

# **PRODUCTS**

**2010**

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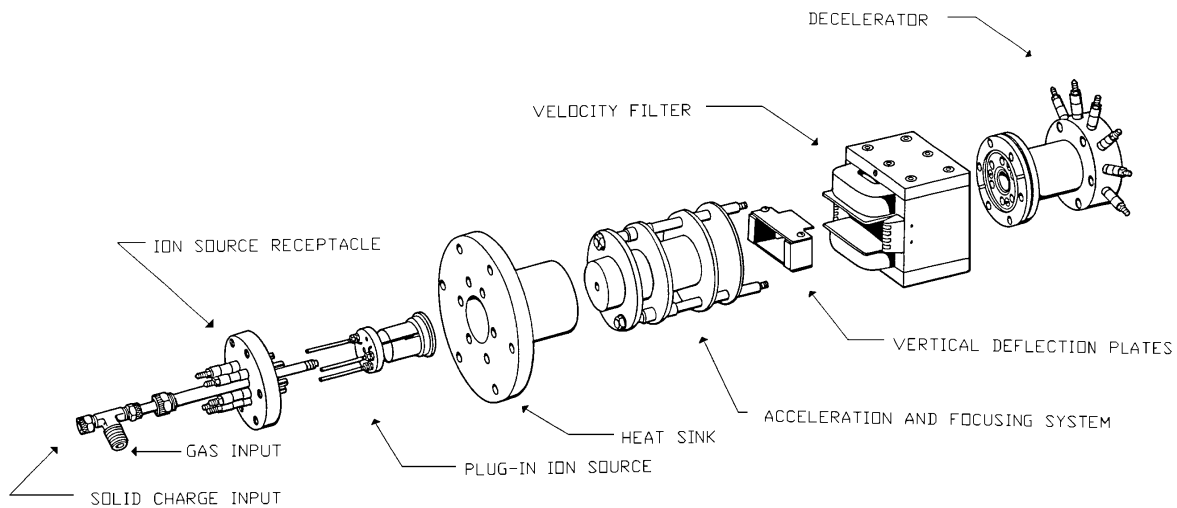
**January, 2008**

Colutron Corporation was founded in 1964 by Lars Wåhlin to conduct basic research in physics supported by the sales of scientific instruments. The Corporation was named after the University of Colorado. Both experimental and theoretical research has been performed at Colutron in the fields of Atomic, Atmospheric and Astrophysics.

# Table of Contents

<b>Colutron Ion Beam Kits</b>	4
Circuit Diagram	20
<b>Colutron Ion Source Assemblies</b>	5
Power Requirements	5
Exploded Views of Model 101, 101-Q	6,7
<b>Colutron Heat Sinks Model 103 (For Ion Source)</b>	7
<b>Colutron Lens System Model 200-B</b>	8
<b>Colutron Velocity Filters Models 300, 600, 600-B</b>	9
Power Requirements	11
Specifications	11
Velocity Filters mounted in vacuum chambers (H-series)	12
<b>Colutron Model 400 Decelerator</b>	13
<b>Colutron Ion Gun Systems</b>	14
Model G-1 and G-1-D Non-bakeable systems	15
Model G-2 and G-2-D Bakeable systems	15
Specifications	15
Model G-1 and G-2 Diagram	16
Model G-3 Diagram	17
Circuit Diagram (Model G-1 and G-2)	20
Circuit Diagram (Model G-1-D and G-2-D)	20
Optional Equipment	18
<b>Colutron Control Units (Ion Gun Systems and Kits)</b>	19
<b>Price List (Ion Beam Equipment)</b>	21
Spare Parts	22

# COLUTRON ION BEAM KITS



## ***BK-3 Ion Beam Kit***

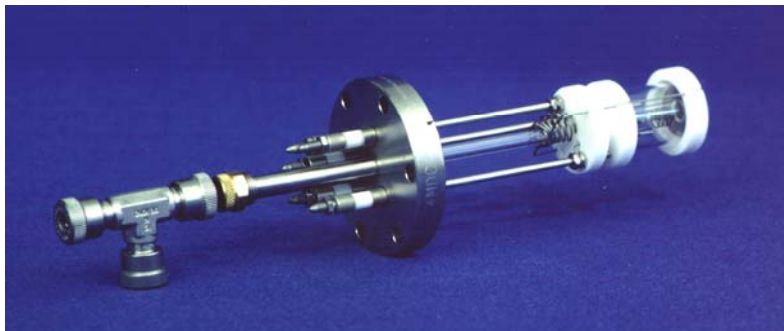
The Colutron Ion Beam Kit consists of an ion source, heat sink, acceleration and focusing system, vertical deflection plates, velocity filter, velocity filter guard ring control unit (not shown), and decelerator. The customer must supply the vacuum system, power supplies and housing.

The Beam Kit can be operated from 1 eV to 10 keV with ion currents up to several  $\mu\text{A}$ . The velocity filter analyzer can supply mass separated beams with a resolution of up to  $M/\Delta M = 400$ , where  $\Delta M$  = full width at half peak height. The dispersion of mass separated beams is adjustable (see specifications for the Colutron Velocity Filter Models 300,600, and 600-B).

The energy spread of the ion beams produced by the Beam Kit has been measured to be as low as 0.11 eV. This is mainly due to our Colutron Ion Source which is included with the Beam Kit. The overall length of the kit when assembled is approximately 16 inches without the decelerator. Any component of the Beam Kit may be purchased separately.

The Colutron Ion Beam Kits are also available mounted inside vacuum housings. Please see page 14 for information about Colutron Ion Gun Systems.

# COLUTRON ION SOURCE ASSEMBLY MODEL 100



*Model 100-Q Ion Source Assembly*

The Colutron Ion Source is a convenient plug-in unit that eliminates handling and assembling of a number of small parts, as with conventional ion sources. This feature makes for very swift and easy installation and removal. Current outputs are easily controlled up to the milliamperage range. The energy spread of ion beams extracted from our source has been measured to be as low as 0.11 eV. A magnetic field is not needed for our source to function. Extraction and ionization efficiencies for most elements range from a few percent to 30 percent.

The Colutron Ion Source is available in a Boron Nitride (Model 100) and Quartz (Model 100-Q) construction. The Model 100-Q is shown above. The Model 100-Q has the same overall dimensions as the Model 100, and was developed to update and replace the older Model 100. The Model 100-Q has a much lower outgas rate than the Model 100 when the source is initially turned on, and hence saves time during the initial start up of the source.

A complete Colutron Ion Source Assembly (Models 100 or 100-Q) is composed of the following parts: ion source Model 101 or Model 101-Q with gas inlet tube, 2 3/4" conflat<sup>®</sup> ion source receptacle (also available with o-ring or smooth face flange), gas tee and charge holder. We also have a third plug-in ion source Model 101-O which incorporates an oven capable of evaporating material up to 2,000° C. The oven source is available with the Boron Nitride construction only. All receptacles are furnished with five feed through connections to accept either the Model 101 or Model 101-Q plug-in sources without oven, or the Model 101-O plug-in source with oven. When the source with oven is not used, the extra two feed throughs could be used for thermocouple wires etc.

The Colutron Ion Source can be used for either solids or gasses. When solid charges are preferred, a charge holder is necessary. Charge holders are made of stainless steel, quartz, and alumina. The alumina and quartz charge holders can also be used with the carbon tetrachloride method.

