3CM ION SOURCE

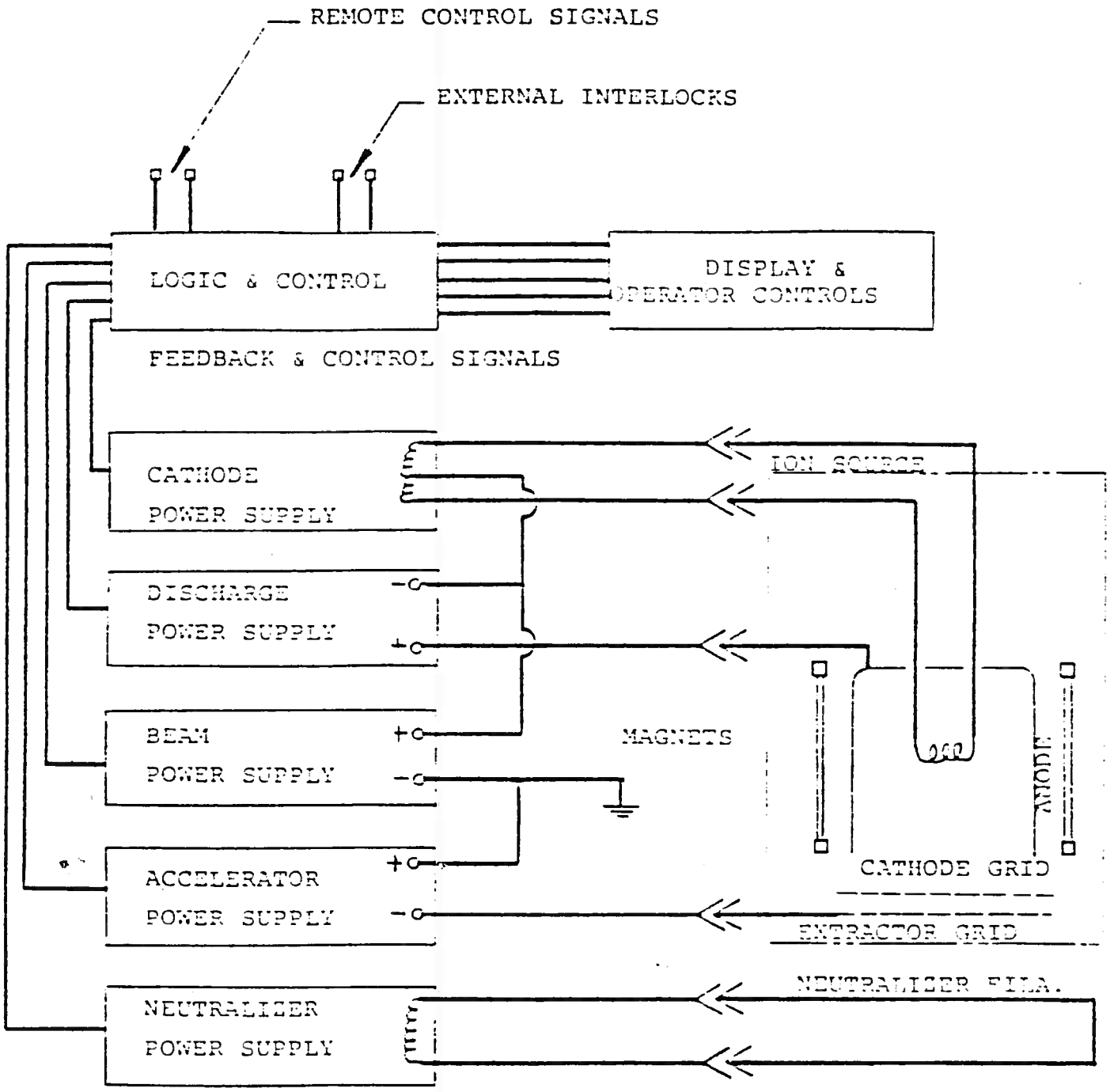
		PAGE
I.	THEORY	1-2
II.	DESCRIPTION	3-4
III.	MOUNTING	5
IV.	ION GAS SUPPLY	6
V.	INTERCONNECTIONS	7
VI.	OPERATIONS	8
VII.	MAINTENANCE	9-10
VIII.	SPARE PARTS	11
IX.	POWER SUPPLY	12
X.	DRAWINGS	13

