



Ikarus-II Light Engine

Fact sheet

In-Vision

10/30/2019

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1 Revision history

1.1 Parameter definitions

Version	Date	Author	Description and reason of change
2.15	10/28/2019	MB	Updated definitions of Intensity uniformity
2.14	10/25/2019	MB	Updated definition of Irradiance uniformity
2.1	05/07/2019	MB	Initial version

Table 1: Parameter definitions revisions

1.2 Specifications

Version	Date	Author	Description and reason of change
2.16	10/30/2019	MB	Updated optical specifications
2.15	10/28/2019	MB	Updated specification of Intensity uniformity
2.14	10/25/2019	MB	Updated optical specifications
2.11	10/15/2019	MB	Updated available off-the-shelf lenses
2.1	05/07/2019	MB	Initial version

Table 2: Ikarus-II revisions

2 General

Ikarus-II Full-HD/1080p DLP projection module is tailored to stereolithography (SLA) applications and offers the benefits of a compact, light-weight, yet high-performance optical module with many options for customization. The projector builds around Texas Instrument's DLP6500 platform and is available with a variety of screw-on lens types, addressing application-specific requirements such as wavelength, throw ratio, feature size and projection distance. Both off-the-shelf lenses as well as customized modifications are available with a short lead time through In-Vision in-house design and production lines.

Optical distortion is kept at minimum levels, whereas illumination uniformity is maximized across the full image area owing to on-axis, TIR-prism illumination of the DLP®.

All lenses and optical components are designed and manufactured by IN-VISION®, offering our customers plenty of options for adaptations to their specific needs.

Illumination and projection lenses are optimized for UV and blue LED light sources, enabling highest transmission efficiency and maximum contrast values. Modules are equipped with the desired light source upon order placement. Standard wavelength is $405nm$, others on request.

3 Definition of parameters

3.1 CTF

First, we must define the so-called Michelson contrast. This value represents the amplitude difference between the peaks and valleys of a periodic function (e.g. sine, rectangular). The Michelson contrast is defined as:

$$Contrast = \frac{I_{peak} - I_{valley}}{I_{peak} + I_{valley}} \quad (1)$$

The CTF (Contrast Transfer Function) represents the measured Michelson contrast at a certain line pair frequency in mm (Lp/mm). The line pair frequency is a measure of resolution. Typically, CTF values are stated for a Lpf which represents one pixel row/line in ON-state and one pixel row/line in OFF-state (e.g. for a lens with 75 pixel pitch in the image space, the Lpf is $1000/75/2 = 6.67Lp/mm$). Figure 1 represents a section of the light engine image. The yellow line represents a path along which the intensity values are

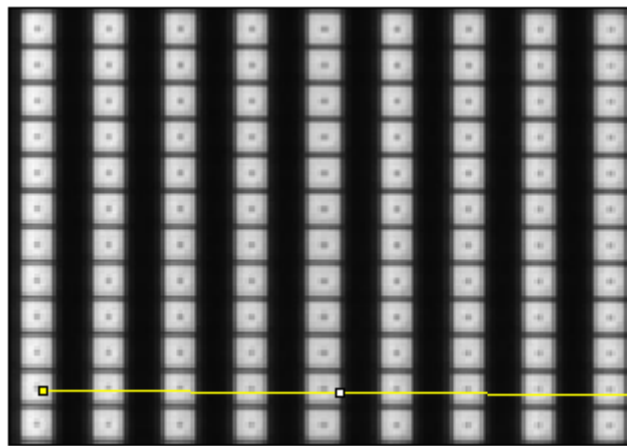


Figure 1: CTF definition, image 1

extracted, which can be used to determine CTF (see figure 2).

3.2 Radial distortion

Distortion is a value representing the deviation of the image height y (pixel position) which is expected from the magnification compared to the measured, real image height (all positions are relative to the position of the central pixel, so a position deviation of the complete image does not count). Its value is defined as, typically stated in % (multiplied by 100):

$$Dist = \frac{y_{real} - y_{ideal}}{y_{ideal}} \quad (2)$$

A lower distortion value represents higher-quality lens designs, but typically needs more lens elements to be achieved.

