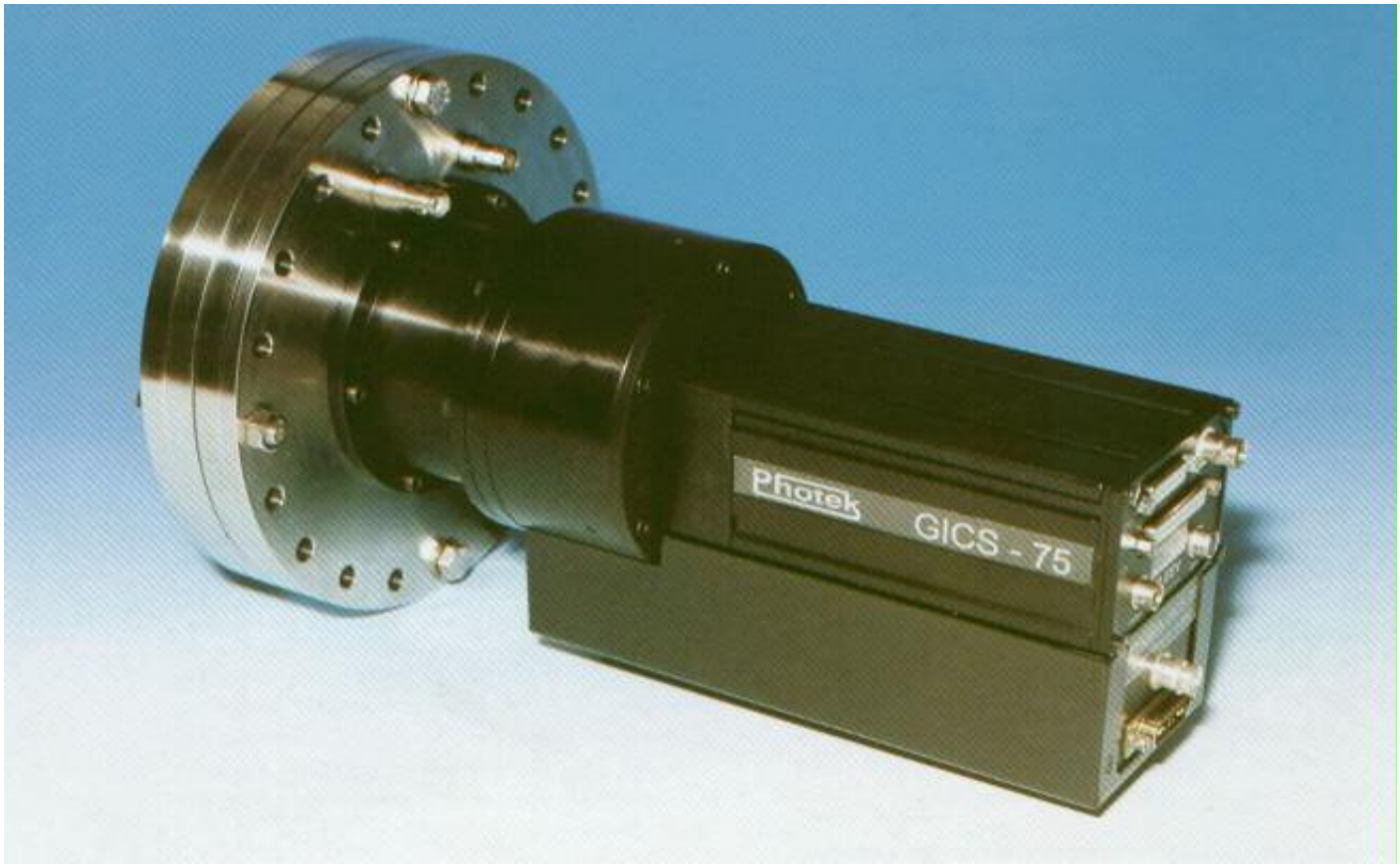
VACUUM COMPATIBLE DETECTORS



GICS-75 – A 75 mm active diameter MCP detector fibre optically coupled to a Photon Counting ICCD Camera with 5 ns gating and synchronous 512 x 512 CCD and custom image processing software

FEATURES

- Custom CAD Designed
- Manufactured in Europe
- Integrated Detector Systems
- High Calibre Design Team
- Ultra High Speed
- Ultra High Resolution
- Detection of Molecules, fragments, ions, anti-matter, neutrons, letpons, hadrons , photons etc.