I. THEORY OF OPERATION

The Commonwealth Scientiftic Corporation's Millatron ion beam source is a broad beam type of the Kaufman design.* A hot filament is used as a source of electrons to ionize the source gas and establish the basic plasma. This plasma is confined within the volume enclosed by the cylindrical anode closed at the rear and the front cathode grid. The positive ions are accelerated out of the gun by applying a voltage that biases the plasma positively with respect to the grounded vacuum chamber. To utilize the accelerated ions, a stage to hold a specimen, such as a microcircuit wafer, is placed in the vacuum chamber. Refer to Figure 1 for the block diagram of the CSC ion source system.

To assist in the ionization process, a weak magnetic field is established with flux lines along the gun axis. This causes the electrons to travel a spiral path from the hot filament toward the anode. This lengthens their path and increases their chances of colliding with a source gas molecule.

* Refers to Fundamentals of Ion-Source Operation
by Dr. Harold R. Kaufman



30CM ION SOURCE AND POWER SUPPLY BLOCK DIAGRAM

FIGURE NO. 1

The accelerated ions are collimated by providing an identical grid in close proximity to the cathode grid enclosing the plasma. This second grid is always biased negatively with respect to ground, and is called the extractor grid.

When the positive ions strike the specimen, a transfer of energy causes some atoms and molecules to escape the surface of the specimen. If the specimen is a non-conductor, an accumulation of positive charges can occur. To neutralize this charge buildup, a source of electrons is supplied by a hot filament located in the ion beam external to the plasma enclosure. The negative extractor grid prevents electrons from entering the positive plasma.

II. DESCRIPTION OF ION SOURCE

Each component of the 3cm ion source is discussed with reference to its location relative to its mounting flange.

The electrical feedthrus terminate in Beryllium-Copper connectors which are enclosed in ceramic. Also included in the feedthru is an 1/8 inch diameter stainless steel tube to admit the ion gas. The main body of the ion source plugs into the fixed socket. There are eight pins which connect as follows:

Two Center Pins - Cathode Filament

One Center Pin - Anode

Two Outer Pins - Neutralizer Filament

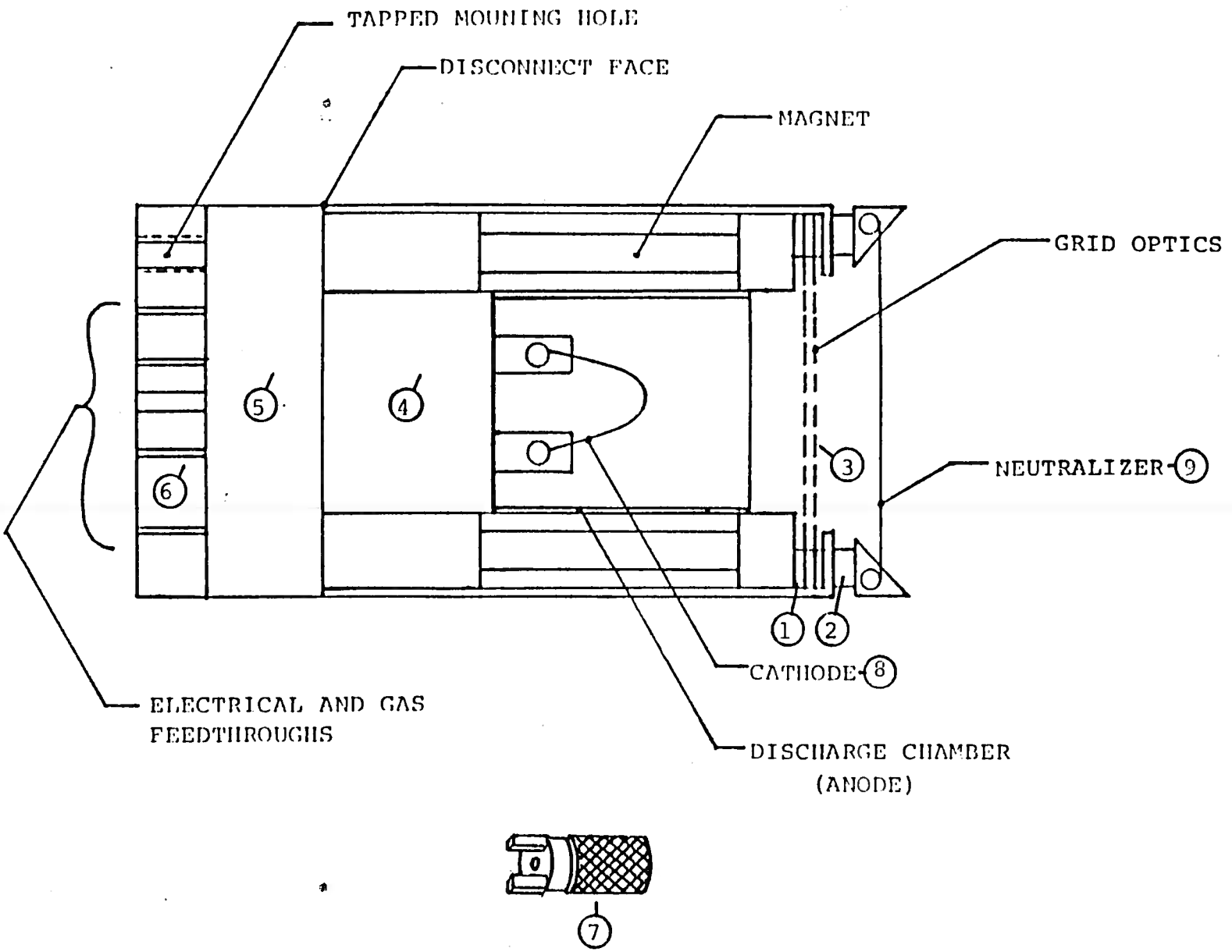
One Outer Pin - Extractor grid also referred to as accelerator grid.

Two Outer Pins - Ground

To assure positive contact the main body also contains two threaded rod connectors which extend thru the main body and are fitted with custom nuts. The custom nuts are attached with set screws so that the connector rods may be tightened or loosened with the CSC supplied wrench to allow removal of the outer shell of the ion source from its mating socket.

3cm Ion Source cross section

FIGURE 4



This outer shell contains the twelve permanent magnets clamped between two magnetic steel rings and the conductors for the neutralizer filament and the extractor grid.

The cathode grid (adjacent to the plasma) is mounted to the upper pole piece with four stainless steel and ceramic standoffs. The extractor grid is also mounted with four longer standoffs to same upper pole piece. The spacing between grids should be 0.020 inches (0.5mm) for grids with 1.0 mm diameter holes.

The extractor grid connection is made with a hex screw through one of the standoffs. The cathode grid is electrically floated as it will assume the plasma potential.

The neutralizer filament is connected across the front of the ion source and consists of three twisted tungsten filaments 0.005 inch diameter (or one 0.010 inch diameter).

The cover shield is held in place by the nuts on the hold down rods that pass thru the upper and lower pole pieces.

III. MOUNTING

Reference Drawings A-12231,A-12232 & A-12311

The 3cm Ion Source may be mounted in two ways. First, rigidly mounted to a feedthru plate. The standard plate is a six inch O.D. Conflat flange. Optionally a four and 5/8 O.D. Conflat or an O ring sealed plate (with or without O ring groove) can be furnished. This method requires a port of at least two and 3/4 inches inside diameter to accept the ion source body.

