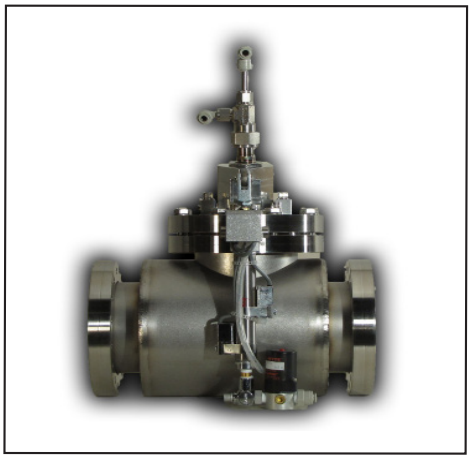
National Electrostatics Corp.
7540 Graber Rd., P.O. Box 620310, Middleton, WI 53562-0310 USA

03/19

Faraday Cups



Model FC18
NEC's highest power cup with a conservative 1kW power rating for beams with a minimum diameter of 3mm.

Model	Beam Power Rating	Aperture
FC18	1000W	1.0" (2.54cm)
FC28	100W	0.375" (0.95cm)
FC50	50W	1.0" (2.54cm)

The above beam power ratings are for a continuous beam with a diameter of 3mm or greater and with appropriate cooling.

APPLICATIONS

NEC manufactures various types of Faraday cups for a variety of applications involving the monitoring of ion beam currents. The NEC Faraday cups are ideal for applications requiring accurate measurement of ion beam intensity in cases where the ion beam diameter is one inch or less.

For applications involving high energy or high current beams, the Model FC18 is designed to handle 1kW of continuous beam power. The FC50, capable of handling 50kW of beam power, is designed for applications requiring maximum beam clearance when the cup is retracted. For applications involving nanosecond pulsed beams, the Model FC28 is specifically designed to measure the coincidence and/or duration of pulsed beams. This model is not retractable.

DESIGN

The configuration of NEC Faraday cups varies from model to model dependent upon power rating and application requirements. However, all NEC Faraday cups are equipped with electron suppression assemblies and can be biased for accurate beam current readings. In addition, the ion beams are incident on tantalum or molybdenum. This high 'Z' material greatly limits neutron production.

As with all NEC components, the Faraday cups are ultra-high vacuum compatible. Though some varieties of the Faraday cups contain vacuum grade polyimide as bearing material, most varieties are of all-metal and ceramic construction and are fully bakeable.

The cup is tantalum to limit neutron production. The tantalum cones are vacuum outgassed above 800° C prior to final assembly to minimized initial outgassing when intercepting beam.

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All standard models utilize a molybdenum beam aperture. This aperture protects the insertion mechanism and assures proper operation of the suppression assembly. The suppressor is necessary to return secondary electrons, which affect the beam current readings. Standard connectors (MHV and BNC) are used for current reading from the cup and for providing suppression voltage. The Faraday cup and electron suppression assembly can be biased separately to a maximum of 500V. This assures accurate beam current measurements.

The position of the Faraday cup is controlled by a pneumatic cylinder, which is actuated by air pressure. The motion is transmitted through a bellows seal to move the Faraday cup to one side of the beam path.

Standard housings are available, dependent on model. They can also be inserted into customer supplied housings, again dependent on model. Standard flanges include ConFlat, Dependex, and NEC; however custom flanges are available upon request.

Model FC50 *in a standard 4" dia. housing with 6" OD flanges.*

ACCESSORIES

A complete Faraday cup system includes a Faraday cup, a controller for actuation, and either a picoammeter or log amp for current reading.

NEC offers two types of controllers - a local controller that can control up to four Faraday cups and a remote controller that can control up to six Faraday cups.

When using the remote controller, logarithmic amplifiers can be used to convert current readings from the Faraday cup to voltage output for use with digital acquisition systems. Various amplifiers are available from NEC including positive or negative in both 115V and 230V options.

The specific variation of log amp used with the Faraday Cup system is based on the following parameters.