APPLICATIONS

- Mass Spectroscopy
- Electron Microscopy
- VUV Imaging
- Space Telescopes
- Fusion Research
- Nuclear Physics
- Field Ion Microscopy
- Measurement of Chemical Bond Strength
- Low Temperature Physics
- Synchrotron Radiation
- Photo Ionisation

INTRODUCTION

Photek is a small company of dedicated scientists and engineers engaged in designing, manufacturing and selling detectors to meet specific customers requirements. We have designed and built custom detectors for many of the major laboratories in Europe.

Photek detectors are used to measure picoseconds, nano-degrees Kelvin, anti-proton fluxes, molecular spin etc: the diversity is quite extraordinary. The following photographs and text gives some indication of the capabilities of Photek to design and manufacture custom detectors for the vacuum environment.

RESPONSIVITY OF VACUUM COMPATIBLE DETECTORS

The basic detector element is a microchannel plate (MCP). This is fabricated from a microtubular matrix of secondary electron emissive glass, and responds well to electrons, other charged particles. The approximate responsivity, collated from various published sources, is shown in Figure 1. The exact response depends upon many parameters including the angle of incidence of the charged particles and the history of the MCP. MCP vacuum baking sometimes reduces the responsivity but also reduces the noise generated by these detectors.

CsI coating will enhance the responsivity of an MCP, but as this is chemically reactive to moisture, it may be unsuitable for application where the detector has to be repeatably exposed to air.

Powder scintillators are normally used to convert the electron output of microchannel plates to an optical output in Vacuum Imaging Detectors. Table 1 shows the time response and optical output of common powder scintillators.

VACUUM IMAGE DETECTORS

Photek holds stocks of 12, 18, 25, 40 and 75mm active diameter MCPs and fibre optic screen assemblies. The general schematic format is shown in Figure 4.

A typical assembly, VID240 is shown in Figure 3. This particular device is designed for UV spectroscopy, and used a 40/25 fibre taper outside the vacuum for connection to a linear diode array

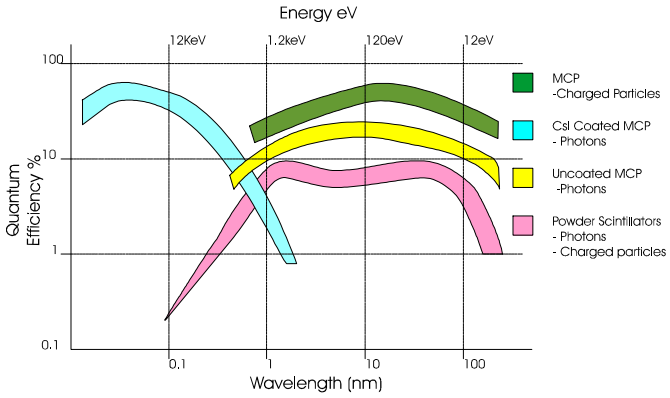


Figure 1 – Responsivity of Vacuum Int. Detectors

Photek manufactures a wide range of image intensifiers, and the metal-ceramic bodies of these devices are often used as the basis for the Photek range of Vacuum Compatible detectors. Figure 3 shows a bare image intensifier adapted to be mounted on a vacuum manipulator M3 screw connector with flying high voltage leads and operated as a beam finder.

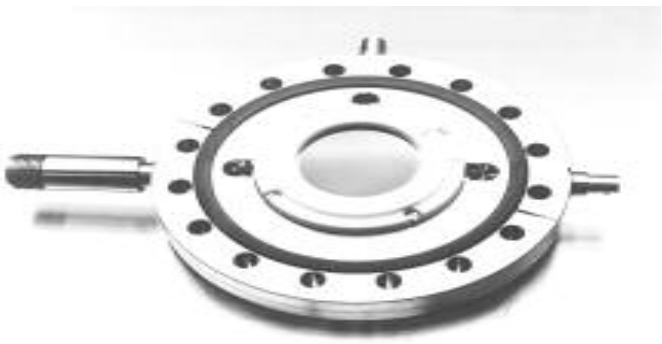


Figure 2 – Vacuum Imaging Detector 340 (Radial Connectors)

Image Intensifier bodies can also be mounted directly onto a vacuum flange as shown in Figure 5. The device illustrated is part of an ultra high resolution photon counting UV imager with resolu-

Figure 3 – Bare Image Intensifier (VID125 & Flying Leads)

