OPERATING INSTRUCTIONS

EX05

WITH 8015

HA060002 ISSUE 6

AUGUST 1994

EX05 with 8015

Contents

Diagrams

INTRODUCTION

The EX05 ion source is a high performance ion source suitable for use as an etching source in Auger, or X-Ray Photoelectron Spectroscopy (XPS) experiments. It is also suitable for use as an ion source for Secondary Ion Mass Spectrometry (SIMS), Secondary Neutral Mass Spectrometry (SNMS), and Low Energy Ion Scattering (LEIS) experiments.

The EX05 gun has an electron impact source, and may be used with inert gases to provide ion beams in the energy range 0.1 to 5 keV.

DESCRIPTION OF THE EX05

The construction of the EX05 ion gun is illustrated schematically in Fig.1.

The ion source is an electron impact source, equipped with 2 filaments suitable for use with high purity inert gases.

Gas is supplied to the source region via the gas inlet valve from a high pressure (1 atmosphere) supply. Differential pumping of the source permits an analysis chamber vacuum of better than 5E-7 mbar during operation.

The ion optical column for focussing the beam onto the sample consists of 2 lenses, followed by 2 pairs of plates for beam scanning.

TECHNICAL SPECIFICATION

Operating Voltage	:	0.1 → 5keV.
Maximum Current	:	>10μA (at 5kV, 15mA emission, 15mm working distance)
Minimum Spot Size	:	<120μm (at 5kV, 15mm)
Maximum Current Density	:	>50μA mm^{-2} (5mAcm^{-2}) (at 1μA, 5kV, 15mm)
Maximum Scanned Area	:	5mm x 5mm (5kV, 30mm)
Power Supplies	:	8015 with 346 or 384 scan unit
Ion Gun Lead	:	CE801501
Mounting	:	FC38 rotatable conflat flange (200mm port length for 30mm working distance)
Pumping	:	Differential pumping of source (single stage via tapped FC38 conflat flange)
Gas Inlet	:	Via FC19 conflat flange

RECOMMENDED PUMPING AND GAS REQUIREMENTS

VG Microtech recommend that your EX05 is used under the following conditions:-

Differential Pumping	>5 Ls-1 (at the source) for Argon
Chamber Pumping	>150 Ls-1 for Argon
Source Gas Purity	99.999% purity
EX05 Port Length	185mm to 230mm

It should be noted that the EX05 will in fact operate with a lower pumping speed at the source, but this will lead to an increased analysis chamber pressure.

To achieve the above source pumping speed, it is recommended that the pumping tube to the source is kept to the shortest length and maximum diameter possible, and a source pump with a pumping speed of >50Ls-1 (for Argon) is used. (Using standard1½" (38mm) O.D. tubing, the tube length should be kept to <1m to achieve a 5Ls-1 pumping speed at the source).

RECOMMENDED OPERATING CONDITIONS

The source operates with a gas load between 5x10-5 mbarL5-1 and 5x10-4mbarLs-1. If the pumping speed at the position at which the source pressure is measured is known, and is S, this will correspond to a measured pressure of (Gas Load) / S mbar.

The chosen operating conditions will be a compromise between the maximum etch rate possible, minimum beam spot size possible (in order to obtain the best quality crater possible) and in some cases, minimum chamber pressure possible.

It is suggested that operating the source at a gas load of just less then 10-4 Ls-1 will give a suitable balance between these requirements.

FITTING THE EX05 ION GUN

The EX05 ion gun should be fitted with the orientation of the beam scan plates as close as possible to the X and Y translation motions of the sample. The orientation of the scan plates can be seen by examining the orientation of the slot in the nose of the gun.

The gas inlet should be connected to the FC19 flange at the rear of the gun, in such a way that it is possible to at least rough pump the volume between the gas admit leak valve and the source isolation valve (fig 3). When fitting the gas line, it should be noted that the user will need to remove the ion source cover (fig 7) to change filaments, and, therefore, the gas line should be constructed in such a way that this can easily be done. To obtain the fastest response possible to source pressure adjustments, the gas inlet leak valve should be fitted on or as near as possible to the EX05. The volume up to the gas inlet valve should be at a pressure, to ensure that any small leaks in the gas line do not result in contamination of the source gas.

8015 FRONT PANEL CONTROLS

The 8015 Front panel controls shown in Fig.2 are described in this section:-

VR1 : Drift Voltage.

VR2 : Ion Energy

VR2 selects the incident ion energy from 0 to 5kV.

VR3 : Condenser Lens Course Control.

VR4 : Focus Lens Course Control.

VR5 : Condenser Lens Fine Control.

VR6 : Focus Lens Fine Control.