- Beam Polarity (Positive or Negative)
- Input A.C. Voltage (115V ir 230V)
- Internal on/off relay (Yes or No)
- Output Voltage (typically 0-6V)

When using the local controller, a picoammeter is needed for current readout. It provides a 0-2V signal for use with the analog meter on the front of the controller. NEC can provide one or suggest a suitable model upon request.

Multi-Unit Faraday Cup controller for local control. Controls up to four (4) Faraday Cups.

[FC v2]

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FC18

Power Rating: 1000W

Designed for applications where high energy or high beam currents are expected.

The FC18 Faraday cup configuration is a unique tantalum cone design. This steep cone shape spreads the beam power over the side of the cone which decreases the effective power density on the tantalum surface, eliminating local hot spots. This cone is indirectly water cooled to allow a conservative beam power rating of 1000W for a continuous beam with a minimum diameter of 3mm. The indirect cooling design allows the use of ordinary tap water without current leakage.

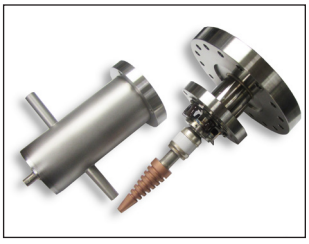
This deep tantalum cone design, combined with the electron suppression assembly, provides very accurate beam current measurements.

FC50

Power Rating: 50W

Designed for applications requiring maximum beam clearance when the Faraday cup is retracted.

The cup assembly is mounted on a single flange with feedthroughs. This allows the complete FC50 to be conveniently mounted into the customer's vacuum chamber. The Model FC50 is an insertion Faraday cup mounted on a welded bellows assembly. This assembly has a 2" (50mm) stroke. The minimum recommended vacuum housing is a 4" O.D. 16 gauge tube. Custom insertion lengths and mounting flanges are available. Custom housings are also available upon request.



FC28

Power Rating: 100W (fixed position)

Designed primarily as a timing device by measuring the coincidence and/or duration of pulsed ion beams.

There is a .002" thick tungsten grid at the exit of the suppressor assembly. This grid has an 85% to 90% optical transparency. The purpose of the grid is to limit the spread of the delivered pulse which is affected by the transit time of the beam across the gap between the grid and the target. However, the grid does affect the accuracy of the current intensity measurement. The Model FC28 is a fixed Faraday cup. It cannot be removed from the beam path. Therefore, it is limited to usage at the end of the beamline.

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SPECIFICATIONS

	FC18	FC50	FC28
Beam Power Rating: (for a ≥3mm beam dia.)	1000 Watts	50 Watts	100 Watts
Beam Aperture:	1” (25mm) dia. molybdenum	1” (25mm) dia. molybdenum	3/8”(9.5mm) dia. molybdenum
Cup Material:	Tantalum cone	Tantalum	Tantalum sheet with copper heat sink
Housing:	6.0” dia., Stainless steel	Available as an option (min. port clearance is 2.37”)	1.5” dia., Stainless steel
Insertion Time:	Approximately 1 second	Approximately 1 second	N/A (fixed assembly)
Inerstion Drive:	Pneumatic, bellows sealed, solenoid control requires 24 V	Pneumatic, bellows sealed, solenoid control requires 24 V, 0.3A	N/A (fixed assembly)
Suppression and Bias:	500V maximum	500V maximum	500V maximum
Cooling:	Water (indirect), 1/4” tubing	Radiation only	Air, 3 cfm, 1/2” tubing (no cooling required below 10W)
Electrical Connection:	Two - MHV connectors (Mating connectors are provided)	Two - MHV connectors (Mating connectors are provided)	One - BNC (Mating connector is provided)
	One - D connector (Mating connector is provided)	One - 9 pin D connector (Mating connector is provided)	One - Wire connection
Compressed Air:	60 to 110 psig, 1/4” tubing	60 to 80 psig , 1/4” tubing	N/A
Overall Length*:	9.00” (229mm) with 6” O.D. Conflat flanges	N/A	9.25” (235mm) with 6” O.D. CF flanges

*Overall Length dependent on flange type/size. Custom flanges available upon request.

[FCUP-v2]

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