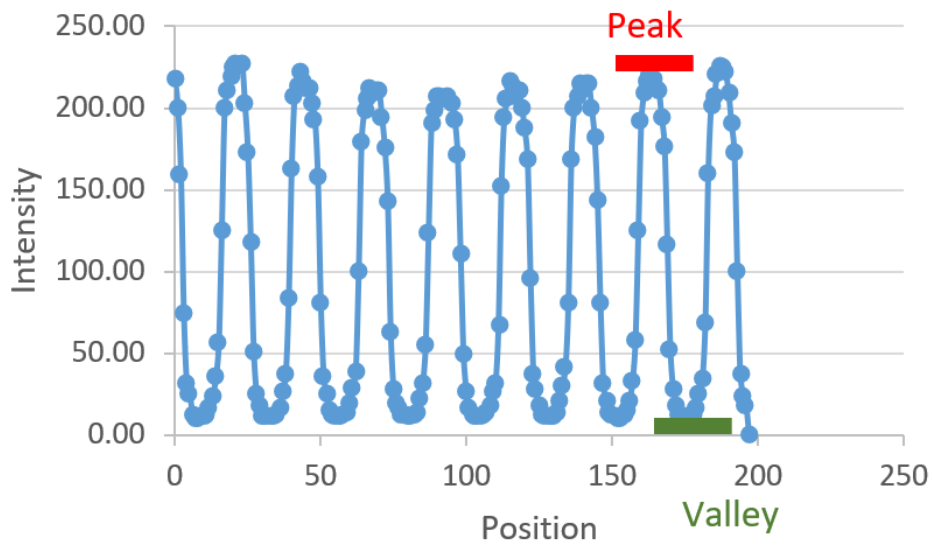


Figure 2: CTF definition, image 2

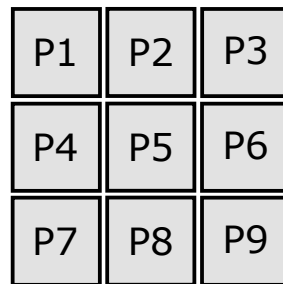


Figure 3: Scheme for Intensity uniformity calculation according to [1]

3.3 Intensity uniformity in image

This value presents how the intensity differs across the image.

3.3.1 Intensity uniformity according to standard IEC 61947

This definition of Intensity uniformity refers to [1] and can be calculated (in %) with respect to fig. 3 as follows:

$$U_{min} = 100 \times \frac{Min [P1, \dots, P9]}{Average [P1, \dots, P9]}$$

3.3.2 Intensity uniformity according to In-Vision standard

Intensity uniformity according to In-Vision standard is measured by using 25 distributed measurement points, each representing 40×40 pixels in ON-state. The intensity is measured locally. The uniformity is defined by the ratio between the dimmest and brightest measurement point, a uniformity of 100% would mean that all measurement points are equally bright. Typically, higher values represent higher-quality systems.

4 Specifications

Parameter	Specification
Display type	TI DLP6500
DLP controller	TI DLPC900
Resolution	1920 × 1080
Chip pixel pitch	7.56 μ m
Min. Intensity uniformity (IEC definition – see section 3.3.1)	> 92%
Min. Intensity uniformity (In-Vision definition – see section 3.3.2)	up to 92%
Full On/Off Contrast	up to 1500 : 1
ANSI Contrast	up to 500 : 1
Optical output power in the image plane	365nm: up to 2.0W 385nm: up to 4.0W 405nm: up to 4.0W 460nm: up to 4.5W
Operating temperature range	15..35°C
Max. relative humidity	non-condensing
IP code	IP40
Pattern rate binary	9523Hz
Pattern rate grayscale	247Hz
Control interfaces	USB DLP and LED Trigger inputs Status Signal
Data interfaces	HDMI USB

Table 3: Ikarus-II specifications

Tables 4 to 6 shows data for the available off-the-shelf lenses.

5 Mechanical drawings

The mechanical drawing for the LE can be seen in figs. 4 to 7.

Parameter	Specification
Available wave lengths	365, 385, 405nm
Distance mechanical reference to image plane	350mm
Image pixel size	50 μ m \pm 1%
Image distortion	< 180 μ m
Image distortion	< 0.33%
Contrast Transfer Function (CTF) @ 10.0LP/mm	> 70%

Table 4: Topol specifications

Parameter	Specification
Available wave lengths	365, 385, 405, 460nm
Distance mechanical reference to image plane	550.57mm
Image pixel size	84 μ m \pm 1%
Image distortion	< 91 μ m
Image distortion	< 0.1%
Contrast Transfer Function (CTF) @ 6.0LP/mm	> 70%

Table 5: Nihan specifications

Parameter	Specification
Available wave lengths	405nm
Distance mechanical reference to image plane	406mm
Image pixel size	100 μ m \pm 1%
Image distortion	< 324 μ m
Image distortion	< 0.3%
Contrast Transfer Function (CTF) @ 5.0LP/mm	> 70%