VR7 : Filament current limit control. VR7 allows the user to reduce the filament current during filament degassing.

SW1 : Provides Fine Control for the emission set with SW2.

SW2 : Emission Course Control (50µA to 15mA.

SW3 : Electron Energy Control.

PB1 : Selects the full scale current range to be 200µA or 20µA.

PB2 : Allows a 15V suppression bias to be applied to the sample to suppress secondary electron emission when measuring sample current.

PB3 : Switches all HV outputs on.

PB4 : This switch is only functional for an EX05F FAB source. Selects "ion" or "neutral beam" operation. This switch has no function with an EX05.

PB5 : Selects the source extraction voltage. "Hi" is used for most applications; "Lo" is used for ISS (Ion Scattering Spectroscopy) experiments.

PB6 : Switches the filament on or off.

INDICATORS

Filament:	Will remain green in normal operations but will indicates red if a fault occurs i.e. blown filament.
Emission:	Indicates that correct emission has been obtained.
Beam On:	Indicates if the beam is blanked or not.
Interlock:	Will remain green in normal operation but will indicates red should a cover from the unit be removed or rear panel B.N.C. interlock connector is not closed.
HV:	Indicates the presence of high voltage, this will indicates red if a fault occurs.

REAR PANEL

Interlock:	Should be shorted for normal operation. This allows the user to interlock the unit to an external signal.
Filament (SW4):	Selects filament 1 or 2.
Target Current:	Target (sample) current meter input.
Beam On/Off:	This allows the beam to be blanked (switched off) and is used in conjunction with the computer control. If not used, the BNC should be fitted with a shorting plug to switch the beam on.
Hv Connector:	HV outputs to the ion gun.

FILAMENT OUTGASSING

The differential pumping line of the source should be under vacuum at a level of 10^{-8}mb or less before the filament can be outgassed.

1. Ensure current limit is set to minimum.

2. Switch on power, beam on indicator should glow green and interlock indicator also should be green. If not check connectors at rear panel. Switch on filament and switch on high voltage.

3. Slowly increase the current limit, ensuring that the source pump pressure remains less than 10^{-7}mbar.

4. Slowly increase emission whilst observing pressure in the source, if source the pump pressure rises above 10^{-7}mb do not increase emission until the pressure starts to recover, repeat this process until 10mA emission is achieved.

INITIAL GUN ALIGNMENT

1. Admit gas to source at a pressure of between 10^{-6} and 10^{-5} mbar.

2. Set desired emission current (normally between 5mA and 10mA: Lower emission current will give longer filament lifetime).

3. Switch on HV supply and increase Ion energy and drift settings to maximum.

4. Observe target current and maximise with condenser settings.

5. Focus the image with the focus settings.

6. Adjust the gas pressure until a maximum is achieved. Repeat steps 4 and 5 until the conditions are optimised.

7. The EX05 is now ready for operation. If the ION energy is changed it may be necessary to re-optimise.

SWITCHING OFF EX05

1. Turn down the course emission to 50μA.

2. Switch off filament.

3. Switch off Hv supply.

4. Switch off main power.

5. After 5 minutes close gas flow valve.

ROUTINE OPERATION OF THE EX05

In this section, the operation of the EX05 and its associated power supplies is described. It is assumed that the filament has previously been thoroughly outgassed. IF A NEW FILAMENT HAS BEEN INSTALLED, OR THE SYSTEM HAS BEEN BAKED, THE FILAMENTS MUST BE DEGASSED. FAILURE TO DO MAY SEVERELY REDUCED THE LIFE-TIME OF THE FILAMENTS.

1. Ensure that the gas supply line too the source has been evacuated, and that a suitable supply of high purity (>99.99% purity) has then been provided up to the gas inlet valves.

2. Ensure that the pressure in the differential pumping line is better then 10^{-8} mbar.

3. Introduce gas into the source region, such that the pressure in the differential pumping line is in the region of 10^{-6} to 10^{-5} mbar.

4. Ensure that 8015 power supply controls are as follows:

VR1	-	Fully anti-clockwise
SW2	-	50μA emission
VR2	-	1kV
RV1	-	"High" for normal operation "Lo" for LEISS.

5. Switch on mains power to 8015 and beam scan unit.

6. Switch on the filament.

7. Switch on the HT with switch PB3 select the desired beam energy with VR2, and increase the drift voltage to the desired value using VR1.

8. Increase the emission current to the desired value with SW2 and SW1.

9. Adjust the source pressure and emission current as required. (N.B. For optimum performance, the optimum pressure must be set precisely).