## **POWER REQUIREMENTS**

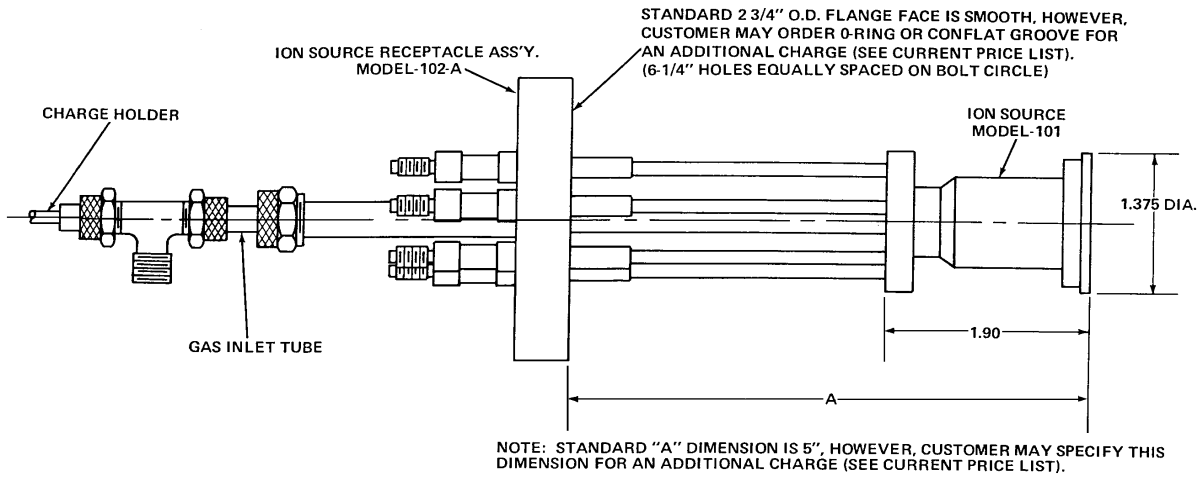
**FILAMENT:** 16 V - 20 A DC for 20 mil filament  
16 V - 12 A DC for 15 mil filament

**ANODE:** 0 - 150 V 0.4 A DC

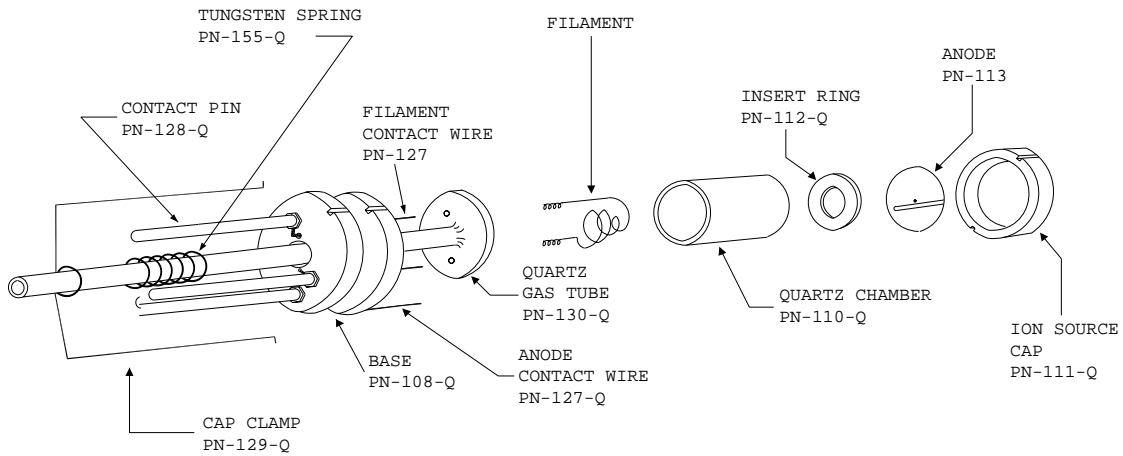
**IMPORTANT:** Use voltage control for ion source - **not** current control.

# COOLING REQUIREMENT

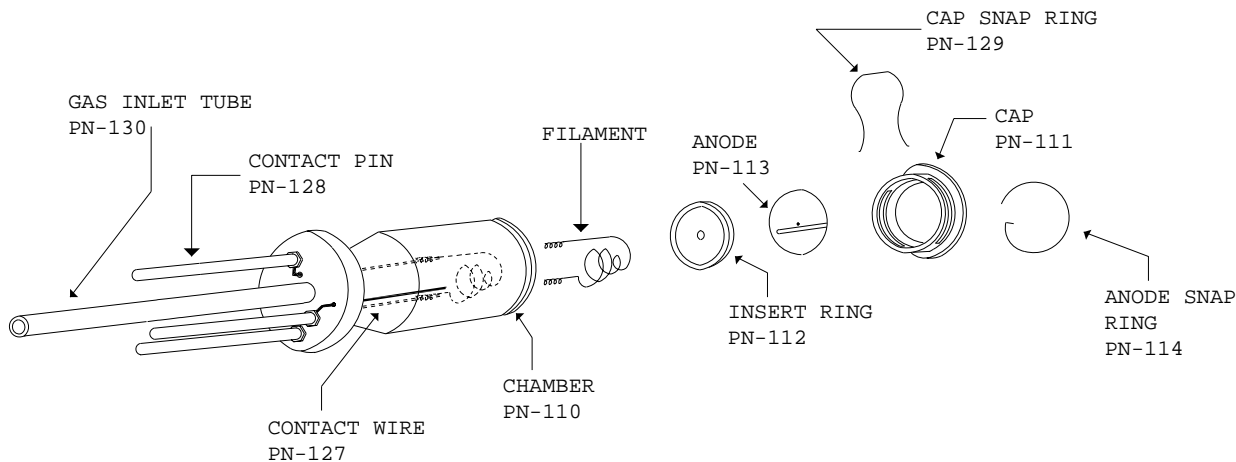
The ion source requires the liquid cooled Model 103 heat sink.



**Model 100 Ion Source Assembly Dimensions**



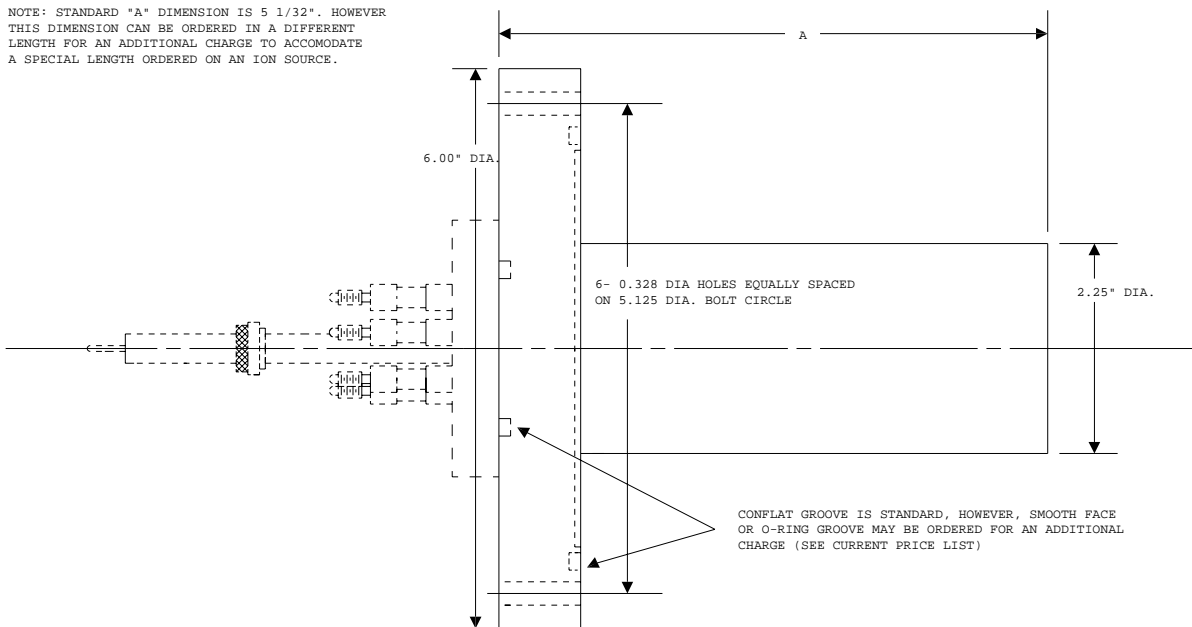
**Exploded View Model 101-Q Ion Source (Quartz)**