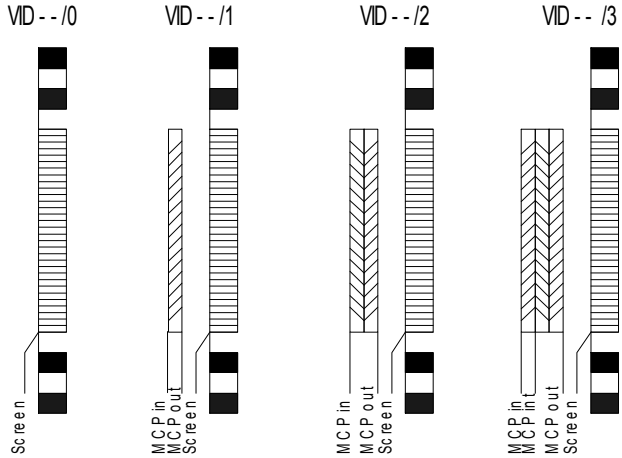


Figure 4 – Vacuum Imagers – Schematic Formats

The inherent resolution of a scintillator screen on its own is typically 75 lp/mm. With one MCP. This is reduced to 30-40 lp/mm, but a gain of approximately 10^4 is achieved; with 2 MCPs, resolution is in the range of 20-30 lp/mm but the gain in the range of 10^5 to 10^7 is possible.

The gain and temporal response of the detector depends on the phosphor screen selected of which characteristics are shown in Table 1.

Figure 5 – High Resolution UV Imager VID325 (Connected to blank flange assembly for transport)

TYPE	COLOUR	PEAK EMISSION NM	DECAY TIME TO 10% BRIGHTNESS	EFFICIENCY (LUMENS PER WATT)
P11	BLUE	446	50 µs	10
P20	YELLOW/GREEN	540	50 µs – 10 ms	30
P31	GREEN	550	40 µs	25
P43	GREEN	548	1.2 ms	50
P45	RED ENHANCED WHITE	-	1.4 ms	20
P46	YELLOW/GREEN	530	160 ns	7
P47	BLUE	410	80 ns	2.3

Table 1 – Phosphor Characteristics

READOUT SYSTEMS

Vacuum Image Detectors convert particles and high energy photons into visible images. These in turn can be converted into quantitative data by utilising a solid state detector such as a diode array or CCD camera. As Photek does not manufacture these items, we are pleased to sell our detectors on their own, or coupled to a readout system selected by the customer, with or without a frame grabber and image processing software.

Considerable experience of integrating cameras by EG&G, EEV, CIDTEC, Philips and Sony, has been gained. These devices mostly give an analogue TV signal and Photek can also provide A-D conversion electronics with or without photon/particle event software, and appropriate centroiding. Centroiding option allows this resolution of Vacuum Image Detectors to be enhanced to 3080 x 2304 pixels in the photon counting mode.

Our GM1KV gate module enables our Vacuum Image Detectors to provide time resolved images with frame exposure time down to about 100 nanoseconds.

Photek also manufacture streak and framing camera tubes for camera manufacturers with time resolution on the order of picoseconds

RESISTIVE ANODE

This is the ideal readout for very low count rates, on systems requiring an X-Y address as well as event timing information. A two-dimensional resistive sheet encoder, specially terminated at the edges to reduce distortion, enables accurate charge cloud centroiding to be carried out by taking the ratio of the output signals from the four corners. Essentially this is a Ultra High Vacuum (UHV) version of the Image Photon Detector (IPD), and is sensitive to charged particles and UV photons. It can, therefore, be used for field ion microscopy and mass spectroscopy where the time of flight gives information on mass or molecular spin.

The Photek IPD processing electronics and image processing system are compatible with this detector. The support electronics encodes positions to a 512 x 512 of elements and operates at count rates up to 10^5 counts/seconds. As events positions are calculated in real time excellent spatial and temporal resolution can be attained

Figure 6 shows a 40 mm resistive anode detector with ancillary head electronics built for high resolution VUV spectroscopy .

Figure 6 – 40 mm Resistive Anode Detector Assembly with Preamplifiers

VACUUM PHOTOMULTIPLIERS

These devices often described as Time of Flight (ToF) Detectors gives better temporal resolution than dynode electron multipliers or channel electron multipliers. The anode is designed with a matched cone structure to give sub-nanoseconds pulses from single photons or particles into a 50 ohm cable.

Our pre-amplifier PA 200-10 and discriminator electronics enable these devices to be connected to sampling scopes, or to provide event counting at rates up to 400 MHz.