10. Adjust VR3 and VR5 and VR4 and VR6 to select the required current and to focus the beam on the sample.

11. Check the beam current, and repeat step 10 is necessary.

12. Adjust the beam scan unit magnification to give the required field of view.

EX05F

INTRODUCTION

The EX05F dual ion/neutral beam source is designed to allow the user to have the option of a neutral incident beam for, in particular, static SIMS experiments.

In ion beam mode, the EX05F operates in a similar manner to the EX05 , but with a reduced maximum current.

In neutral beam mode, a portion of the source gas is diverted into a gas cell located immediately after the condenser lens. (Fig.9) A fraction of the ions from the source are then neutralised by collision on passing through the gas cell. The remaining ions are removed using a deflector located between the gas cell and focus lens. Thus, a static neutral beam is obtained from the gun.

EX05F Technical Specification

Operating Voltage - 0.1 → 5keV

Maximum Current (Ion Mode) :- > 2.5μA
(at 5kV, 15mA emission,
15mm working distance)

Maximum Equivalent Current
(Neutral Mode) > 250nA

Minimum spot size (Ion Mode): < 150μm
(at 5kV, 15mm)

Power Supplies	-	8015 with F modification 346 or 384 Scan Units.
Mounting	-	FC38 rotatable conflat flange (200mm port length for 30mm working distance)
Pumping	-	Diffential pumping of source (via F38 conflat port)
Gas Inlets	-	2 inlets via FC19 conflat flanges for source and gas cell

FITTING THE EX05F

The EX05 ion gun should be fitted with the orientation of the beam scan plates as close as possible to the X and Y translation motions of the sample. The orientation of the scan plates can be seen by examining the orientation of the slot in the nose of the gun.

Gas inlets should be connected to the FC19 flanges at the rear of the gun, using two separate isolation valves (Fig.10). This allows independent isolation of the source and gas cell inlets. When fitting the source inlet (at the top of the gun), it should be noted that the user will need to remove the ion source cover (fig 7) to change filaments, and, therefore, the gas line should be constructed in such a way that this can easily be done. To obtain the fastest response possible to source pressure adjustments, the gas inlet leak valve should be fitted on or as near as possible to the EX05. The volume up to the gas inlet valve should be at a pressure, to ensure that any small leaks in the gas line do not result in contamination of the source gas.

INITIAL SET UP OF THE EX05F

Initial set up of the EX05F (i.e. filament outgassing and initial gun alignment) should be carried out with the gas cell inlet isolated, and the ion beam mode of operation selected on the front panel fo the 8015 power supply. The drift voltage, (VRI) should however not be adjusted.

ROUTINE OPERATION OF THE EX05F

a) ION BEAM MODE

Operation of the EX05F in ion beam mode is similar to that of an EX05. Ensuring that the gas cell inlet is isolated from the gas supply, ion beam mode is selected on the front panel of the 8015 power supply, proceed as for "Routine operation of the EX05" (p.12), without adjusting the drift voltage (VRI) setting.

b) NEUTRAL BEAM MODE

To obtain a neutral beam from the EX05F FAB gun, the following steps should be followed:-

1) Set up the EX05F in the ion beam mode.

2) Select "Neutral Beam" operation on the front panel of the 8015 unit with PB4.

3) Reduce the source diffential pressure to approximately 5 x 10^{-6}mbar.

4) Admit gas to the collision cell until the chamber pressure is ~5 x 10^{-7}mbar. Monitor the unsuppressed sample current I_N, on a conducting sample. This will give a reading of approximately 0.3 times the neutral beam current. Adjust the gas cell pressure and/or condenser lens, and/or source emission to obtain the desired neutral current.

To measure the neutral beam current more accurately, one of two methods may be employed.

a) EQUIVALENT CURRENT MEASUREMENT

1. Having obtained a neutral unsuppressed sample current, I_N.

2. Select "ion beam" mode on the 8015 front panel, and measure the unsuppressed ion current Iμ while scanning over a sample area of approximately 2mm x 2mm.

3. Measure the suppressed (i.e. true) ion current I_T.

4. Calculate the ratio R given by
   $R = (I\mu - I_N - I_T)/I_T$.

5. The neutral equivalent current is then given by:

   $I_{Equiv} = I_N/R$

b) SIMS SIGNAL MEASUREMENT

Where the EX05F is being used in conjunction with a mass spectrometer to perform SIMS experiments, the equivalent current may be deduced by comparing the SIMS signal obtained from a conducting sample using the neutral beam, to that obtained using an ion beam scanning over an area of approximately 2mm x 2mm.

FILAMENT CHANGING (EX05F)

The procedure for changing filaments on the EX05F FAB gun is identical to that for the EX05 ion gun (see p.15).