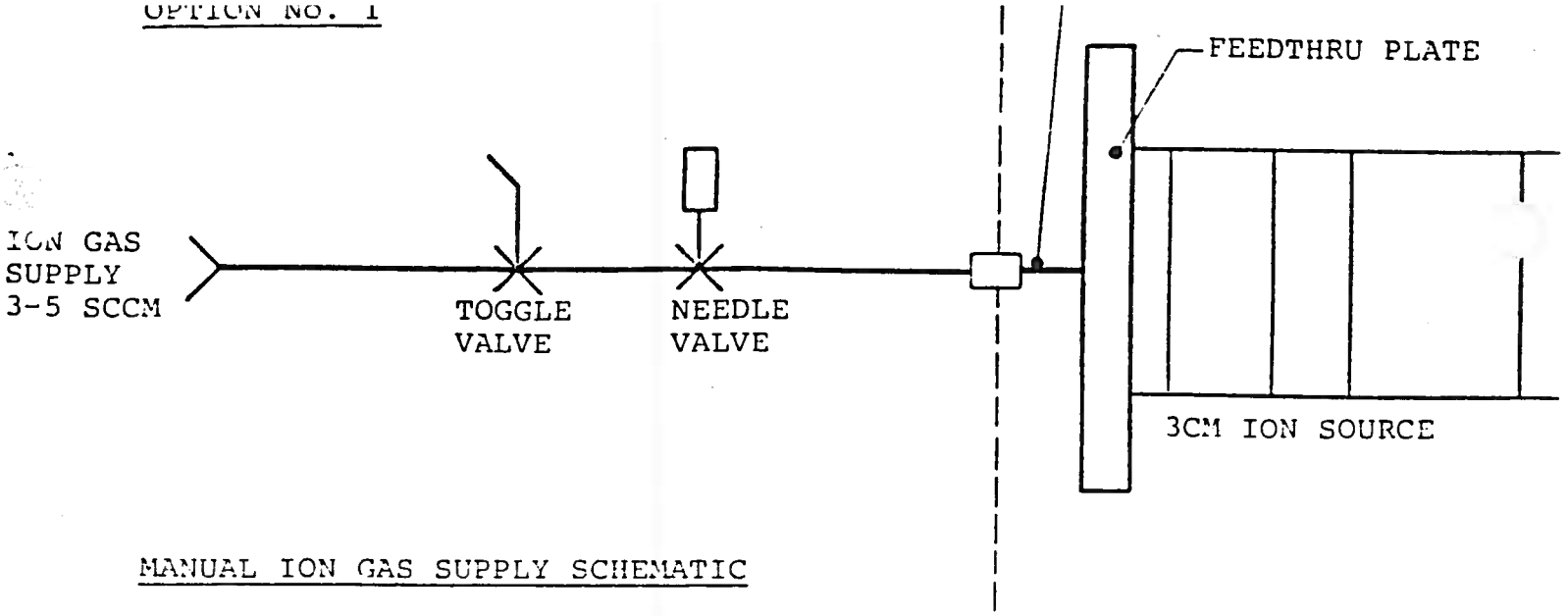
The second method of mounting is to extend the electrical conductors and the gas feed tube the required length for remote mounting the ion source body (mounting by customer). The feedthru plate for this method can be a 2 and 3/4 inch diameter Conflat or two 1 inch base plate feedthrus.

IV. ION GAS SUPPLY

In order for the pressure in the ion source to be high enough to sustain a plasma within the ion source discharge chamber a supply of three to five SCC/M Argon is required for most vacuum systems. This flow requirement will change according to the type of gas used.