*Exploded View Model 101 Ion Source (Boron Nitride)*

## COLUTRON HEAT SINK MODEL 103

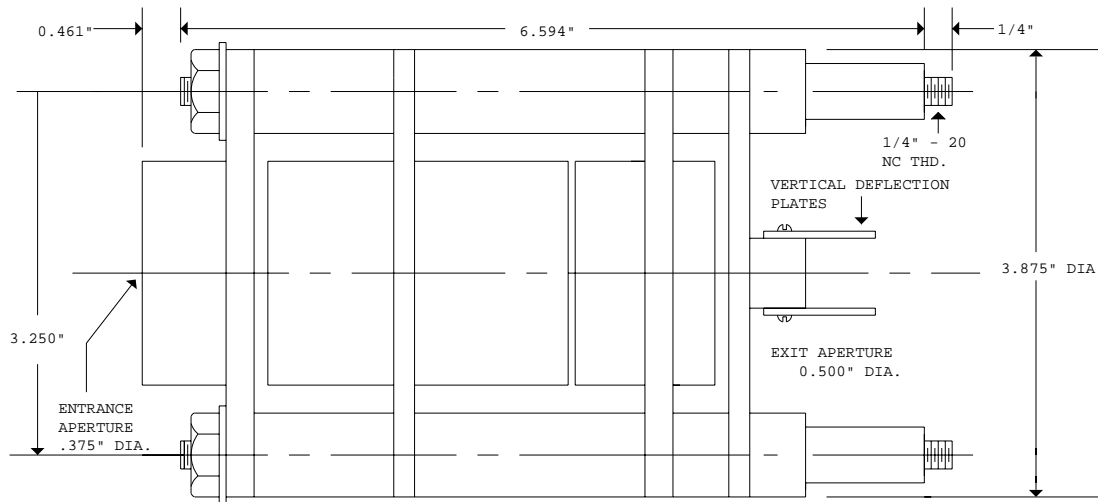
NOTE: STANDARD "A" DIMENSION IS 5 1/32". HOWEVER THIS DIMENSION CAN BE ORDERED IN A DIFFERENT LENGTH FOR AN ADDITIONAL CHARGE TO ACCOMMODATE A SPECIAL LENGTH ORDERED ON AN ION SOURCE.



### *Model 103-B Heat Sink*

The Colutron Heat Sink is made of 304 stainless steel and is bakeable. It is a liquid cooled unit, with the cooling jacket completely surrounding the ion source. The inlet and outlet holes are 1/8 P.T. The Model 103 is available with a Conflat® (103-B) or O-ring (103) sealing surface. Colutron recommends the CU-1 cooling unit for ion source cooling, especially when used together with the Model 600-B velocity filter or G-2 ion gun system (see page 19). The Heat Sink weighs about 6 1/2 lbs.

# COLUTRON LENS SYSTEM MODEL 200-B



## *Model 200-B Lens System*

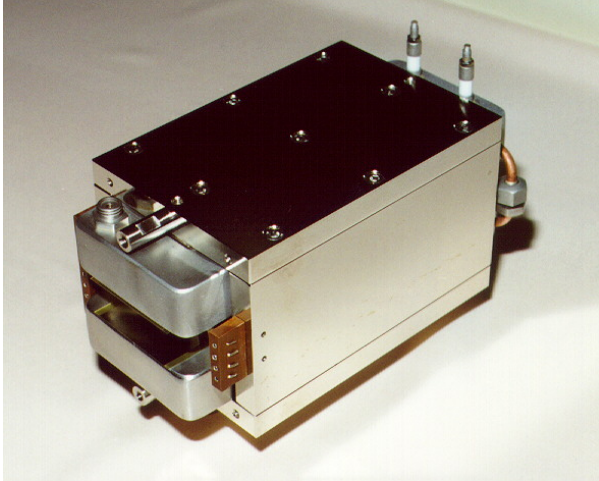
The Lens System Model 200-B is designed for operation with the Colutron Ion Source Models 100 and 100-Q. The Lens System can extract and focus beams over an energy range from 1eV to 10 keV\*. It consists of an extraction lens in combination with an einzel lens.

The Lens System can easily be attached to any of the Colutron Velocity Filters Models 300, 600, and 600-B. The Lens system also comes equipped with a set of vertical deflection plates mounted at the beam exit.

\* For beam energies less than 500 eV, use the Colutron Decelerator Model 400.



# COLUTRON VELOCITY FILTERS MODELS 300, 600 AND 600-B



The velocity filter consists of a magnet and a pair of electrostatic deflection plates. The plates are mounted between the magnet poles to produce an electric field  $E$  perpendicular to the magnetic field  $B$  (crossed  $E$  and  $B$  fields). The schematic on the next page shows the Model 300. The Models 600 and 600-B are similar except that the overall length and width is 8.0" instead of 4.40", and 4" instead of 3.50" respectively.

In most cases, the velocity  $v = (2qV/m)^{1/2}$  of charged beams are obtained by

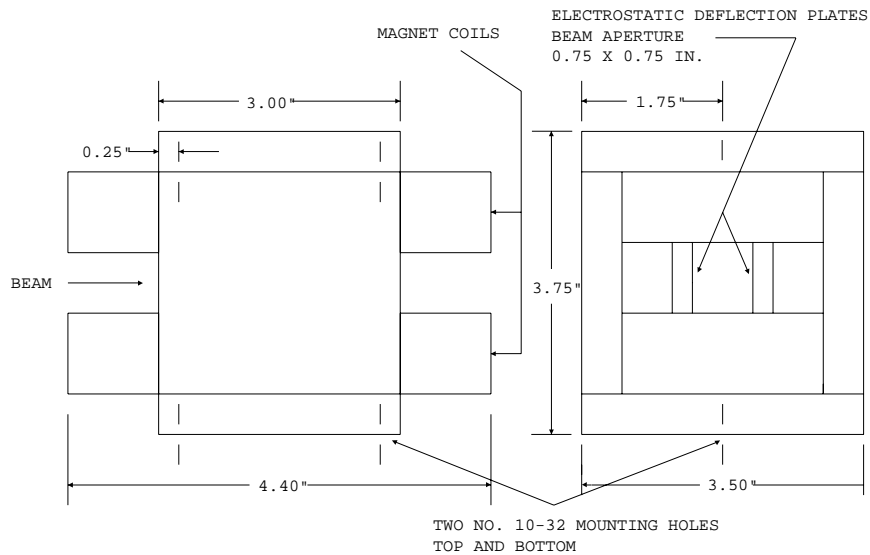
### ***Model 600-B Velocity Filter***

accelerating the particles of mass  $m$ , and

charge  $q$  across a constant electric potential  $V$ . Different masses in the beam will be dispersed by the filter since they have different velocities. The filter's ability to disperse masses makes it a superior tool in mass spectroscopy, and some of its main features are:

- ❶ Straight line system
- ❷ Adjustable dispersion
- ❸ Small size; up to 50 times smaller in weight and size compared to a sector magnet analyzer
- ❹ The filter will also select the same velocity for both negative and positive particles simultaneously

The Colutron filter is normally operated as a non-focusing device. However, by a slight adjustment of one or two guard ring potentiometers (balance or middle shim of the Model GR-3-6 control unit) the filter becomes a cylindrical lens. This feature is often used when a line image at the target is required. The velocity filter resolution is vastly improved by optimizing the ion beam profile using the new Colutron BVS systems (see page 28 and S.G. Hall *et al.*, Rev. Sci. Instr., **68**, 3335 (1997)).



### ***Model 300 Velocity Filter***

The capability of the filter is determined by the following formulas:

$$D \approx \frac{l \cdot a}{4} \frac{E}{V} \frac{\Delta M}{M} \quad \text{where}$$

$D$  = the dispersion between the masses  $M$  and  $(M - \Delta M)$ , and

$$M = 2 q V [B/E]^2 \quad \text{where}$$

$M$  = the mass (mass number) which is passing through the filter undeflected and collected on the target

$a$  = the length of the filter

$l$  = the drift distance from the center of the filter to target (drift distance)

$E$  = the electric field strength in V/m

$V$  = acceleration voltage or ion energy

$B$  = magnetic field strength

$q$  = the ionic charge

$M/\Delta M$  = maximum mass resolution;  $\Delta M$  = the full width at half maximum intensity

The model 300 and 600 velocity filters are non-bakeable and can be used in vacuum systems with pressures as low as  $10^{-7}$  Torr. The Model 600-B velocity filter is bakeable up to  $200^\circ$  C and can be used in vacuum systems with pressures as low as  $10^{-9}$  Torr. In order to make the velocity filter bakeable, the magnet coils of the velocity filter are encapsulated in stainless steel jackets. The Model 600-B is liquid cooled and is capable of higher magnetic currents and magnetic fields (see specifications below). All the Colutron velocity filters are available mounted in vacuum housings (see page 12).