CHANGING THE FILAMENTS

The EX05 filaments can be changed without removing the whole gun from the vacuum chamber. To replace the filaments, the following procedure should be followed with reference to Fig. 7 ensuring that gloves are worn when handling in vacuum parts:-

1. Let the vacuum system up to atmospheric pressure of nitrogen or argon.

2. Undo the 8 x M8 bolts which retain the ion source cover, and remove the ion source cover.
(Item 1).

3. Loosen the 3 M3 screws which retain the end plate, and remove the end plate and O-Ring (this will probably remain located in the end plate). (Items 2 and 3).

4. Remove the ceramic spacer (item 4).

5. Remove the filament cup assembly (item 5).

6. Undo the 4 grub screws (2 per filament) which retain the 2 filament assemblies, and remove. (see fig 8).

7. Fit 2 new filament assemblies (VG Microtech part no. FIL31). Ensure that the filaments are set to a height of 6mm above the cup, and spaced 6.5mm apart (+ 3.25mm from the centre).

8. Carefully tighten the 4 grub screws to secure the 2 filaments, ensuring their heights remain 6mm above the cup, and their spacing remains at 6.5mm.

9. Carefully refit the filament cup, while locating the filament connector pins.

10. Refit the ceramic over the filament cup.

11. Refit the O-ring and end plate and tighten the 3M3 retaining screws while the end plate is pushed fully home.

12. Replace the old gasket, refit the ion source cover and tighten the 8 x M8 retaining bolts.

EX05 MECHANICAL SPARES KIT (SPK19)

DESCRIPTION	QUANTITY
Filament	6
O-Ring	1
Ceramic Spacer	1
Filament Cup Assy	1
Grub Screw, M2 x 2	4
Washers. M1.6	6
Screw, M1.6 x 12	2
Screw, M1.6 x 8	2
Ceramic Bush	4
Screw, M3 x 6	6
Filament Jig	1