Table 6: Melzer specifications

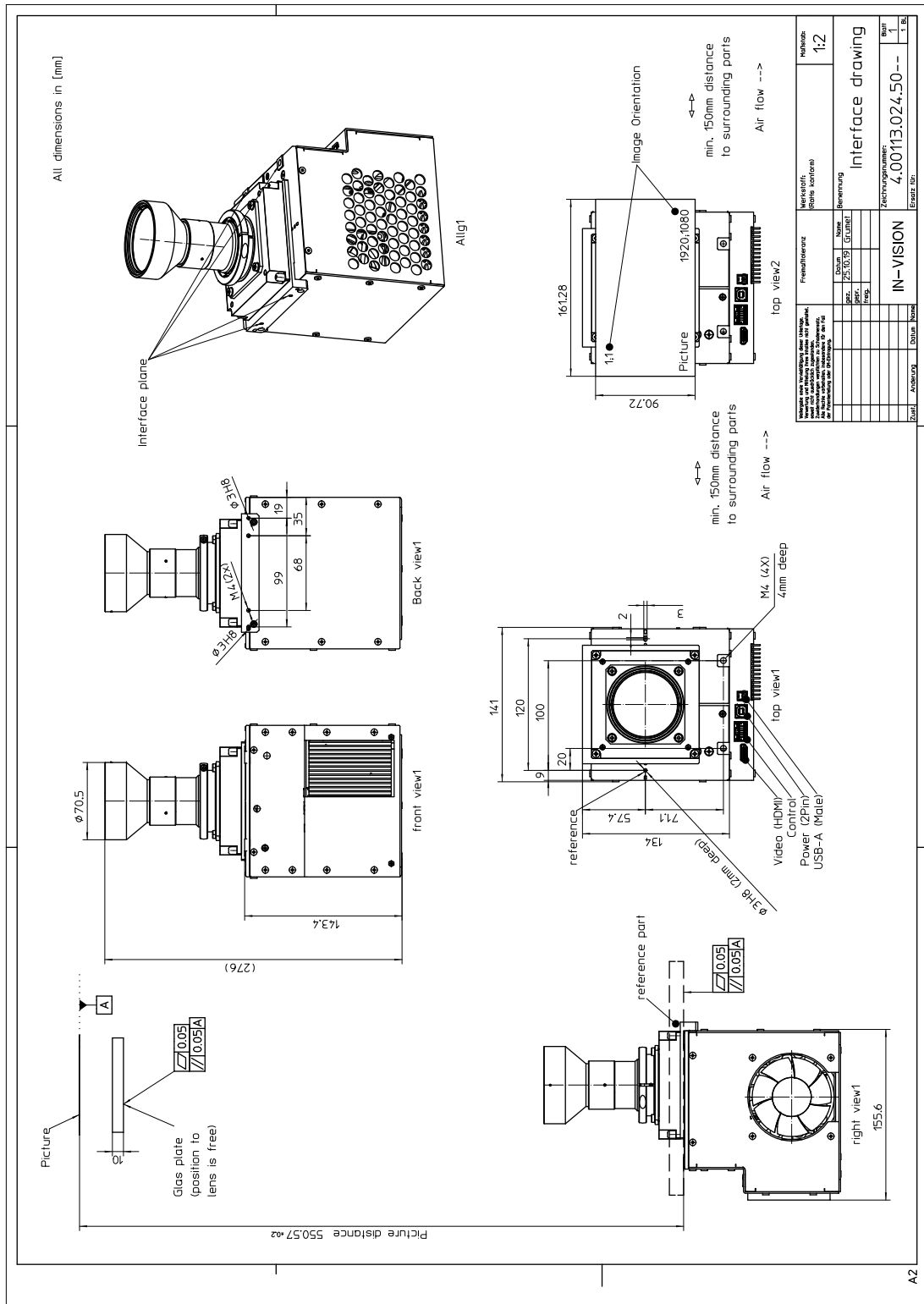


Figure 6: Ikarus-II Light Engine drawing (with Nihan lens, 385nm light source, XY module and air cooling)