## Velocity Filter Power Supply Requirements:

	<u>MODEL 300</u>	<u>MODEL 600</u>	<u>MODEL 600-B</u>
Deflection Plates	350V, 120mA	350V, 120mA	350V, 120mA
Magnet	9.5V, 3A	9.5V, 3A	28V, 14A

### NOTE:

All velocity filters have horizontal and vertical beam deflectors)

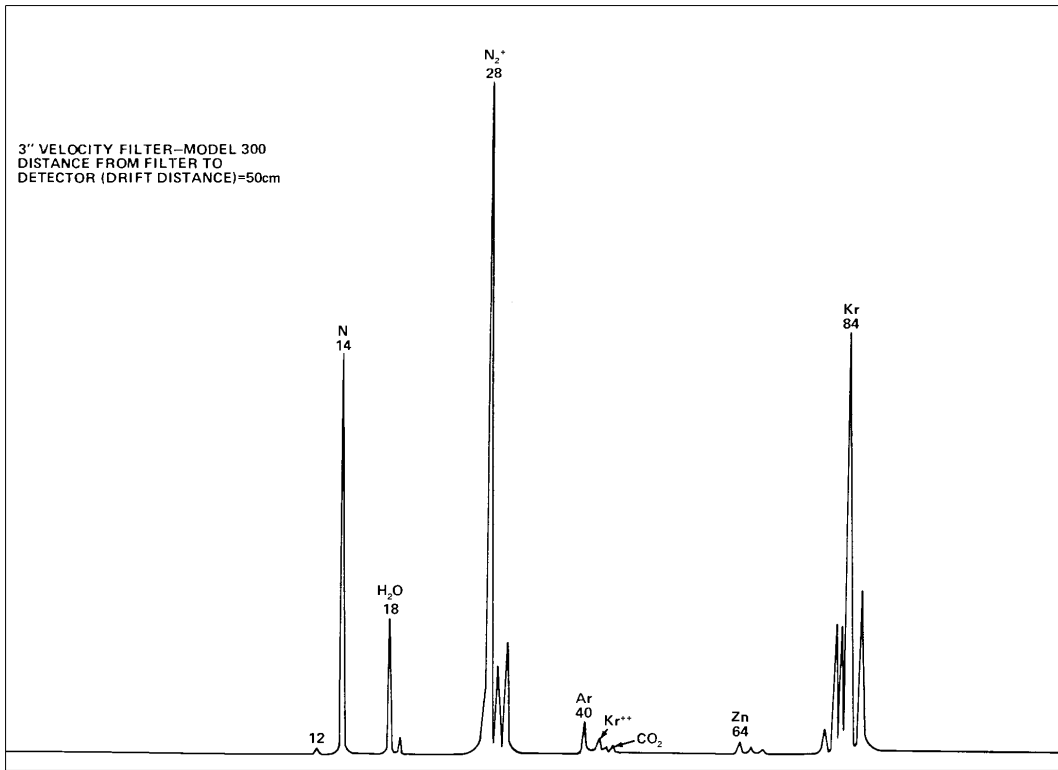
The Model GR-3-6 guard ring control unit is used for all 3 filters and must be ordered as a separate item for each filter, however it is included in the price of a ion beam kit (BK series) or ion gun system (G-series). The horizontal deflection plate supply connects to the rear of the model GR-3-6 control unit, and is used to set the potentials to the velocity filter guard rings.

## Velocity Filter Specifications:

a (length)	0.076m (3")	0.152m (6")	0.152m (6")
<i>E</i> (Max. Electric field)	12,500 V/m (at 225 V)	16,800 V/m (at 300 V)	16,800 V/m (at 300 V)
V (accel. voltage)	10 eV to 10 keV	10 eV to 10 keV	10 eV to 10 keV
<i>B</i> (Max. Mag. field)	1,100 Gauss	1,100 Gauss	3,000 Gauss
<i>M</i> / $\square$ <i>M</i> (resolution)	$\square$ 200	$\square$ 400	$\square$ 400
Beam Aperture	1.91 x 1.91 cm	1.78 x 1.78 cm	1.78 x 1.68 cm
Magnet Power	30 Watts	30 Watts	400 Watts
Weight	12 lbs.	21 lbs.	20 lbs.
Max. Bakeout Temp.	-	-	200° C
Vacuum Range	> 10 <sup>-7</sup> Torr	> 10 <sup>-7</sup> Torr	> 10 <sup>-9</sup> Torr

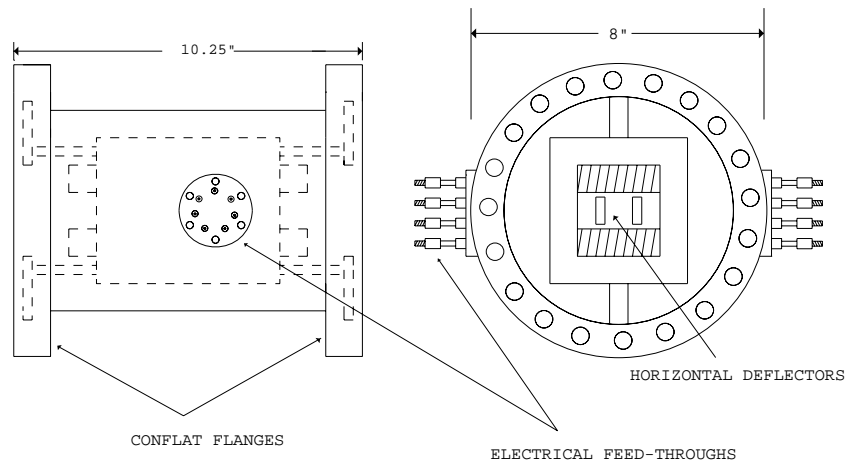
### NOTE:

Model 600-B has magnet coils encapsulated in a stainless steel jacket for liquid cooling. Please use only an ozone safe refrigerant such as Dupont HFC-134a or Kerosene for cooling. **DO NOT USE WATER.** Cooling rate is 0.5 liters/min. Colutron recommends the CU-1 cooling unit for model 600-B cooling (see page 19).



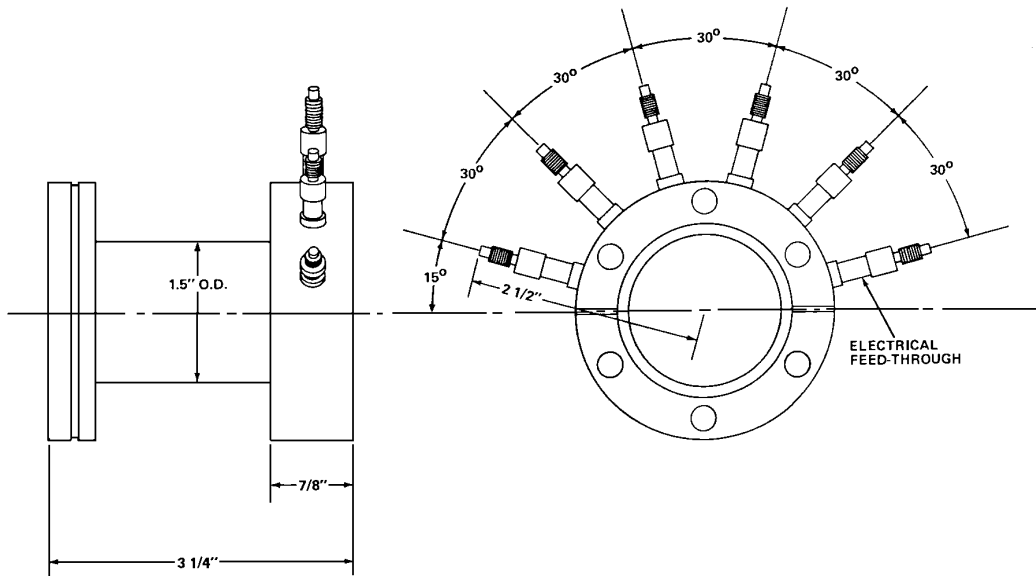
Sample Mass Spectrum From Model 300 Velocity Filter