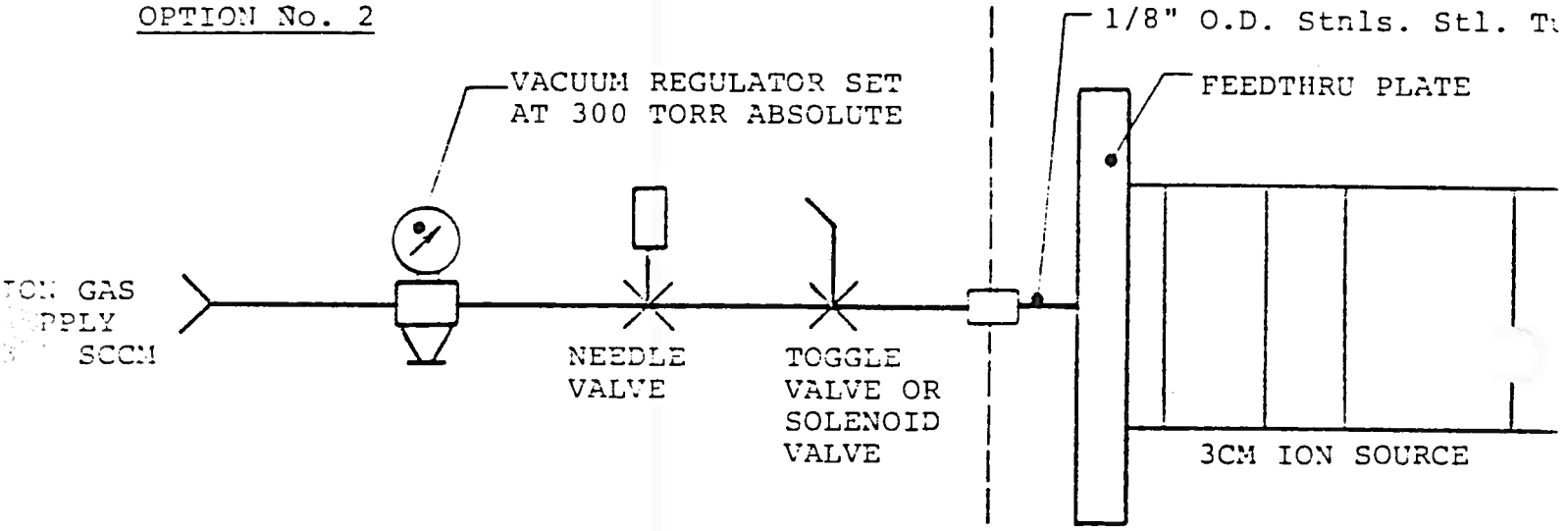
Three methods of controlling this gas flow are shown on the following schematic diagrams.

