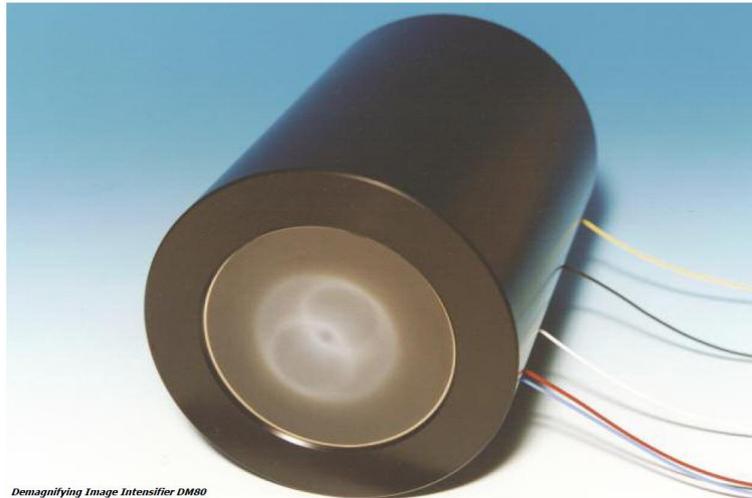


Demagnifying Image Intensifiers



Demagnifying Image Intensifier DM80

FEATURES

- 47, 80 and 150 mm input window
- 6:1 zoom ratio
- Magnification from 0.1 to 0.6
- Gateable
- Distortion less than 5%
- Gen I high dynamic range

APPLICATIONS INCLUDE

- X-ray imaging
- Beta autoradiography
- Dynamic X-ray TV
- Nuclear physics
- X-ray crystallography
- Non-destructive testing

INTRODUCTION

The DM47, DM80, DM150 are rugged metal-ceramic tubes with tetrode electrostatic focusing. Change of magnification is accomplished by simultaneously adjusting the voltage of three electrodes. The photocathode is remotely processed in a vacuum transfer system, assuring high efficiency and low-noise. It is processed on a plano-concave fiber optic window, with a maximum useful diameter of 45, 76 or 140 mm. This range of demagnifying intensifiers has no microchannel plate (MCP) – the photon gain is dependent only on the operating voltage and the efficiency of the photocathode and phosphor screen. Compared to a fiber optic taper, the electrostatic tube offers a photon gain of around 100 photons/photoelectron at 10 kV with P43 phosphor; sufficient to overcome readout noise of scientific CCDs without degrading dynamic range or resolution, which is typically less than 20 microns at the output surface. The design gives a small amount of pin cushion distortion and blemishes.

OPERATING VOLTAGE

| Magnification | 0.1 | 0.25 | 0.4 | 0.6 |
|------------------|-------|-------|-------|-------|
| Cathode | 0 | 0 | 0 | 0 |
| Uf 1 (Gated On) | 73 | 57 | 110 | 330 |
| Uf 1 (Gated Off) | -300 | -320 | -500 | -1000 |
| Uf 2 | 360 | 120 | 270 | 730 |
| Um | 460 | 1540 | 4250 | 10000 |
| Anode | 10000 | 10000 | 10000 | 6000 |

Typical operating voltages are shown in the table. For most customers, the tube will be supplied with a resistor network encapsulated with the tube to work at a defined magnification. Alternatively access can be given to all electrodes to enable the tube to be used in zoom mode from programmable power supplies.

GATING

A gating pulse unit is available for this tube, which has a rise time/Fall time of about 0.2 μ s and is suitable for gating in the micro-second range.

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OPERATION MODES

| Magnification | 0.1 | 0.25 | 0.4 | 0,5 | 0.6 |
|---------------|-----|------|------|------|-----|
| DM47 | 4.7 | 11.7 | 18.8 | 23.5 | 2 |
| DM80 | 8 | 20 | 32 | 40 | - |
| DM150 | 15 | 37.5 | - | - | - |
| Distortion | 5% | 0% | 2.6% | 5% | 5% |

Fixed Input Format

The image input size is assumed to be frozen at a defined diameter. The size of the output image can be adjusted in the range 0.6 to 0.1 by controlling the focus voltages. The tube can be operated from a fixed voltage divider chain at any chosen magnification.

Fixed Output Format

If the desired output format is assumed to be frozen by, for example, an 11 mm diagonal CCD, then the size that this maps onto the photocathode can be changed by adjusting the voltages on the focus electrodes within the range 1,6 to 10 times bigger than the output.

Dynamic Range

The dynamic range of the demagnifying image intensifier has been independently measured and shows that good results can be obtained over a 5 order of magnitude range.

| Magnification | 0.1 | 0.25 | 0.4 | 0.6 |
|-----------------|-----|------|-----|-----|
| Cathode (lp/mm) | 6 | 12 | 18 | 32 |
| Screen (lp/mm) | 60 | 48 | 45 | 53 |

Resolution

Resolution of these detectors is dependant on a number of factors including: the electro optic design, the operating voltages, the magnification and the phosphor screen. The table on the left side shows typical figures for S20 cathode, P43 phosphor and 10 KV operating voltage.

| Magnification | Uniformity | >0.25 | 0.25 to 0.15 | 0.15 to 0.075 | <0.075 |
|---------------|------------|-------|--------------|---------------|-----------|
| DM47 | ± 15% | 0 | 3 | 8 | Unlimited |
| DM80 | ± 15% | 1 | 6 | 16 | Unlimited |
| DM150 | ± 15% | TBD | TBD | TBD | Unlimited |

Uniformity and Blemishes

Typical uniformity and blemishes at 0.6 magnification are shown in the table on the left side. Please note that the majority of blemishes are associated with defects in the large fiber optic input windows. The size that these blemishes are measured at the screen will decrease as the magnification moves towards 0.1.

Gain

The gain of these demagnifying image intensifiers is related to:

- The QE of the Photocathode
- The efficiency of the phosphor screen
- The operating voltage
- The magnification of the detector

For a low noise S20 cathode and P43 phosphor at 0.25 magnification and operating at 10 KV the photon gain is typically 100 to 200 photons/photoelectron (10 to 20 photons/photon with a 10% QE cathode).

It is worth remembering that the phosphor screen will appear much brighter at 0.1 magnification than it does at 0.6 magnification because the electrons are concentrated on a much smaller area of the phosphor screen.

Distortion

The distortion of this detector is less than 5% over the majority of the active area, however, at certain magnifications, the distortion at the very edge does increase to higher levels. If image distortion is of great concern it is recommended that the active area be limited to 42 mm for the DM47-025 and 70 mm for the DM80-040.

Photocathodes

Photek can offer a range of photocathodes including bialkali, Low noise S20, S20 and S25. Please refer to our separate photocathode datasheet for further details.

Phosphor Screens

Photek can offer a large range of phosphor screens including P11, P20, P32, P43, P46 and P47. Please refer to the separate phosphor screen datasheet for further details.

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