

2-in-1 Monitor for FEL Radiation

Beam Position Monitor and Intensity Monitor for FEL Radiation



Highlights

Feature	Benefit
Two monitors housed in the same enclosure	Space saving
Low pressure used for the rare gas in the vacuum chambers	The monitors are almost completely transparent
Wide dynamic range	Measuring from low to very high intensity signals
Free from degradation and destruction	The monitors can be used continuously for online shot-to-shot intensity measurements with the maximum repetition rate of 100Hz
Different gases can be used within this instrument from nitrogen to neon and xenon	Flexibility in terms of extended range of operation
Cross-calibrated photodiodes	The monitors can be calibrated absolutely, providing the absolute number of photons per single pulse
The vacuum system includes the vacuum vessel and mechanics	The relative distance of all the plates from the passing photon beam can be adjusted

Applications

Non-invasive measurement of the photon pulse energy (equivalent to the number of photons per pulse) and of its transverse position. As a bonus, it is possible to characterise the transverse intensity distribution (horizontally and vertically) by means of knife-edge scans, and use the position monitor as a beam defining aperture.

How Does It Work?

The working principle of the Intensity Monitor (IO Monitor, IOM) is the atomic photo-ionisation of a rare gas at low particle density in the range of 10^{11} cm^{-3} ($p \sim 10^{-5} \text{ mbar}$).

The photon beam traveling through a rare gas-filled chamber generates electrons (and ions), which are extracted and collected by means of an in-vacuum condenser (i.e., an ion chamber). In order to effectively collect the electrons, one of the two condenser plates is typically biased up to $\sim 100\text{--}200\text{V}$ and the charge is read on the other plate.

From the charge generated this way it is possible to derive the absolute number of photons per pulse shot by shot. The advantages of this kind of approach are multiple and described in the Highlights section above.



Specifications

Chamber material	Stainless steel
Chamber length	500 mm
Chamber height	350 mm
Chamber diameter	200 mm
In/Out flanges	DN40 CF
IOM and BPM blades material	Copper
IOM blades min./max. gap	2/40 mm
BPM blades min./max. gap	1/40 mm
Bias voltage max	Up to 3000 V
Working vacuum pressure	$\sim 10^{-5} \text{ mbar}$

Note: The specifications can be customised to the user's needs.

The Beam Position Monitor (BPM), exploits the presence of four independent blades that can be inserted into the beam, typically interacting only with the tails of the transverse photon distribution. As the beam hits the blades, four separate currents are generated and collected, giving the possibility to determine the centroid of the intensity distribution in the plane perpendicular to the photon propagation.

Using the BPM blades it is also possible to perform knife-edge scans as well as use the BPM as an adjustable beam-defining aperture.

The monitors do not suffer from saturation effects. Moreover, they are independent from the beam position fluctuations and are usable on a broad wavelength range.

Available Options

- Adjustable pumping system.
This system is capable of precisely regulating the gas pressure in the chamber by means of a butterfly valve that adjusts the effective pumping speed of a turbo-molecular pump attached to the IOM chamber. In this way it is possible to set the correct pressure and/or to compensate for possible fluctuations of the gas flow, which is coming from another port on the chamber.
- Spinning rotor gauge system.
With this system the pressure can be read and adjusted with a precision of 10^{-7} mbar .
- XPi Data Acquisition.
With this system the charge generated by the passage of an FEL pulse can be measured. The system performs a triggerable charge measurement ranging from 50pC (with a resolution of 50aC) up to 1.8nC (with a resolution of 1.8fC). With a software programmable integration-time starting from 500 μs up to 1s, current measurement ranging from 50pA (resolution of 50aA) up to 3.6 μA (resolution of 3.6pA) is achievable. Each input channel has two integrator stages so that the current-to-voltage conversion can be continuously performed during the ADC conversion, avoiding any dead time in the data output.

See the single product brochures for details.