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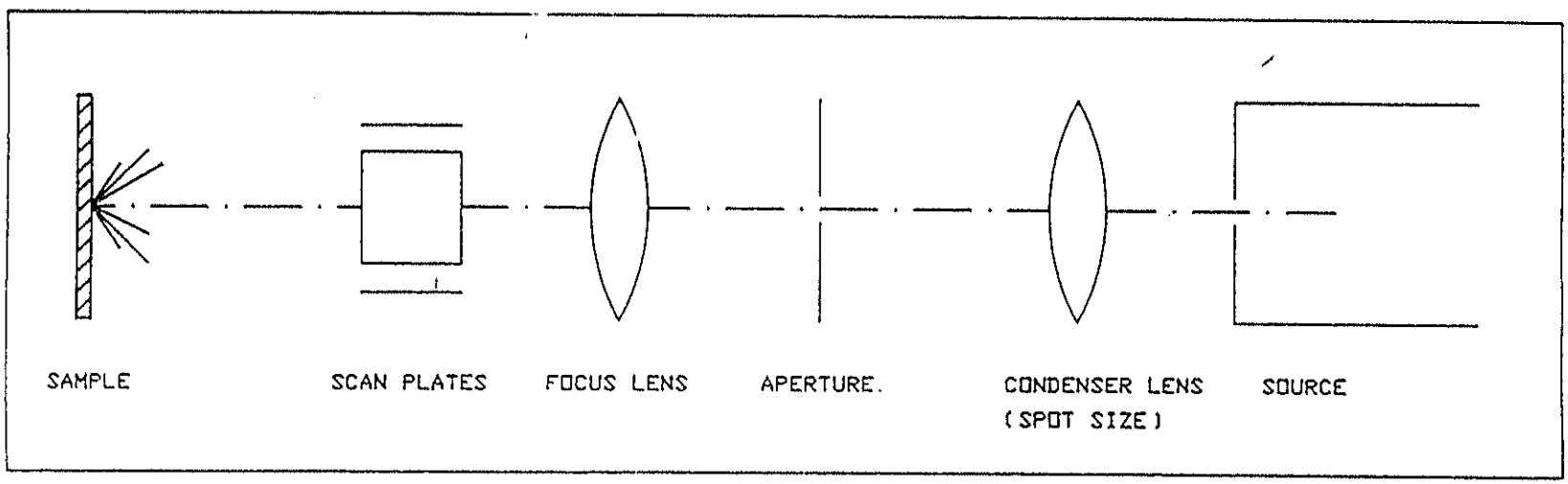
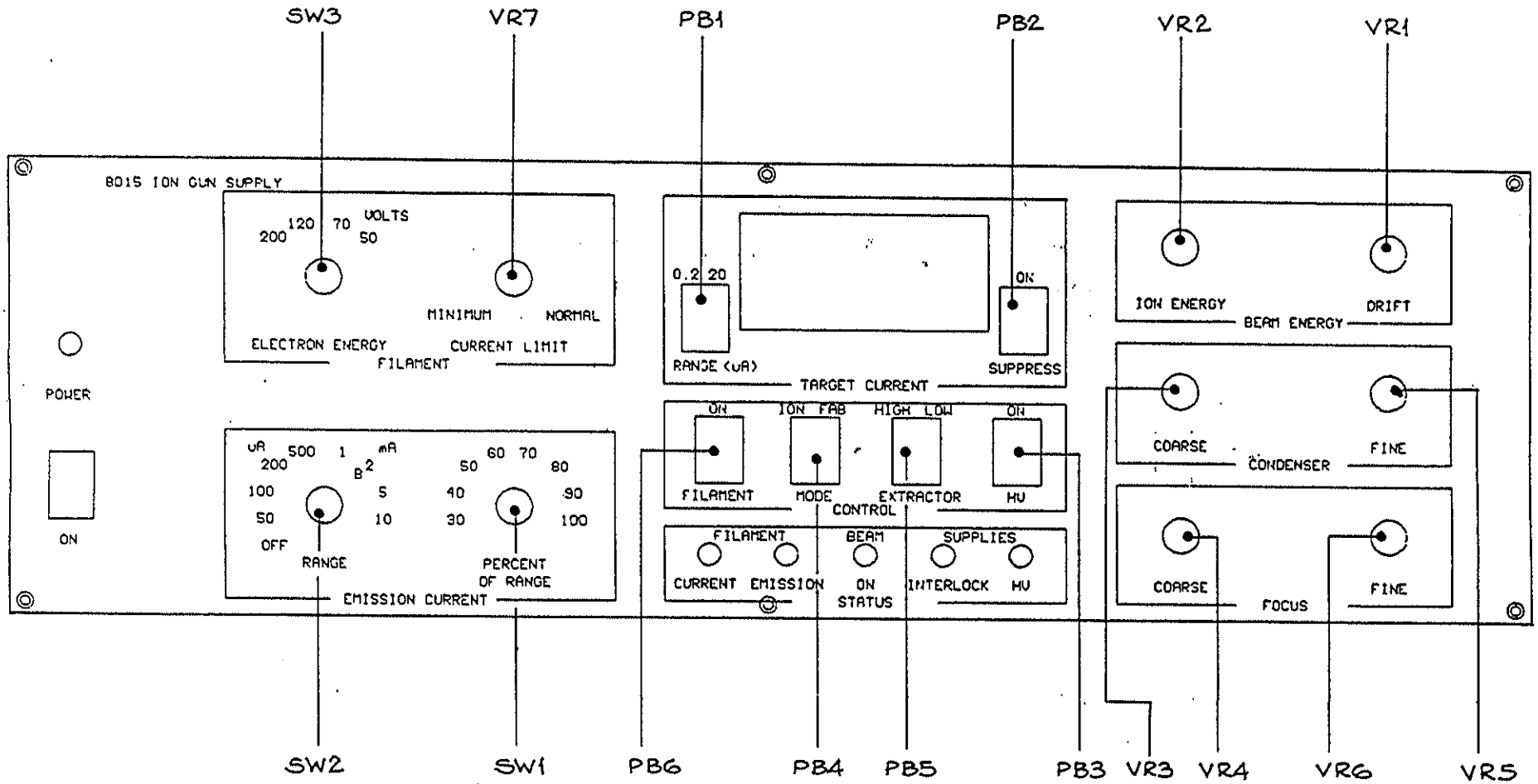
Figure 1 Schematic of ION OPTICAL COLUMN





FRONT PANEL LEGEND.
BA801510C

V.G. MICROTECH LTD, UCKFIELD.