Smaller devices are faster because the electrical signal has a shorter distance to travel, they have a lower capacitance (and thus shorter CR time constant). Typical performance parameters are shown in Table 2.

MULTIPIXEL PARALLEL READOUTS

Multi-anode devices are sometime required for high speed parallel channel detection. These are often designed to customer specific requirements: equal area concentric rings for Fabry-Perot inteferometry are an example.

Photek has designs that are in regular production, and are shown in Figure 7.

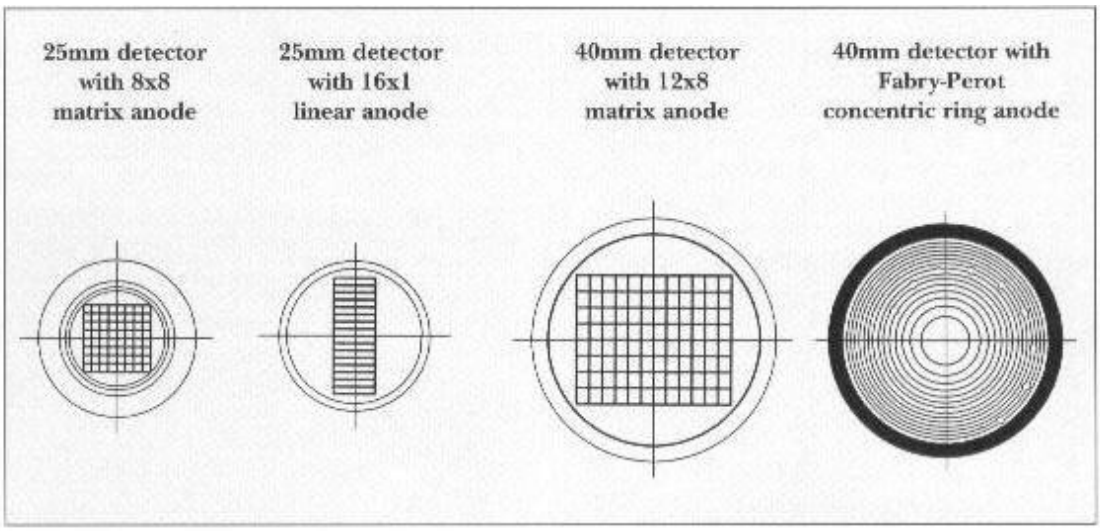
	10 MM DIAMETER	13 MM DIAMETER	25 MM DIAMETER	40 MM DIAMETER
RISE TIME	70 ps	100 ps	250 ps	500 ps
FWHM	150 ps	250 ps	500 ps	1000 ps
3DB FREQUENCY RESPONSE	1600 MHz	750 MHz	500 MHz	250 MHz
TRANSIST TIME JITTER	~ 15 ps	~ 15 ps	~ 50 ps	~ 100 ps

POWER SUPPLIES

Photek can supply a range of high voltage power units and systems compatible with its range of vacuum compatible imaging detectors

SYSTEM INTEGRATION

Photek has all the capabilities for customising and integrating them with cameras and other electronics to provide complete systems. Imaging software IFS216 can also be supplied.



25/64	25/16	40/96	FABRY PEROT CONCENTRIC RINGS

FIGURE 7 - MULTI-ANODE DESIGN

AVAILABILITY OF FLANGES AND DETECTORS

CF flanges are based on the established conflat ® design in which a precision OFHC copper gasket is captured between two knife edge sealing surfaces. The vacuum interface devices are also available mounted on ISO and other 'O' ring sealed flanges with an equivalent tubulation to the CF mounted detectors.

FLANGE SIZES	DETECTORS KEY: O AVAILABLE ON REQUEST ⊙ STANDARD X NOT AVAILABLE								
COPPER SEALED	VID 12	VID 18	VID 25	VID 40	VID 75	VPM 8	VPM 12	VPM 25	VPM 40
CF38 (70 MM OD)	⊙	⊙	X	X	X	⊙	X	X	X
CF64 113.5 MM OD	O	⊙	⊙	X	X	O	⊙	X	X
CF100 151.6 MM OD	O	O	O	⊙	X	O	O	⊙	X
CF150 202.4 MM OD	O	O	O	O	⊙	O	O	O	⊙
CF200 202.4 MM OD	O	O	O	O	O	O	O	O	O
CF250 305 MM OD	O	O	O	O	O	O	O	O	O

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