OPTION NO. 1



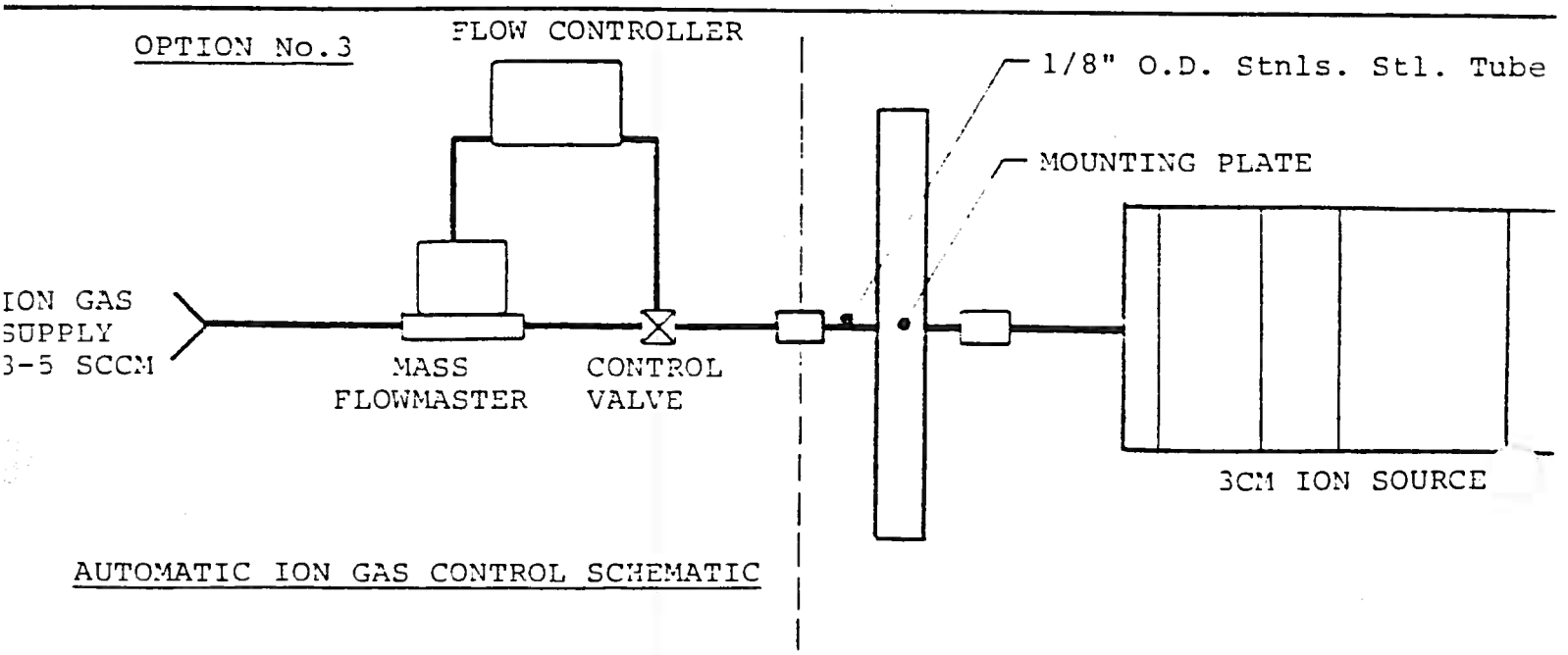
MANUAL ION GAS SUPPLY SCHEMATIC

OPTION No. 2



RECOMMENDED MANUAL ION GAS CONTROL SCHEMATIC

OPTION No.3

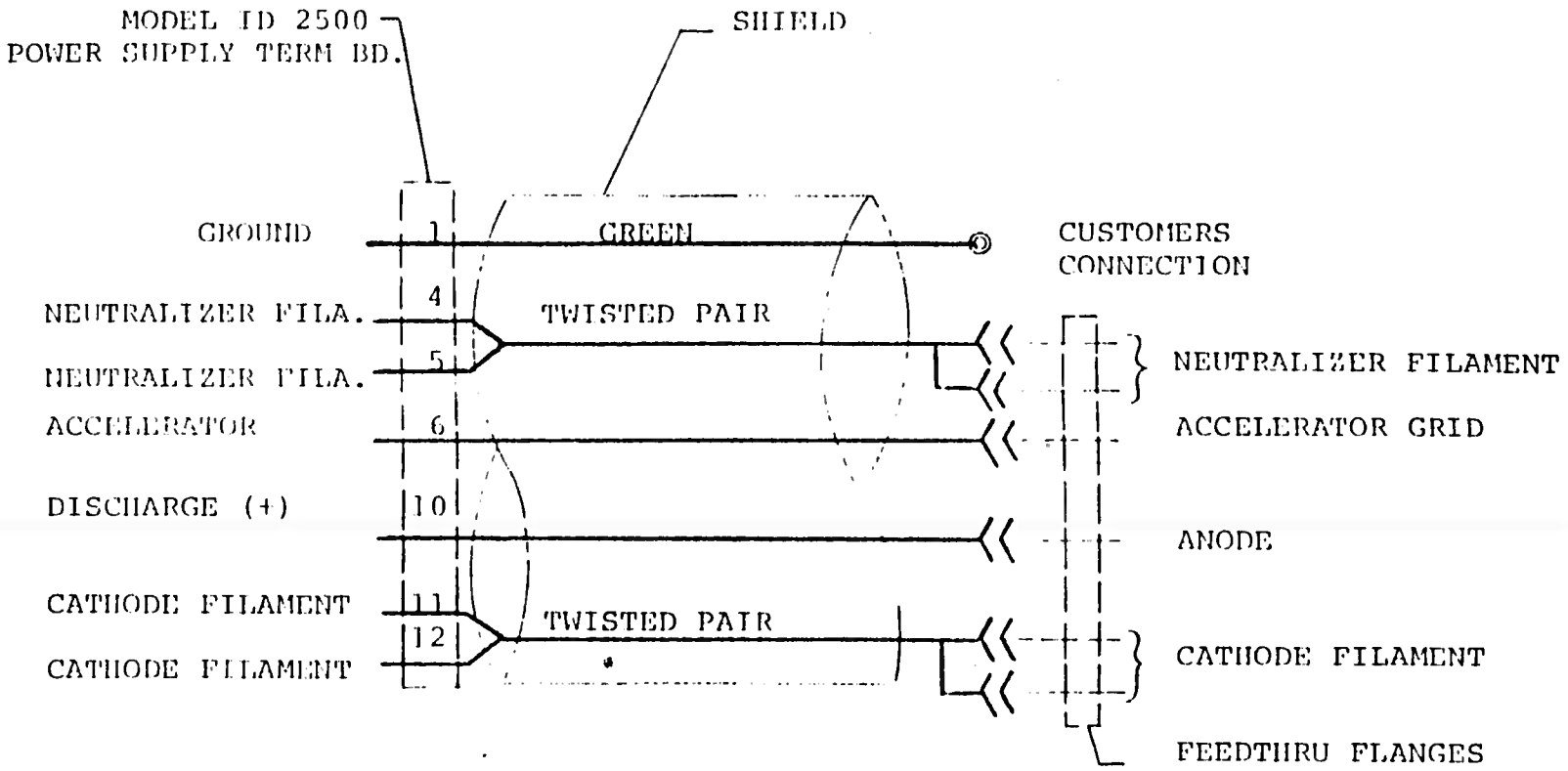


AUTOMATIC ION GAS CONTROL SCHEMATIC

V. INTERCONNECTIONS

Reference Figure 3

The interconnections between the power supply and the ion source are shown on the reference drawing. The two sets of filament conductors are twisted pairs. All of the conductors have 3KV insulation and are protected by braided metal and plastic sheaths. The connections at the power supply are made with spade lugs and set screw push on connectors are used at the feedthru plate.



INTERCONNECTION DIAGRAM

SCALE DNA	APPROVED BY	DRAWN BY S. COLLINS
DATE 1-31-94		REVISED
		DRAWING NUMBER

VI. OPERATION

The operation of the ion source is described in detail in the attached instructions for the ID-2500 power supply.

VII. MAINTENANCE

The 3cm ion source is designed to simplify and reduce the maintenance required for dependable operation.

The expendable items are the cathode and neutralizer filaments. The operating life of these tungsten filaments depends on the ion output level selected for operation, since the plasma density is controlled by the cathode filament temperature and the resultant ion beam current density is proportional to the plasma density. The neutralizer is operated to provide an electron current that matches the ion current so the neutralizer filament life is also dependent on the ion output level.

