



User Manual

MIC-205

Micro Ion Chamber



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1 SAFETY INFORMATION

1.1 Electrical Risks

While assembling/disassembling or performing maintenance, make sure to adhere to proper electrical, X-Ray, and mechanical safety precautions.

Warning	Isolate the device from mains power supply before carrying out any maintenance work.
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Follow local, national, and international regulations at all times.

Do not tamper with equipment unless you are properly trained to do so.

Electrical equipment should always be properly grounded. Do not tamper with grounding wires.

1.2 Handling Information

This device is not designed to be handled during normal operation. While assembling the device, heed the following warnings.

Warning



Always handle device in a safe way.

Handle the device gently.

Improper handling can cause damage to the device. Never lift from stepper motors, or any other part not designed to bear the weight of the machine

2 INTRODUCTION

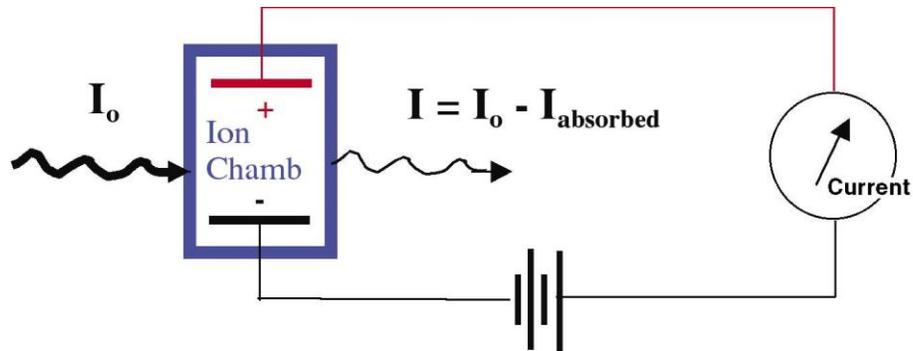
2.1 Micro Ion Chamber (MIC-205)

A small ionization chamber detector has been developed for monitoring the intensity of hard X-ray beam for Synchrotron facilities around the world. The small dimensions of the ionization chamber (20 mm along the beam direction and 30 mm perpendicular to it) make it possible to place it very close to the sample.

The housing of the detector is made of stainless steel, nickel-plated copper electrodes, SHV and BNC electrical connectors, and gas connector with a leakage rate of gas is less than 2 torr/5 minutes under 10 torr vacuum environment.

2.2 Device Overview

Absorption of x-ray photons in materials follows the rule, $I = I_0 e^{-\mu t}$ where I is the x-ray intensity after passing through a material, I_0 is the initial intensity, μ is the absorption coefficient for that particular photon energy and t is the thickness of the absorbing material. This photon absorption results in an electron/ion pair being produced in the absorber material. All an "ion chamber" does is to apply a potential held around these newly created electron/ion pairs, separate them and measure the resulting electric current to determine how many pairs were created and thus how many photons were absorbed.



$$\therefore \text{Photons Absorbed} = I_{\text{absorbed}} = (I_0 - I) = I_0 (1 - e^{-\mu t})$$

or, symbolically:

$$N = (I_0 [1 - e^{-\mu t}]) \times (E/V_0) \times q$$

Where: N = charge created

μ = linear absorption coefficient (cm⁻¹)

t = absorption length (cm)

E = photon energy (eV)

V_0 = average excitation energy / ion (eV)

q = electron charge (coulomb)

so, the measured ion chamber current, I_{ion} , amps = coulombs / second = N / second

Solving for incident flux I_0 gives:

$$I_0 \text{ (photons/sec)} = I_{\text{ion}} (1/[1 - e^{-\mu t}]) \times (V_0/E) \times (1/q) = K_{\text{ADC}} * I^{\text{ion}}$$

with knowns: $\mu = (\mu/\rho) \times \rho$ from NIST tables (cm⁻¹)

t = Ion Chamber path length (cm)

V_0 = ionization energy for various ions (eV)

(only first ionization energy used for simplicity) q = 1.602×10^{-19} coulomb

It is typical to connect the output of the ion chamber to an additional measurement system such as a picoammeter, a current amplifier, a voltage-to-frequency converter, an A/D converter or any combination of the above. Each of these intermediate devices multiplies the signal by a known and controllable gain.

2.3 Micro Ion Chamber Spark Over

Many questions are asked on what voltages can a MIC-205 Micro Ion Chamber handle? This answer will depend largely on the experiment test setup that is used (i.e. gas type and pressure).

The field strength at which a gas suffers dielectric breakdown is approximately proportional to its pressure. The shortest distance that the high voltage sees is from the high voltage plate to the metal housing which is ~3.5mm. Using this distance and using a safety factor of 1.4 to get 2.5mm spacing below is a chart that summarizes the breakdown fields for pertinent gasses and potentials corresponding to sparking the gap.

