electronic regulation mixed with opto-mechanical regulation
Luminance range	$20\mu\text{cd}/\text{m}^2$ - $11\text{ kcd}/\text{m}^2$
Regulation resolution	$10\mu\text{cd}/\text{m}^2$ (at low luminance range)
Stabilization time	<100 sec
Temporal stability	<1%
	<i>Halogen bulb-1550nm filter</i>
Type of light source	halogen bulb with narrow band 1550nm spectral filter
Spectral band	$1550\pm 15\text{nm}$
Radiance range	At least $0.1\text{ mW}/\text{sr m}^2$ - $1\text{ W}/\text{sr m}^2$
Regulation resolution (at low range)	$0.05\text{ mW}/\text{sr m}^2$
	<i>Halogen bulb-only SWIR filter</i>
Type of light source	halogen bulb with longpass SWIR filter
Spectral band	From about 900nm to 2200nm
Radiance range	At least from about $2\text{ mW}/\text{sr m}^2$ to about $20\text{ W}/\text{sr m}^2$
Regulation resolution (at low range)	$1\text{ mW}/\text{sr m}^2$

\*specifications are subject to change without prior notice

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