

40 mm High Performance Image Intensifiers

Introduction

Proxitronic now offers large area image intensifiers with 40 mm active diameter. Check here the advantages and uses of large-sized image intensifiers.

Most efficient coupling to large area CCD

According to Liouville's theorem any optical demagnification (either by taper or by lens) is accompanied by a reduction of luminosity ($N_{\phi} \text{ m}^{-2} \text{ s}^{-1}$). This applies to any stage of the optical chain: on the input side it applies to the projection of the image onto the image intensifier, the same holds true for the image transfer from the image intensifier onto the focal plane array (CCD or CMOS).

[The only (expensive!) exception from that law is the use of a demagnifying inverter, which on the other hand is restricted to fiber optics as an input substrate, thus limiting quantum efficiency and image quality.]

On the input side this effect is however more critical because any loss of input light will result in a loss of signal, whereas at the output it will affect only the signal intensity.

Therefore the performance of an optical sensor can be optimized in many cases by choosing a large area sensor with a matching image intensifier in front.

With the notable exception of night vision goggles, nowadays virtually all image intensifiers are combined to a focal plane array (CCD or CMOS). With ever increasing number of pixels, large area CCDs are of growing popularity. In particular scientific applications frequently tend to demand sensors larger than 25 mm. In such cases a 40 mm intensifier is the best choice because it allows to use the full active area without image minification, which would be accompanied by undesired side-effects, most notably distortion and reduced transmission.

Improved light collection with large active area

Not surprisingly, applications that require an image intensifier are typically light-starving. Thus any loss of light on the input side is to be avoided. The projection of the object onto the active device is accompanied with losses proportional to the squared aspect ratio. Thus a 40 mm intensifier will get 2.5 times more light compared to a 25 mm one.

Faster acquisition upon direct contact with sample

One important usage of large intensifiers is the image acquisition in direct contact with self-emitting samples. The two most important fields of application are scintigraphy and X-ray imaging. As no lens can be used, the important parameter is the area directly covered because the acquisition time can be significantly reduced upon usage of a large-sized intensifier.



Compared to EMCCD: larger active area → lower requirement for optical reduction (i.e. lower losses)

In recent years, technologies competing with image intensifiers have been developed for low-light applications. The most popular of these is the EMCCD. Currently these sensors are manufactured mostly in 1/2" or 2/3" size. As explained above, the reduction of the image size strongly affects the light collection from the object. Therefore a large image intensifier is intrinsically more light-efficient than any kind of smaller sensor.

Advantages

The common applications for 40 mm intensifiers typically require photocathodes for the visible spectrum, mostly for wavelengths below 600 nm. So S20 and Bialkali photocathodes are the most popular choices and they are well established at Proxitronic.

Indeed most short-gating applications are covered with a common S20 photocathode. The same holds true for situations where the intensifier "looks" at a phosphor screen (e.g. in X-ray imaging). Furthermore S20 is more robust a photocathode than S25. For these reasons Proxitronic recommends the usage of S20 photocathodes.

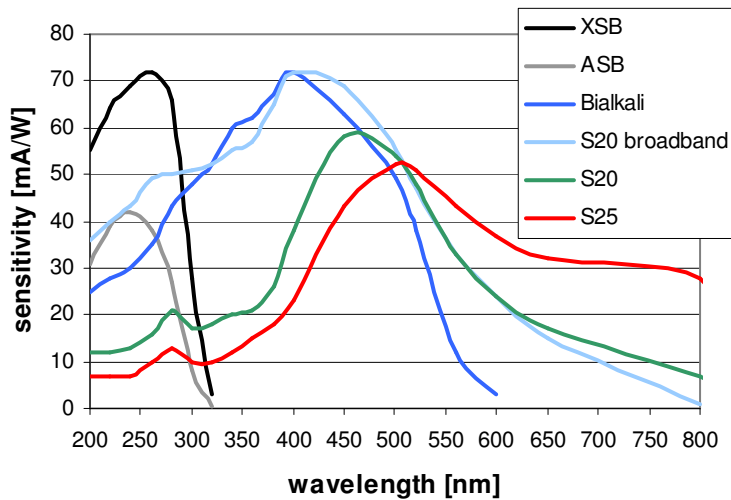
All useful configurations are ready for production:

- FO or quartz input window
- Green / blue photocathode
- Single / double MCP
- Glas / FO output window
- Ring power supply available

Typical specification

	single MCP	double MCP	
photocathode		S20	(Na ₂ KSb)Cs ₂
sensitivity		50	mA/W @450 nm
useful diameter		40	mm
outer diameter		70	mm
outer length		≤22	mm
dynamic range	4000	1000	
resolution	>35	>25	lp/mm
gain	>2·10 ⁴	>1·10 ⁶	W/W @500 nm
luminous non-uniformity	10	15	% st.dev. / mean
phosphor screen		P43	
input window		fiber optic	
output window		fiber optic	
electronic gain	>1·10 ³	>1·10 ⁶	el/el
EBI		<2·10 ⁻⁷	lx
screen voltage		6	kV
gating		10 - DC	ns

Spectral sensitivity

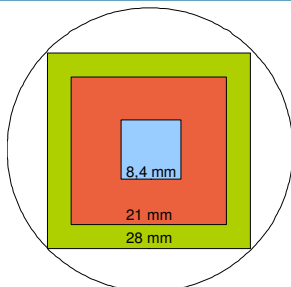


The sensitivities shown above refer to non-gateable photocathodes on a quartz substrate.

Blemish specification

Definition of zones

zone	40 mm I2
1	8,4 mm x 8,4 mm
2	21,0 mm x 21,0 mm
3	28,0 mm x 28,0 mm



Other definitions of zones are possible and can be agreed upon on request.

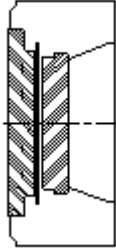
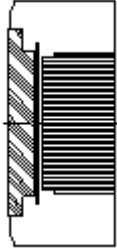
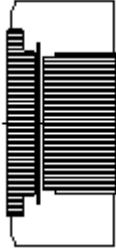
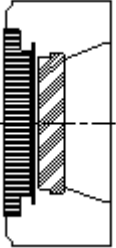
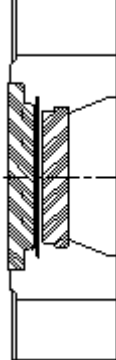
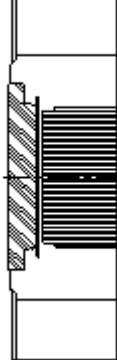
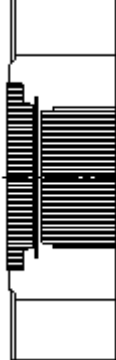

Number of allowed blemishes



	max. blemish size					
	in zone 1		in zone 2		in zone 3	
Image intensifier types*	75 μ m	150 μ m	75 μ m	150 μ m	75 μ m	150 μ m
BV 4063, BV 4083	minimal	4	minimal	6	minimal	15
BV 4063 -V, BV 4083 -V	minimal	4	minimal	6	minimal	15

*Comments

- The sum of all blemish areas must not exceed 1% of the zone area
- The size of a long blemish is considered equal to that of circular-shaped blemish with same area
- Blemishes with a diameter larger than 150 μ m are not allowed
- Bright spots visible with a microscope and dark adapted eyes are not allowed at the recommended intensifier voltages inside the useful area of 40 mm

Drawings

w/o power supply Ø 70 mm	 BV 4061	 BV 4062	 BV 4063	 BV 4064
with power supply Ø 95 mm	 BV 4081	 BV 4082	 BV 4083	 BV 4084
Housing thickness: single MCP: 21,5 mm double MCP: 22,0 mm				

Legend  clear glass  fiber optic