## COLUTRON H-SERIES VELOCITY FILTERS



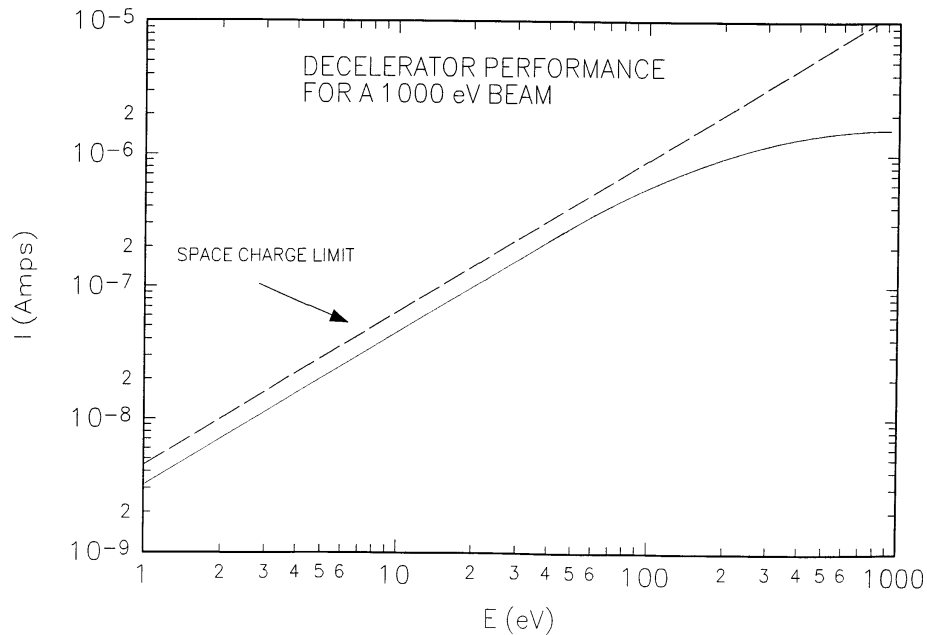
Colutron also offers velocity filters mounted in vacuum housings (300-H, 600-H and 600-B-H). Model 600-H is shown above. Model 600-B-H which is the same size 600-H, has cooling connections for the magnet coils which are not shown in the diagram. The overall length of model 300-H is 6.750" instead of 10.25" as shown in the picture, and the side feed-through ports are centered between the two standard rotatable 8" Conflat® flanges, with a 6" ID. If a custom housing is needed, please send a drawing for quotation.

# DECELERATOR MODEL 400

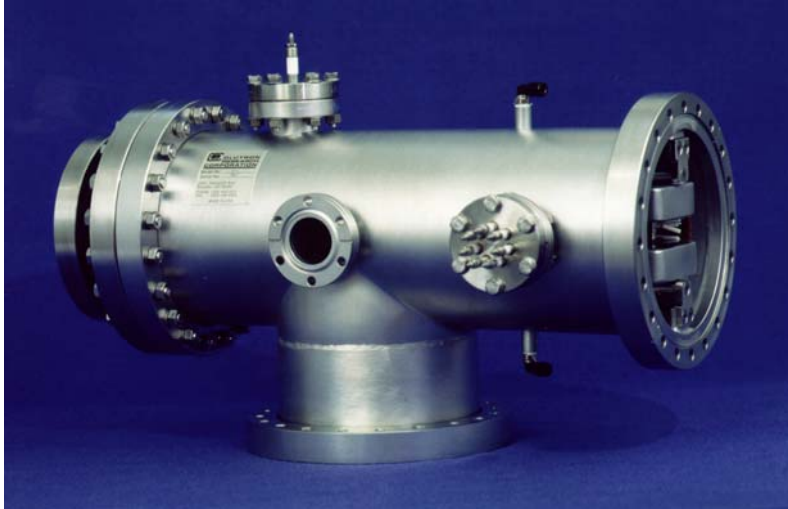


*Model 400 Decelerator*

The Model 400 Decelerator is of the Menzinger type. It consists of 5 focusing elements which are mounted inside a vacuum tube with two 2 3/4" Conflat<sup>®</sup> flanges. O-ring groove or smooth face flanges are also available for an additional charge. The focusing elements without the vacuum housing are also available separately (Model 400-L). The Model 400 is designed for ultra-high vacuum and is bakeable to 250° C. The Decelerator is designed for an energy range from about 1eV to 1 keV. Beams can be decelerated to 1/200 of their original energy without appreciable beam current loss (see figure below for Decelerator performance). The Model 400 weighs about 2 1/2 pounds.



# COLUTRON ION GUN SYSTEMS



*Model G-2 Ion Gun System*

Colutron Research Corporation has two small Ion Gun systems to offer. These are the non-bakeable model G-1 and the bakeable UHV model G-2. The main difference between the model G-1 and G-2 lies in the velocity filter magnet coils. The Model G-2 uses coils which are encapsulated in a stainless steel jacket which allows liquid cooling of the coils so that higher currents required to disperse and separate heavier ions are obtainable. The encapsulated coils also allow the gun to be baked out to 200° C. Each gun includes an ion source assembly, heat sink, acceleration and focusing system, vertical deflection plates, a 6" long velocity filter and a velocity filter guard ring control unit. Components are assembled in a vacuum housing fitted with a flange for mounting onto the customer's equipment. The guard ring control unit can be mounted into a standard 19" rack panel.

The gun systems are capable of producing mass separated ion beams with either spot or line images and with adjustable dispersion. They are well suited for the following:

- Ion injector for accelerators ⇒ Ion implantation, etc..
- Chemical accelerators ⇒ Hot chemistry, merging beams,  
and molecular beam research
- Isotope separation ⇒ Radioactive target preparation  
and activation analysis
- Atomic Physics ⇒ Atomic collision research
- Surface Analysis ⇒ SIMS, etc..

## ION GUN MODELS G-1 AND G-1-D

The model G-1 can be operated in an energy range of 500 eV to 10 keV. If an ion beam energy less than 500 eV is required, we recommend using the model G-1-D, which includes the model 400 decelerator and can produce mass selected ion beams with energies as low as 1 eV. The vacuum housing of the model G-1 series is made of a polished stainless steel tube, 6" in diameter and approximately 19" long. The length includes the model 500 insulator mounting flange. The total length of the G-1-D is 23 1/8" when used with the model 400 decelerator. Both Ion Gun housings are supplied with a 6" ID roughing port. The standard exit flange on the models G-1 and G-1-D are an 8" OD and 6" ID conflat<sup>®</sup> flange. The model G-1-D, however, has a 2 3/4" exit flange when used with the decelerator. Both the model G-1 and G-1-D are good for vacuum use to 10<sup>-7</sup> Torr.

## ION GUNS MODEL G-2 AND G-2-D

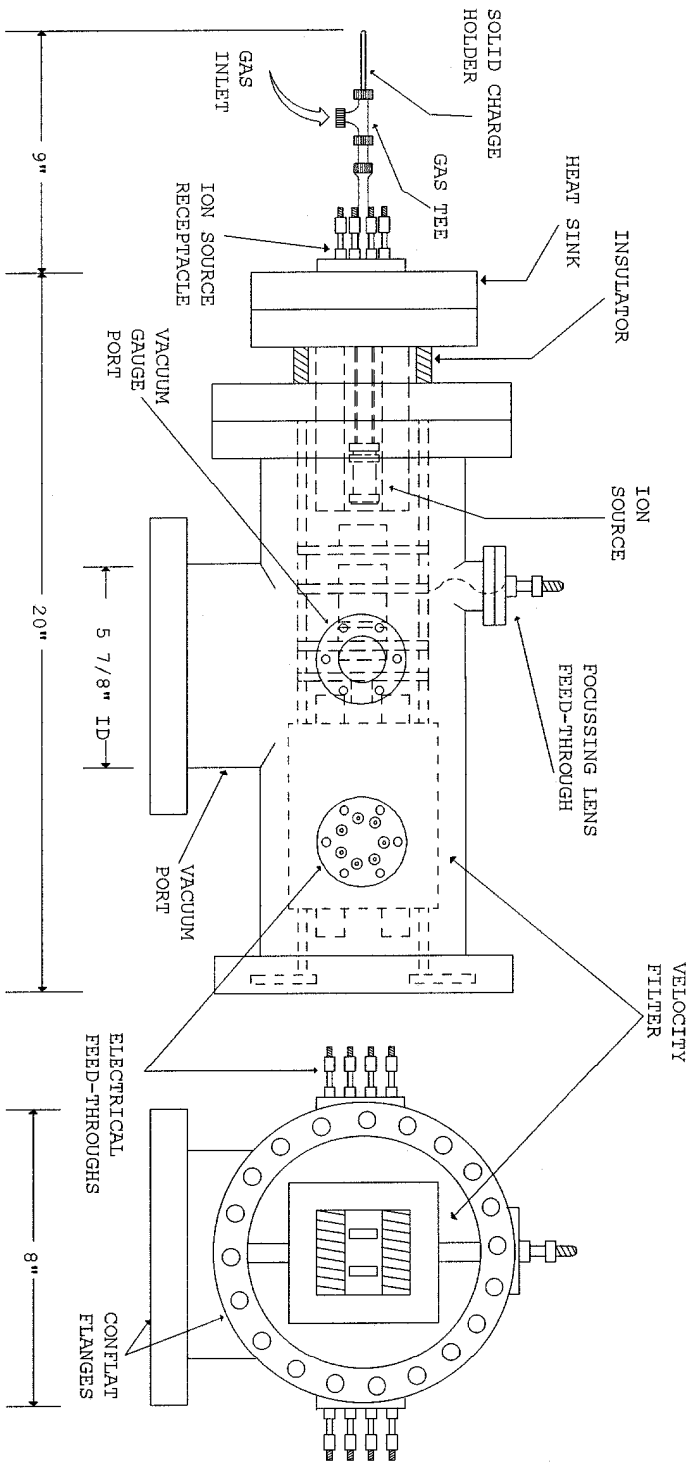
The G-2 and G-2-D Ion Guns are both designed to operate in the 500 eV to 10 keV energy range. The G-2-D Ion Gun however, which has the optional model 400 decelerator, can be used down to 1 eV. There are two differences between the G-1 and G-2 series Ion Guns. The G-2 Ion Guns are designed to be bakeable to 200<sup>0</sup> C, for use with ultra-high vacuum (UHV) systems. The magnet coils on the velocity filter are encapsulated in a stainless steel jacket and are liquid cooled, thus allowing for higher currents and magnetic field strength. Colutron recommends the CU-1 cooling unit for magnet cooling (see page 19). The dimensions of the G-2 and G-2-D are the same as the G-1 and G-1-D respectively. Both the G-2 and G-2-D are designed to be good for a vacuum use to 10<sup>-9</sup> Torr.

