

# LS-MAH

## Manual halogen light source

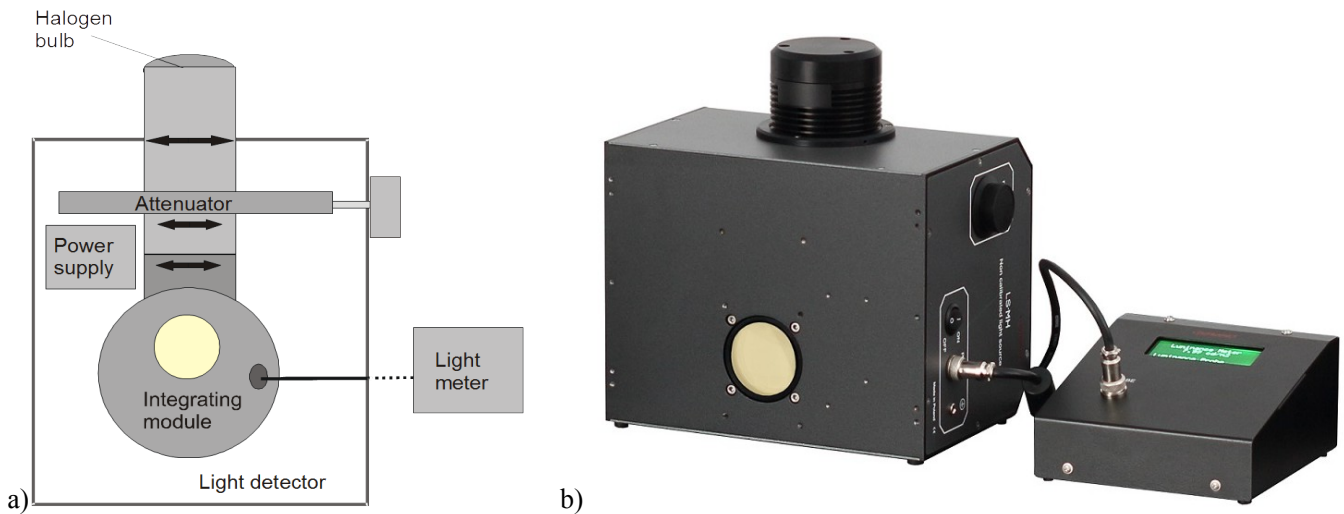


Fig. 1. LS-MAH light source a)block diagram, b)photo



Fig. 1. LS-MAH light source as a part of VINIS test system for testing VIS-NIR cameras

### BASIC INFORMATION:

The LS-MAH light source is a manually controlled halogen light source that simulates natural polychromatic light sources of color temperature about 2856K in visible, near infrared, and partially in short wave infrared spectral bands. Intensity of the light source is regulated using an opto-mechanical attenuator that changes light intensity but does not change color temperature of emitted light. LS-MAH light source is built using a concept of a special optical system projecting light emitted by a halogen bulb to integrating module that later works as a light emitter. The source offers high dynamic range and continuous manual regulation of light intensity.

Basic version of LS-MAH light source is a broadband (emitting light in wide range from visible to short infrared) non calibrated (user can regulate luminance but absolute value is not known) of limited emitter size (40mm diameter) targeted for budget limited projects. The light source when combined with a collimator and a set of targets can create simple but near perfect solution for measurement of imaging parameters (resolution, MTF, distortion) of VIS-NIR cameras, SWIR imagers and with limitations also NVDs.

LS-MAH can be also delivered in more advanced versions that offer measurement of absolute values of luminance, regulation of light spectrum, attachable adapter for resolution targets, bigger aperture of light emitter, and ability to simulate dark night conditions. These advanced LS-MAH sources can be used to built test systems capable to measure both imaging, radiometric and spectral parameters of VIS-SWIR imagers.

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### TECHNICAL PARAMETERS

Parameter	Value
Light emission source	Halogen bulb
Light source diameter	40 mm
Spectral band	At least 400nm to 2000nm (typical optimization 400-1000nm)
Light spectrum	Light of 2856K color temperature in spectral band from 400nm to 1100nm (typical spectrum as in Fig.3)
Method of regulation of light intensity	Manual rotation of a knob that controls opto-mechanical attenuator
Range of regulation of light intensity of the light emitter	At least 60 mcd/m <sup>2</sup> to 6 kcd/m <sup>2</sup> - basic version
Method of regulation of light spectrum	Manual insertion of bandpass or narrow band filters (only in advanced versions)
Total dynamic of light source	At least 10 <sup>5</sup> - basic version At least 10 <sup>8</sup> - advanced version (see Options)
Emission angle	Lambertian source at angles up to 15°
Calibration	Basic version: non calibrated Advanced versions: see Options
Work temperature	+5°C to +35°C
Storage temperature	-5°C to +55°C
Humidity	Up to 90% (non condensing)
Dimensions	280x260x230
Mass	8 kg