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Figure 3: EX05 VALVE LAYOUT

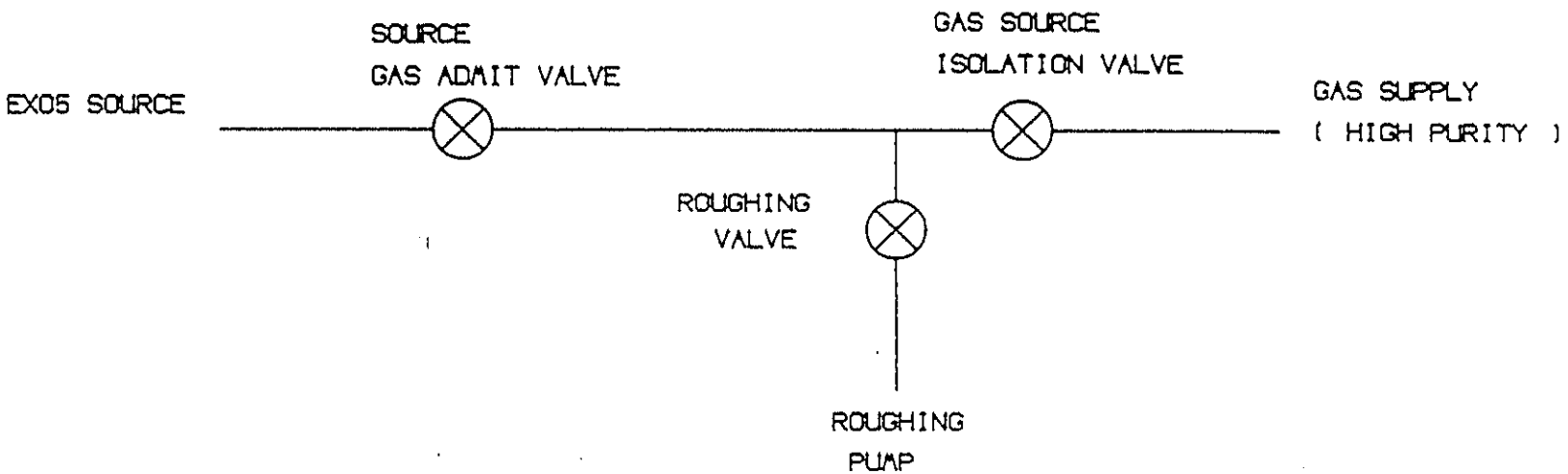

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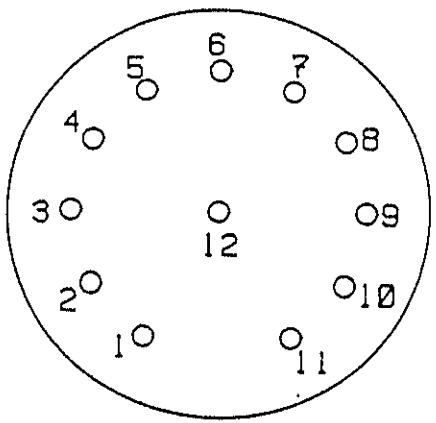
Figure 5 EX05 FEEDTHROUGH CONNECTIONS



FEEDTHROUGH

VIEWED FROM ATMOSPHERIC SIDE

1	X1	SCAN PLATES
2	Y1	
3	X2	
4	Y2	
5	FOCUS	
6	CONDENSER	
7	SOURCE	
8	FIL. 2	
9	FIL. COMMON	
10	FIL. 1	
11	EXTRACTOR	
12	DRIFT	

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Figure 7: EXOS SOURCE ASSEMBLY