### PERFORMANCE SPECIFICATIONS FOR G-1 AND G-2 SERIES GUNS

<b>Beam Energy</b>	G-1, G-2 ⇒ 500 eV to 10 keV G-1-D, G-2-D ⇒ 1 eV to 10 keV
<b>Resolution</b>	M/ΔM ≈ 400
<b>Ion Current</b>	Up to 20 μA focussed 100 μA unfocussed

### POWER SUPPLY REQUIREMENTS FOR G-1 AND G-2 SERIES GUNS

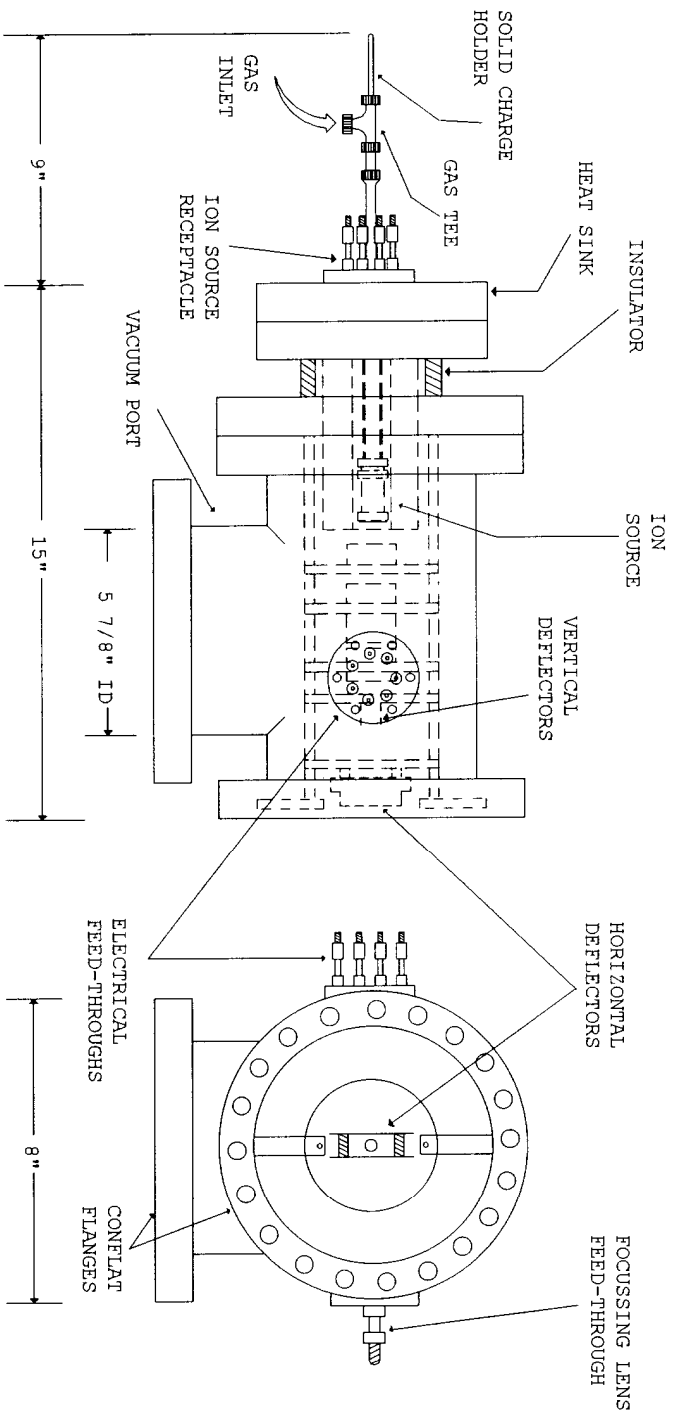
<b>Ion Source</b>	Filament 16 V - 20 A; Anode 0 - 150 V, 0.4 A
<b>IMPORTANT: Use voltage regulated power supplies for the ion source.</b>	
<b>Lens System</b>	0 - 10 kV, 1 mA Acceleration Voltage 0 - 10 kV, 0.5 mA Focussing Voltage
<b>Vertical Deflection Plates</b>	0 - 400 V, 1mA
<b>Velocity Filter</b>	Model G-1 ⇒ 9.5 V, 3 A Continuous operation
<b>Magnet</b>	Model G-2 ⇒ 28 V, 14 A
<b>Velocity Filter Deflection Plates</b>	0 - 300 V, 50 mA (Floating outputs)



### COLUTRON ION GUN MODELS G-1 AND G-2

The model G-1 is shown above. Model G-2 which has the same dimensions as the G-1 uses cooling connections for the velocity filter model 600-B, which are not shown in the drawing. The vacuum port and ion beam exit port are both standard rotatable 8" Conflats, with a 6" ID, with a 20 hole bolt pattern. The three electrical feed-through ports and vacuum gauge port are standard non-rotatable 2 3/4" Conflats, with 1 1/2" ID. If extra ports this size are needed, they may be ordered for \$ 90 each. Send a drawing or sketch to show where the ports are to be located, and if they should be rotatable or non-rotatable.





### COLUTRON ION GUN MODEL G-3

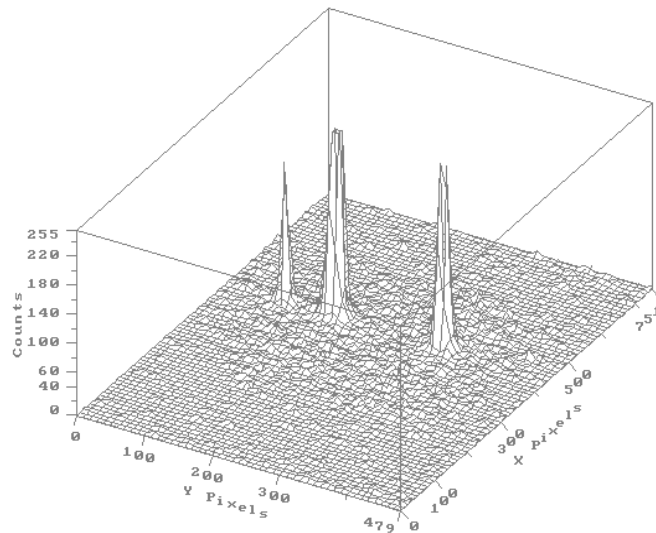
Colutron model G-3 is a gun system without a velocity filter. The whole system is bakeable and has standard rotatable 8" conflat, with a 6" ID. Vertical and horizontal beam deflectors are provided. Power requirements for the ion source, lens system, and deflection plates are the same as for the G-1 and G-2 Ion Guns. Extra ports may be ordered at \$ 90 each.