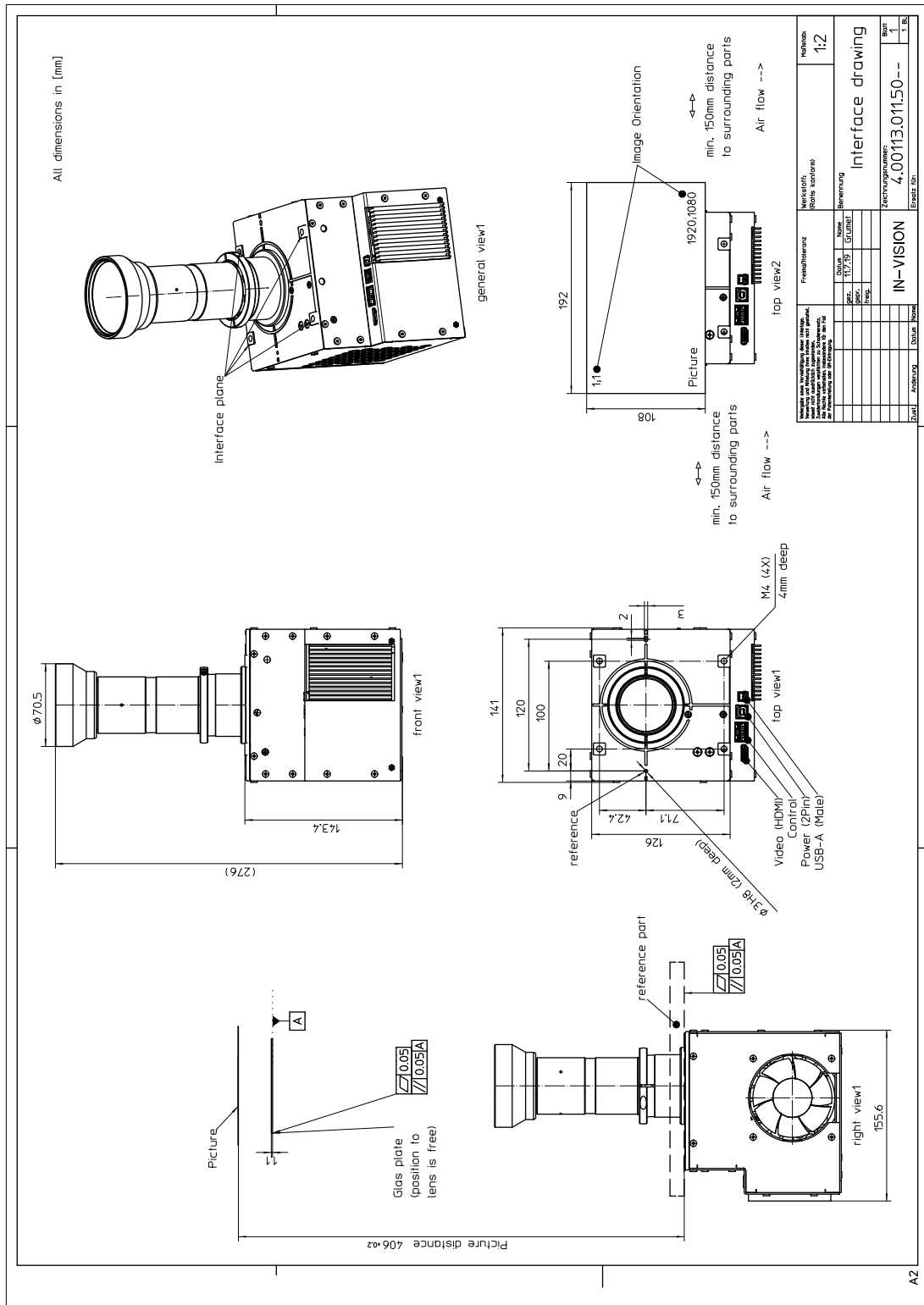


Figure 7: Ikarus-II Light Engine drawing (with Melzer lens, 405nm light source and air cooling)

A Abbreviations

Abbrev.	Meaning
n.c.	not connected
LED	Light Emitting Diode
USB	Universal Serial Bus
HID	Human Interface Device
API	Application Program Interface
MSB	Most Significant Byte/Bit
LSB	Least Significant Byte/Bit
DMD	Digital Micromirror Device
DLP	Digital Light Processor
DLPC	DLP Controller
LUT	Look-Up table
FW	Firmware
LE	Light Engine
HW	Hardware
SW	Software
CTF	Contrast Transfer Function
IP Code	International Protection Marking
LP	Line Pairs
MTF	Mean Time to Failure

Table 7: Abbreviations

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C References

[1] IEC 61947-1:2002: Electronic projection – measurement and documentation of key performance criteria – part 1: Fixed resolution projectors. Technical report, International Electrotechnical Commission, Geneva, CH, August 2002.