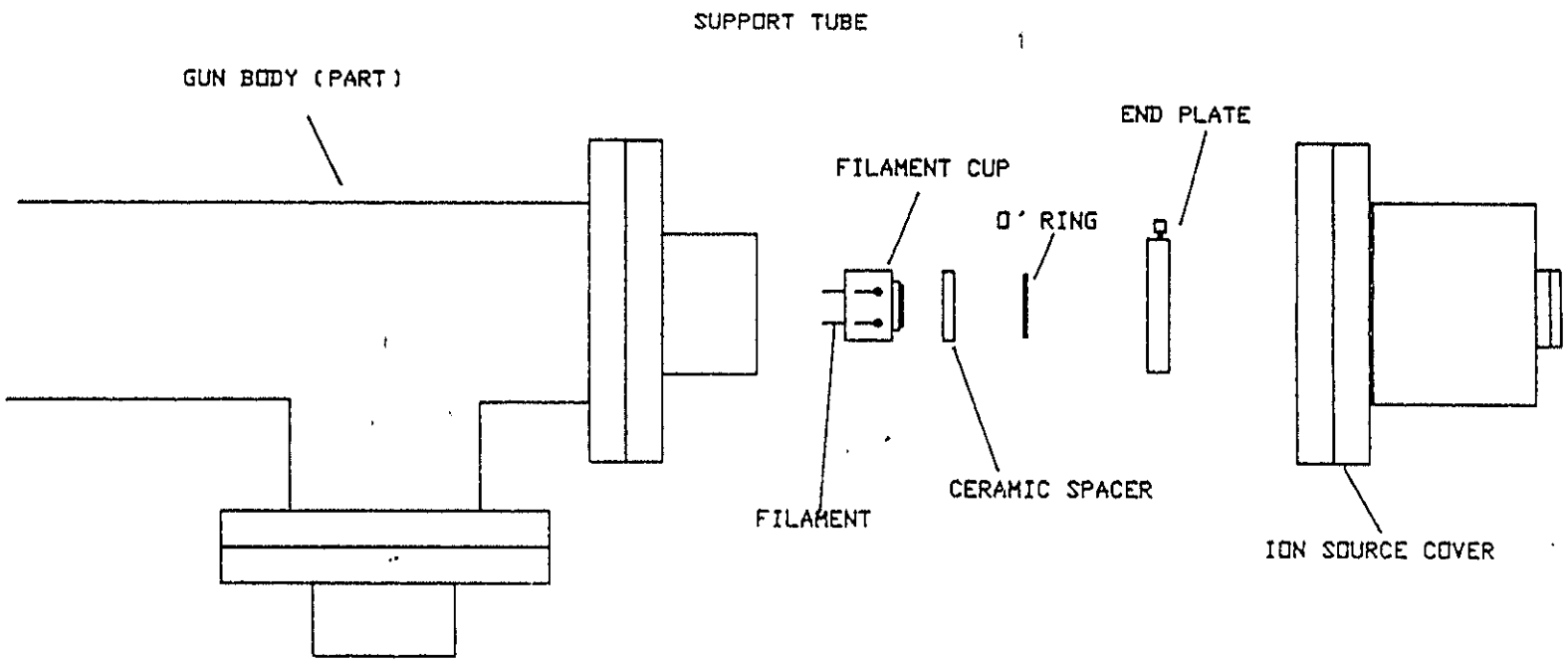

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Figure 8: EX05 FILAMENT CUP

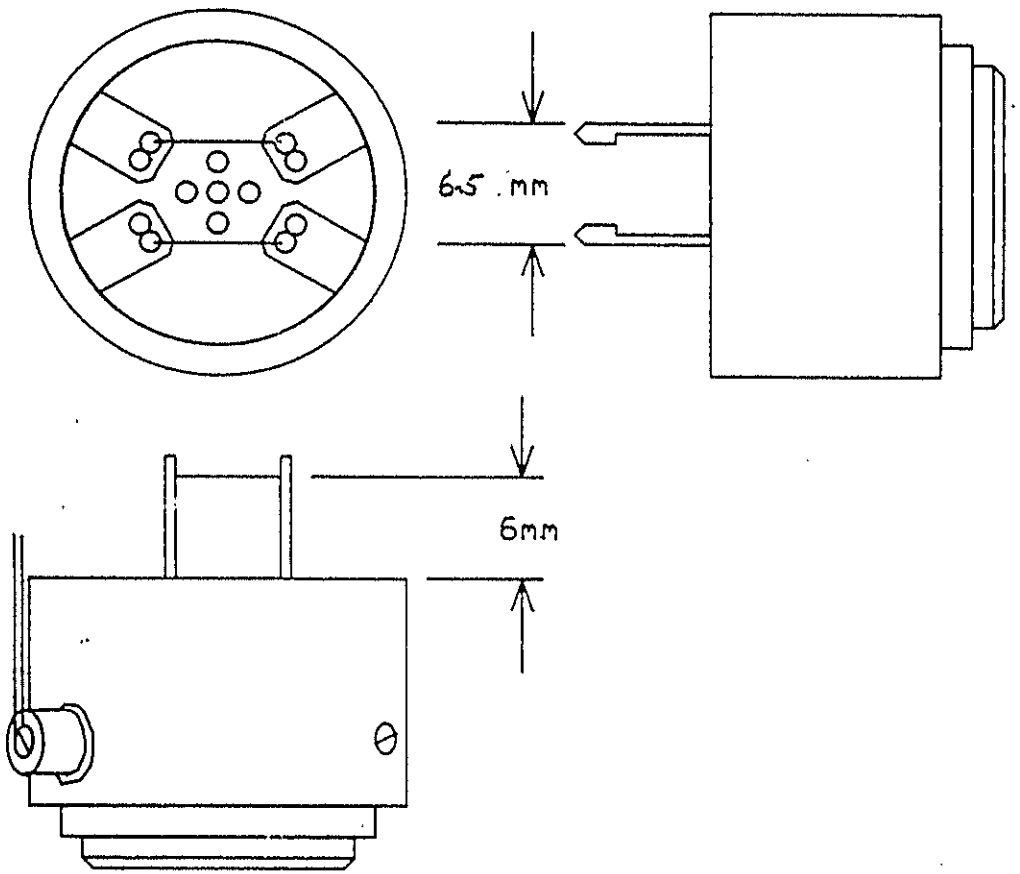

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Figure9 : Schematic of ION OPTICAL COLUMN (EXO5F)