## OPTIONAL EQUIPMENT FOR COLUTRON ION GUN SYSTEMS

❶ **Custom flanges and ports.** Custom flanges and additional ports may be ordered with the Colutron Ion Gun Systems. Contact Colutron for a quote.

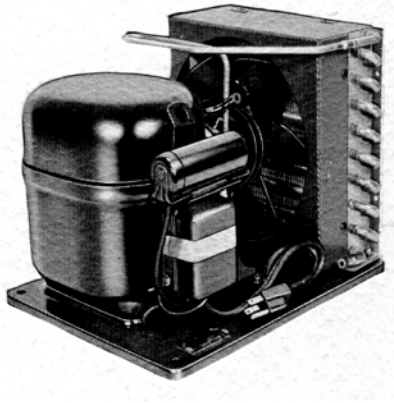
❷ **Beam Decelerator.** Colutron recommends the beam decelerator (model 400) for ion energies less than 500 eV. The models G-1-D and model G-2-D include the standard model G-1 and G-2 respectively with optional model 400 decelerator and model 400-A adapter flange.

✓ Diagnostic aid in determining the atomic mass of the mass separated ion beam. ❸ **Ion Gun Control Units.** Colutron offers control units (E-series) for the above Ion Gun Systems. The control units include all power supplies needed to operate the Ion Gun as well as a cooling unit for the ion source. Vacuum gauge controls are also included. (please see next page).



The picture above was made with the Colutron model G-2 ion gun. The picture shows the spatial profile of  $H_3^+$  (at top),  $H_2^+$  (middle) and  $H^+$  ion beams. The velocity filter dispersion was set low to get all three ion beams onto the viewing area.

# ION GUN SUPPORT SYSTEMS



*CU-1 Cooling System*



*Model E-2 Control Cabinet*

## CU-1 COOLING SYSTEM

Used to cool ion source and/or velocity filter magnet (600-B, G-2 only) . Consists of:

1. 1/4 horsepower condensing unit which uses DuPont® HFC-134a ozone safe refrigerant. (2 pounds refrigerant required, **not included**)
2. pressure and temperature switches for safety interlock
3. cooling lines and fittings

## CONTROL UNITS FOR COLUTRON ION GUNS G-1 AND G-2

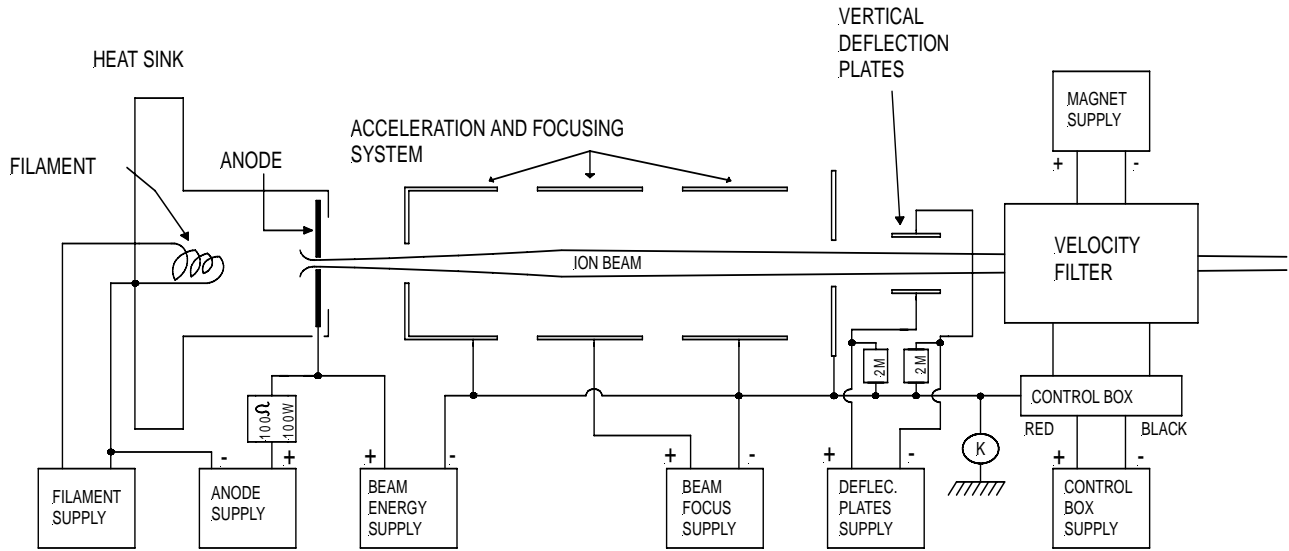
E-1.....	Control Unit for G-1 Ion Gun .....	200 eV - 10,000 eV
E-1-D .....	Control Unit for G-1-D Ion Gun .....	1 eV - 10,000 eV
E-2.....	Control Unit for G-2 Ion Gun .....	200 eV - 10,000 eV
E-2-D .....	Control Unit for G-2-D Ion Gun .....	1 eV - 10,000 eV

The control units consist of a 65-inch tall cabinet mounted on casters and includes the following items:

1. Isolation Transformer
2. Filament supply, anode supply and ion source thermocouple gauge mounted in isolated shelf
3. Acceleration and Focus voltage supplies
4. Magnet, horizontal and vertical deflection plates supplies
5. Ionization vacuum gauge and thermocouple gauges with control unit
6. Power controls and safety interlocks
7. CU-1 cooling unit (HFC-134a) for ion source and velocity filter magnet
8. Beam energy supply (Models E-1-D and E-2-D only)

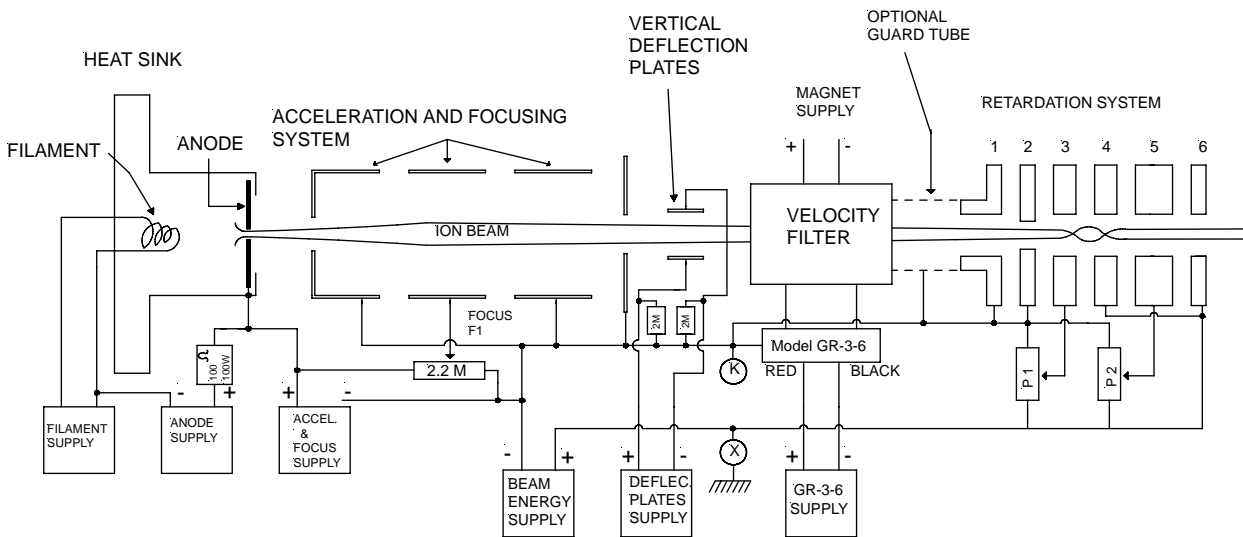
[INPUT: 115V AC Standard, Please Specify 220V if Required]

## CIRCUIT DIAGRAM FOR COLUTRON ION BEAM KIT & COLUTRON ION GUNS MODEL G-1 AND G-2



**WITHOUT DECELERATOR.** Normal operation is to ground point K.

## CIRCUIT DIAGRAM FOR COLUTRON ION BEAM KIT & COLUTRON ION GUNS MODEL G-1-D AND G-2-D



**DECELERATOR USE ONLY.** Normal operation is to ground point X which means that the acceleration and focusing system, deflection plates and velocity filter shims etc.. are floating. Do not exceed 1kV acceleration voltage. Guard tube between velocity filter and decelerator must be connected to K. (Only used at extended drift distance).