Disassembly of the ion source can be accomplished by loosening the two hold down rods using the custom nuts protruding from the front of the ion source. This can be done from the vacuum side of mounting flange if access is adequate. CAUTION!

The body and all stainless steel parts of the ion source become quite hot during operation and extreme care should be exercised in removing the ion source after operation.

The main body unplugs separately from the socket as does the cathode & anode assembly. The anode is retained by two socket head cap screws. Which when loosened allow the anode to be rotated to clearance slots and removed. This allows access to the cathode filament for inspection or replacement. Before reassembly the one piece anode should be cleaned of accumulated back sputter.

The ion optics (grids) should also be inspected for wear, alignment, spacing, and backsputter flakes, and the neutralizer filament should be replaced if required.

Power supply maintenance and trouble shooting is covered in section IX of this manual.

VIII. SPARE PARTS

The following is a list of recommended spare parts for the 3cm ion source. Ref. Figure 4.

DRAWING REF.NO.	QTY.	DESCRIPTION	PART NO.
1	12	Support Insulator	A-10561
2	2	Neutralizer Support Insulator	A-10563
3	1	Standard Dual Ion Optics	A-10654
4	1	Inner Plug	A-10572
5	1	Socket	A-10578
6	1	Socket Back Cover	A-10579
7	1	Custom Wrench	A-11827
8	1	Cathode Filament .010" Dia. Tungsten x 3 3/4" Lg.	
9	1	Neutralizer Filament .010" Dia. Tungsten x 3 1/2" Lg.	