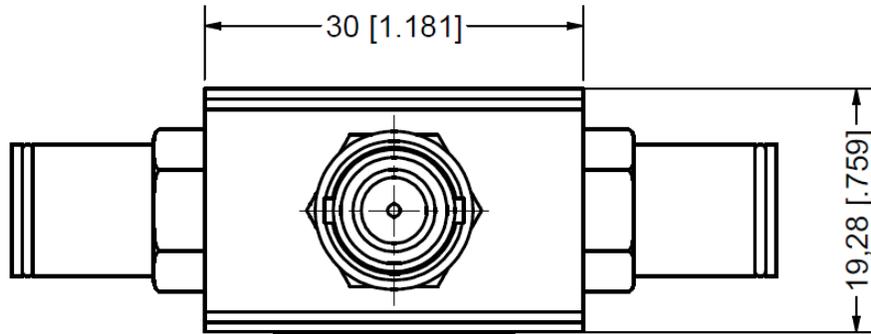
(See gas breakdown chart on next page)

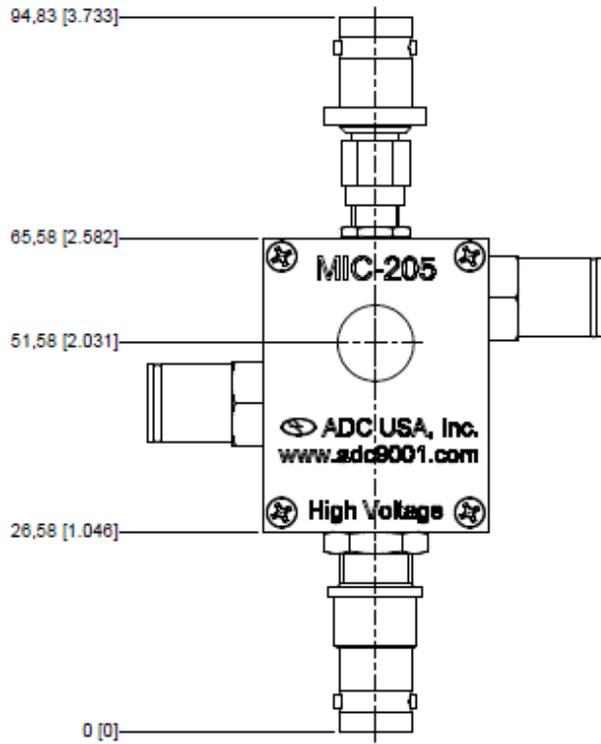
Gas versus gap breakdown chart			
Gas	Breakdown field (kV/mm)	Breakdown voltage for 2.5mm gap(kV)	Breakdown voltage for 3.5mm gap(kV)
Air	3	7.5	10.5

N ₂	3.5	8.8	12.3
He	0.15	0.4	0.5
Ar	0.6	1.5	2.1
Ar(0.75mbar)	0.45	1.1	1.6
Ar(0.25mbar)	0.15	0.4	0.5

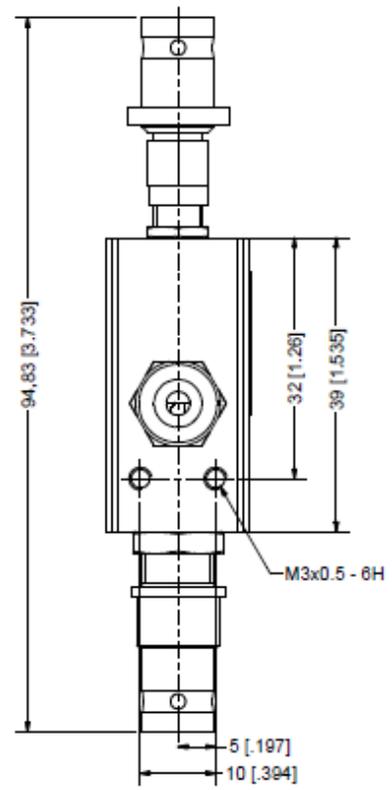
3 PHYSICAL DIMENSIONS

The inner plates are high and low voltage plates are 16mm square and 10mm square. The distance between the plates is 12.5mm.