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**PRICE LIST**

June.2010

**ION SOURCE ASSEMBLY**

(When ordering an assembly, state the model receptacle you need [see reverse side])

Model 100-O (With Oven).....	\$ 2,357.00
Model 100 (Without Oven).....	\$ 2,323.00
Model 100-Q (Quartz).....	\$ 2,085.00

**HEAT SINK**

Model 103 (Non-bakeable, O-ring grooves on both sides of flange).....	\$ 2,365.00
Model 103-B (Bakeable, Conflats on both sides of flange).....	\$ 2,226.00

**LENS SYSTEM**

Model 200-B (Bakeable, includes vertical and horizontal beam deflectors).....	\$ 2,168.00
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**VELOCITY FILTER**

Model 300 (Non-bakeable, 3 inch length, mass resolution 200).....	\$ 2,970.00
Model 600 (Non-bakeable, 6 inch length, mass resolution 400).....	\$ 4,801.00
Model 600-B (Bakeable, 6 inch length, mass resolution 400).....	\$ 8,625.00
Model 600-B-CT (Replacement pair of coils for model 600-B).....	\$ 2,852.00
Model GR-3-6 (Velocity filter guard ring control unit).....	\$ 1,077.00
Model 300-H (Non-bakeable, model 300 filter in vacuum housing, with GR-3-6).....	\$ 9,044.00
Model 600-H (Non-bakeable, model 600 filter in vacuum housing, with GR-3-6).....	\$ 10,904.00
Model 600-B-H (Bakeable, model 600-B filter in vacuum housing, with GR-3-6).....	\$ 16,002.00

**DECELERATOR**

Model 400 (Bakeable, lens system in housing, conflats on both flanges).....	\$ 3,651.00
Model 400-L (Bakeable, lens system only).....	\$ 1,146.00
Model 400-A (Adapter flange for G-1, G-2 or G-3).....	\$ 461.50

**INSULATOR**

Model 500 (Bakeable, both flanges conflat, for Kit or Gun).....	\$ 2,226.00
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**ION BEAM KIT**

[ Insulator model 500 and decelerator model 400 may be used with any of the Kits, but these components must be ordered as separate items when ordering a Kit ]

Model BK-3 (Non-bakeable, includes models 100-Q, 103-B, 200-B, 300, GR-3-6).....	\$ 9,634.00
Model BK-6 (Non-bakeable, includes models 100-Q, 103-B, 200-B, 600, GR-3-6).....	\$ 11,298.00
Model BK-6-B (Bakeable, includes models 100-Q, 103-B, 200-B, 600-B, GR-3-6).....	\$ 15,777.00

**ION GUN SYSTEMS**

Model G-1 [ Non-bakeable system in a vacuum housing and includes models 100-Q, 103-B, 500, 200-B, 600 and GR-3-6 ].....	\$ 26,095.00
Model G-2 [ Bakeable system in a vacuum housing and includes models 100-Q, 103-B, 500, 200-B, 600-B and GR-3-6 ].....	\$ 31,173.00
Model G-3 [ Bakeable system in a vacuum housing and includes models 100-Q, 103-B, 500, and 200-B ].....	\$ 18,659.00
Model G-1-D [ Non-bakeable system in a vacuum housing and includes models 100-Q, 103-B, 500, 200-B, 600, 400, 400A and GR-3-6 ].....	\$ 28,842.00
Model G-2-D [ Bakeable system in a vacuum housing and includes models 100-Q, 103-B, 500, 200-B, 600-B, 400, 400A and GR-3-6 ].....	\$ 35,103.00

**CONTROLS**

Model IT-10-1 (Isolation transformer, 10 kV-1kVA, 115-220/115).....	\$ 1,113.00
Model E-1 (Control unit for Ion Gun Model G-1).....	\$ 32,301.00
Model E-1-D (Control unit for Ion Gun model G-1-D).....	\$ 34,580.00
Model E-2 (Control unit for Ion Gun model G-2).....	\$ 33,300.00
Model E-2-D (Control unit for Ion Gun model G-2-D).....	\$ 37,955.00
Model CU-1 (Cooling unit for ion source and velocity filter magnet, HFC-134a).....	\$ 1,131.00

**COLUTRON ION SOURCE ASSEMBLY SPARE PARTS**

<u>Part No.</u>	<u>DESCRIPTION</u>	<u>Amount</u>
101	Ion Source Model 101 (with Contact Pins, Gas Inlet Tube, No Oven).....	\$ 1,320.50
101-O	Ion Source Model 101-O (with Contact Pins, Gas Inlet Tube, Oven).....	\$ 1,347.50
101-Q	Ion Source Model 101-Q (All Quartz, replaces Model 101).....	\$ 1,077.50
102-S	Ion Source Receptacle (Smooth Face).....	\$ 1,008.50
102-C	Ion Source Receptacle (2 3/4 inch Conflat groove on face).....	\$ 1,008.50
102-O	Ion Source Receptacle (O-Ring groove on face).....	\$ 1,008.50
108-Q	Ceramic mounting base for Quartz Ion Source Model 101-Q.....	\$ 556.00
109	Boron Nitride Ion Source Chamber for Model 101-O (Oven).....	\$ 1,182.50
110	Boron Nitride Ion Source Chamber for Model 101 (without Oven).....	\$ 1,147.50
110-Q	Quartz Chamber for Model 101-Q.....	\$ 54.00
111	Boron Nitride Ion Source Cap.....	\$ 162.00
111-Q	Ceramic Ion Source Cap for Model 101-Q.....	\$ 162.00
112	Boron Nitride Ion Source Insert Ring.....	\$ 56.00
112-Q	Quartz Ion Source Insert Ring for Model 101-Q.....	\$ 57.50
113	Anode.....	\$ 16.50
114	Anode Snap Ring.....	\$ 9.80
115	Filament (15 Mil).....	\$ 14.00
120	Filament (20 Mil).....	\$ 16.50
125	Oven.....	\$ 16.50
126	Oven Contact Wires (One Pair).....	\$ 7.00
127	Contact Wire (One, Anode or Filament for Model 101 and 101-Q).....	\$ 7.00
127-Q	Contact Wire (One, Anode for Model 101-Q).....	\$ 7.00
128	Contact Pin for Model 101.....	\$ 21.50
128-Q	Contact Pin for Model 101-Q.....	\$ 21.50
129	Cap Snap Ring.....	\$ 9.80
129-Q	Cap clamp for Model 101-Q.....	\$ 24.00
130	Gas Inlet Tube for Model 101.....	\$ 66.50
130-Q	Quartz Gas Tube with Disk.....	\$ 187.00
140	Gas Tee (Stainless Steel).....	\$ 103.75
145	Gas Inlet Valve/Fine Metering Valve with scale, 1/4" swagelock.....	\$ 222.75
150	Charge Holder (Stainless Steel).....	\$ 58.50
151	Charge Holder (Quartz).....	\$ 20.00
152	Charge Holder (Alumina).....	\$ 28.00
155-Q	Tungsten Spring for Model 101-Q.....	\$ 20.00

**REPAIR COSTS**

Velocity filter refurbish (New shim plates, cleaning).....	\$ 874.00
Ion Gun system refurbish (New shim plates for filter, cleaning).....	\$ 1,127.00
Model 600-B coil repair (leak repair and leak check).....	\$ 442.00
Ceramic feedthrough replacement (source recept., gun feedthrough, decel. housing).....	\$ 144.00ea

**COLUTRON RESEARCH BOOKS**

200 The Collapsing Universe (1985) [hard cover].....	\$ 17.00
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**NORMAL DELIVERY**

Ion Gun System and Control Units.....	95 Days
Ion Beam Kit.....	30 Days
Ion Source Spare Parts.....	Stock
Repairs.....	7 Days

Prices are F.O.B. Boulder and subject to change without notice.  
 All amounts past due will be assessed a late payment charge of 1.5% per month.  
 Merchandise is carefully packed in compliance with carrier requirements.  
 Claims of loss or damage in transit must be made with carrier by customer.  
 All shipments should be inspected immediately upon receipt.