\*specifications are subject to change without prior notice

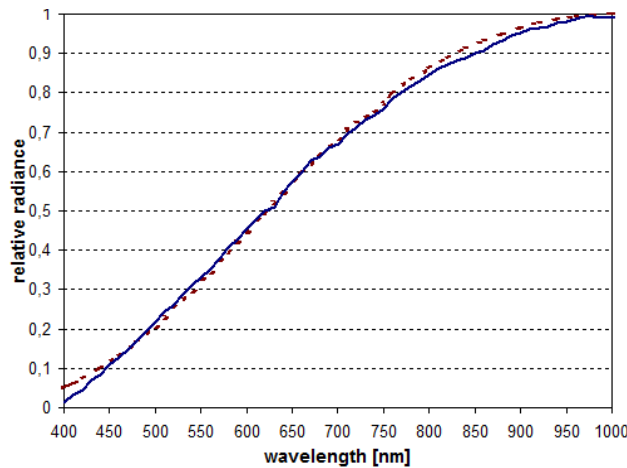


Fig.3. Spectrum of light emitted by LS-MAH source (continuous – real spectrum, dots – ideal 2856K source)

### OPTIONS:

LS-MAH source can be delivered in a series of advanced versions that increase its performance.

#### Optimization for SWIR spectral band: SW option

Typical LS-MAH light source emits light not only in VIS-NIR range but also in SWIR range up to about 2000nm. However, typical LS-MAH light source is optimized for VIS-NIR spectral band and light intensity quickly drops at wavelengths over 1100nm. SW option means that LS-MAH-SW is delivered in a special version when light intensity in SWIR spectral band is significantly increased comparing to typical LS-MAH light source. In detail, the spectrum of LS-MAH-SW up to 1600nm resembles spectrum of 2850K color temperature ideal light source.

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### Calibration in photometric units:

- A1. External luminance meter that measures absolute value of emitter luminance in  $\text{cd/m}^2$  units. Additional meter is delivered. Internal electronics is modified.
- A2. LS-MAH communicates with PC. Software can be used to read and display current light luminance. Internal electronics is modified. PC with proper software to communicate with LS-MAH is delivered.

### Light spectrum

- B1. Modified design of LS-MAH source enables regulation of light spectrum using manually inserted set of three band pass filters: visible only, NIR and SWIR only, SWIR only.
- B2. Modified design enables regulation of light spectrum using manually inserted set of three band pass filters (visible only, NIR and SWIR only, SWIR only) and a set of eight narrow band filters of 10nm spectral bands. Center wavelengths: 400nm, 500nm, 600nm, 700nm, 800nm, 900nm, 1000nm, 1100nm. Bigger number of filters or other wavelengths at SWIR band are possible.
- B3. As in B2 but spectral radiance in  $\text{W/m}^2 \text{ sr } \mu\text{m}$  units can be measured and absolute value is displayed by software. Attention: B3 option is possible only if A2 option is chosen, too.

### Test targets

- C1. Attachable adapter connected to LS-MAH (and optionally to a CDT collimator) where a resolution target can be inserted is delivered. Typical USAF1951 resolution target is delivered too.
- C2. As in C1 but additional targets for MTF measurements are delivered: slanted edge and slanted L shape target.

### Size of light emitter

- D1. Diameter of light emitter is increased to 60mm. Useful option when bigger angular size of target simulated by a collimator is needed. Attention: Lambertian emission angle of the light source is limited to  $11^\circ$ . Design of LS-MAH source is modified.

### Light regulation dynamic

- E1. Light regulation dynamic is increased to  $10^7$ . It means that luminance can be regulated in range at least from  $0.06 \text{ mcd/m}^2$  to  $6 \text{ kcd/m}^2$  and LS-MAH can be used to simulate dark night conditions.

## SUMMARY

LS-MAH manual halogen light source is a near perfect solution for applications where high dynamic broadband/bandpass light source of moderate cost is needed. LS-MAH is especially recommended for budget limited projects with aim to built a moderate cost test system by purchase of hardware blocks and developments of simple test software.

*Version 2.1*

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