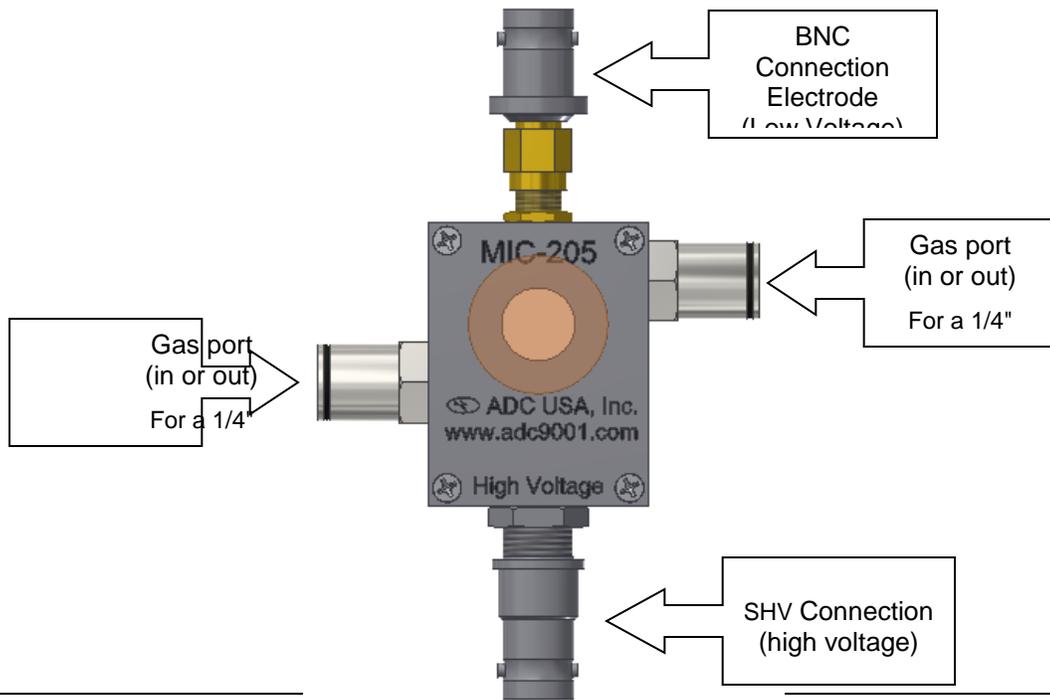


Note:
Weight: 0.101 kg [223 lb]



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4 PHYSICAL DIMENSIONS



5 WARRANTY

ADVANCED DESIGN CONSULTING USA, INC.'s ("ADC's") goal is to provide top-quality, zero-defect equipment to its customers. This product is therefore warranted to be without defects in workmanship or materials under normal and proper use for a period of one year from the date of delivery to the original purchaser ("Purchaser"). Our obligation under this warranty will be limited to the repair or exchange of the product which may thus prove defective under normal and proper use by the Purchaser, and which our examination will disclose to our satisfaction to be defective. The term "normal and proper use," as used in this warranty, will be deemed to mean use only for the purpose for which the product is intended. The material defect warranty will not apply to any material supplied to ADC by the Purchaser. Purchased parts such as bearings, switches, and sensors etc, are warranted by ADC only to the extent and terms of the original manufacturer's warranty.

This warranty will not apply to this product or any part thereof which has been subject to accident, negligence, modification, alteration, abuse, misuse, inadequate or improper maintenance, extreme conditions, and placement in an unsuitable physical or operating environment or has been caused to fail by a product not provided by ADC. Likewise, this warranty does not apply if the product is repaired or serviced by anyone other than ADC or an ADC factory-trained technician, or if operated in a manner contrary to the instructions which accompany the product.

This warranty does not include defects as a result of, but not limited to, errors in design, test data, diagnostics, application specifications, lack of design margin, errors in specifications, or errors in bills of materials as provided or directed by Purchaser.

1. In the event of the product not conforming to the above warranty, ADC will, at its option, either repair or replace the product free of charge to the Purchaser, provided that:
 - a) As a condition to obtaining warranty services, Purchaser must either:

- i) Notify ADC in writing within ninety days after discovery of the defect; or
 - ii) At its own expense, return the defective product to ADC's facility in Lansing, NY no later than ten days following the last day of the warranty period.
 - b) All products require a Return Authorization from ADC prior to their return, which will be issued within five days from receipt of Purchaser's request. Purchaser will advise ADC prior to returning any product for repair.
 - c) The warranty is in force. The warranty is void if your ADC product:
 - i) Has not been operated in accordance with all procedures described in the operating instructions;
 - ii) Has been serviced, adapted or modified without written approval by ADC; or
 - iii) Has been improperly installed, used, maintained or otherwise damaged (including without limitation any damage by fire, smoke or water).
2. There is no warranty coverage for any of the following:
 - a) Costs of removing or reinstalling the product when submitted for warranty service;
 - b) Any non-performance of the product due to inadequate or improper maintenance;
 - c) Routine maintenance, periodic adjustment or performance testing of the product as recommended in the operating instructions; or
 - d) Normal wear and tear on the product.
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obligations. This warranty may only be amended in writing signed by an authorized officer of ADC. The above warranty periods will not be extended by the repair or replacement of product.

5. After expiration of the warranty herein, ADC may continue to offer repair services to keep your equipment operational. Please inquire for the prevailing charges for such service.