Faraday Cup FC-66

APPLICATIONS:

- Continuous Collection and Measurement of Charged Particle Current
- Measurement of Emitted Beam for Electron or Ion Gun
- Gun Alignment and Setting Operating Parameters

FEATURES / OPTIONS:

- Custom Aperture Sizes
- Input Power Continuous up to 4 watts.
- Unmounted for Flexible Placement, BNC Fitting
- Cup Assembly Completely Enclosed in Ground Shield

Faraday Cup FC-66

INTRODUCTION

The Kimball Physics model FC-66 Faraday cup, connected to an ammeter, is used to collect and measure charged particle current, such as the beam emitted from an electron or ion gun. The FC-66 is UHV compatible and fully bakeable.

The Faraday cup consists of a hollow stainless steel cylinder closed at the base, with an appropriately sized aperture for collecting the electrons or ions. An outer, grounded cylinder provides shielding. An electrical connection is made to the base of the Faraday cup, terminating in a BNC.

The current is then typically conducted through a vacuum electrical feedthrough which is then connected to an ammeter. Kimball Physics has optional feedthroughs available for 0.95" and 1.33" CF flanges. Custom designed feedthroughs are available from Kimball Physics as a separate option.

POWER INPUT CAUTIONS

For continuous measurement, the maximum beam power recommended into the standard FC-66 Faraday cup is 4 watts. The Faraday cup temperature should not be raised above 350ºC due to outgassing.

The power input can be calculated by multiplying the beam current times the electron acceleration voltage; for example, 1 mA (1×10^{-3}) at 20 keV (20×10^{3}) gives 20 W, which is much too high for continuous measurement.

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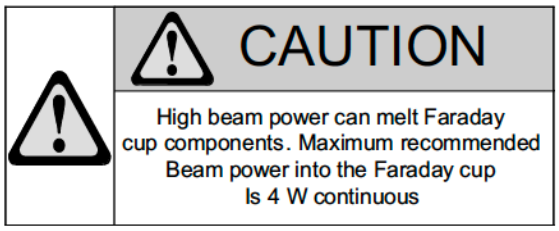
The temperature of the Faraday cup increases approximately linearly with the power input. A 2 W input results in approximately 150ºC, and a 4 W input results in 300ºC.

To use the Faraday cup at high power, measure currents briefly and then let the Faraday cup cool down before repeating the measurement. Due to heat capacity of the cup, a 20 W input for 10 sec into the FC-66 will raise the cup temperature by approximately 150ºC. The cup will cool from 200ºC to room temperature in about 15 min.

Care must always be exercised with a highly focused beam, as a high-power density can bring the Faraday cup to melting temperature in the impact area of the beam. For example, an electron gun with an output of 1 mA at 10 keV focused to a 1 mm spot size has a power density of approximately 13 W/mm^2 or 1.3 kW/cm^2. This can heat the Faraday cup stainless steel at the spot to its melting point in only 11 sec.



INSTALLATION AND OPERATING PROCEDURE

1. Position the Faraday cup in the target area inside the vacuum chamber.

2. Connect the output BNC on the back of the Faraday cup to an electrical feedthrough on the vacuum system (an in-vacuum coaxial cable/ CF flange/ BNC assembly is available from Kimball Physics- see figure page 3).

3. Connect the feedthrough to a suitable user-supplied ammeter. NEVER collect beam current in the Faraday cup unless the cup output is connected to an ammeter or grounded. Without proper termination, the Faraday cup terminal will charge up to full beam energy and electrical discharging will result.

4. Calculate the expected power input into the Faraday cup and check that it is within the acceptable range. See the discussion of power input cautions.

5. Measure electron or ion current with the ammeter.

BIASING THE FARADAY CUP

The Faraday cup can be electrically biased to reduce scattering of electrons or ions collected in the Faraday cup and to reduce secondary electron emission. For electrons or negative ions, +50 V is typically adequate, and for positive ions, -50 V. This can be accomplished by placing a battery between the vacuum feedthrough and the ammeter.

Faraday Cup FC-72	
APERTURE SIZE	5.1 mm diameter,
LENGTH	70 mm, including BNC
DIAMETER	13.2 mm diameter shield
OPERATING TEMPERATURE	350ºC Max
INPUT POWER CONTINUOUS	4 Watts maximum recommended

*In-Vacuum BNC cable for use with Faraday Cups with BNC connectors (Kimball Physics: **FC BNC Feedthrough**). BNC Vacuum feedthrough mounted on 1.33" CF included.*

The cable has a BNC male connector on one end and a grounded shield UHV connector on the other end. The grounded shield UHV connector mates with the BNC feedthrough. It is available in 19" and 39" lengths. Custom lengths are also available

References

For more information about Kimball Physics Detectors and Feedthroughs, please visit our website:

Kimball Physics Detectors
In-Vacuum 1.33" CF BNC Cable and Feedthrough
In-Vacuum 0.95" Sub-Mini Flange BNC Feedthrough

Notes:
1. Cautions:
   -Silver Plated Bolts or Equivalent Lubrication must be used.
   -Please measure the hole depth and other flange / copper ring /part thicknesses
   -Choose a correct bolt length such that the bolt doesn't bottom in the tapped hole prior to tightening the structure.
2. Specifications Subject to Change Without Notice.
3. DE Altobelli, DT Taylor 01/17/2023

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