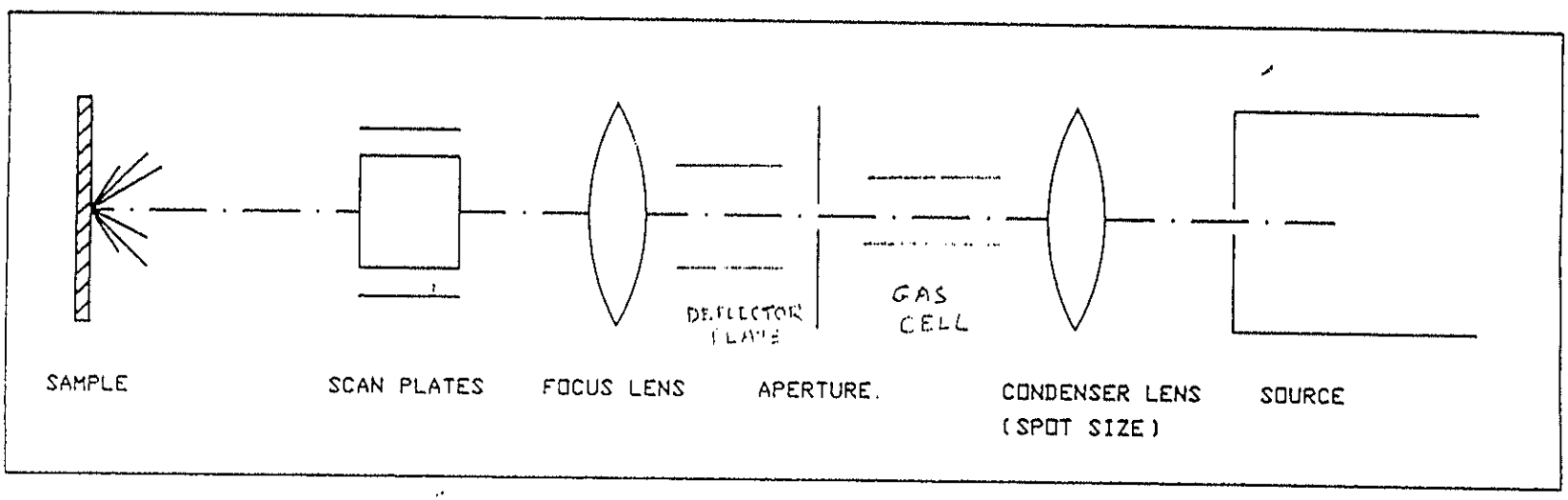

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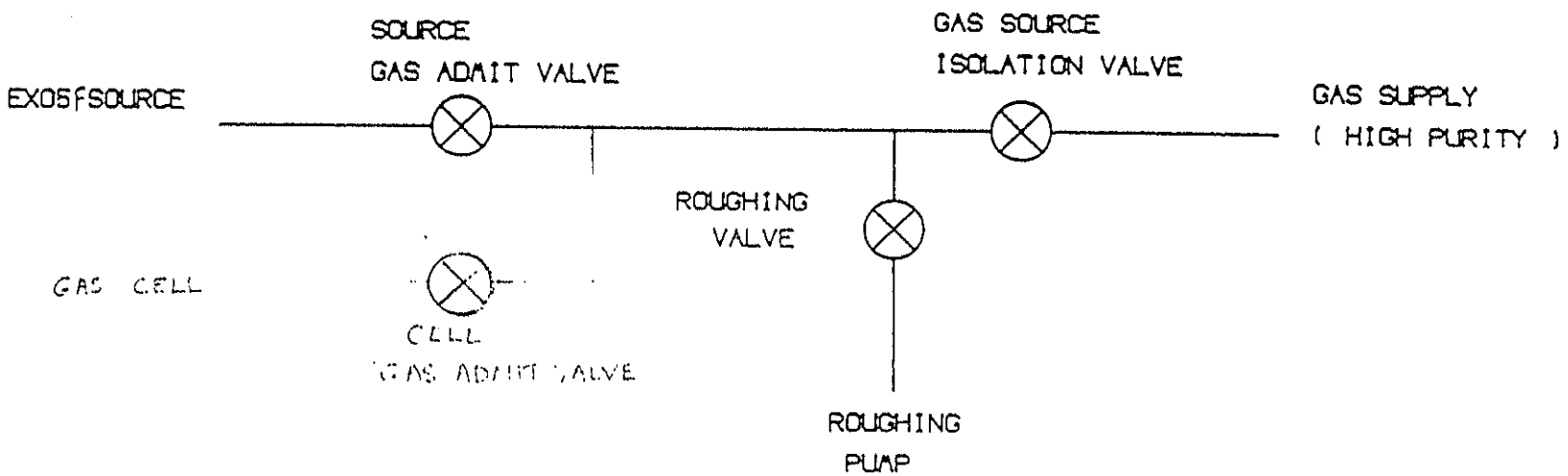
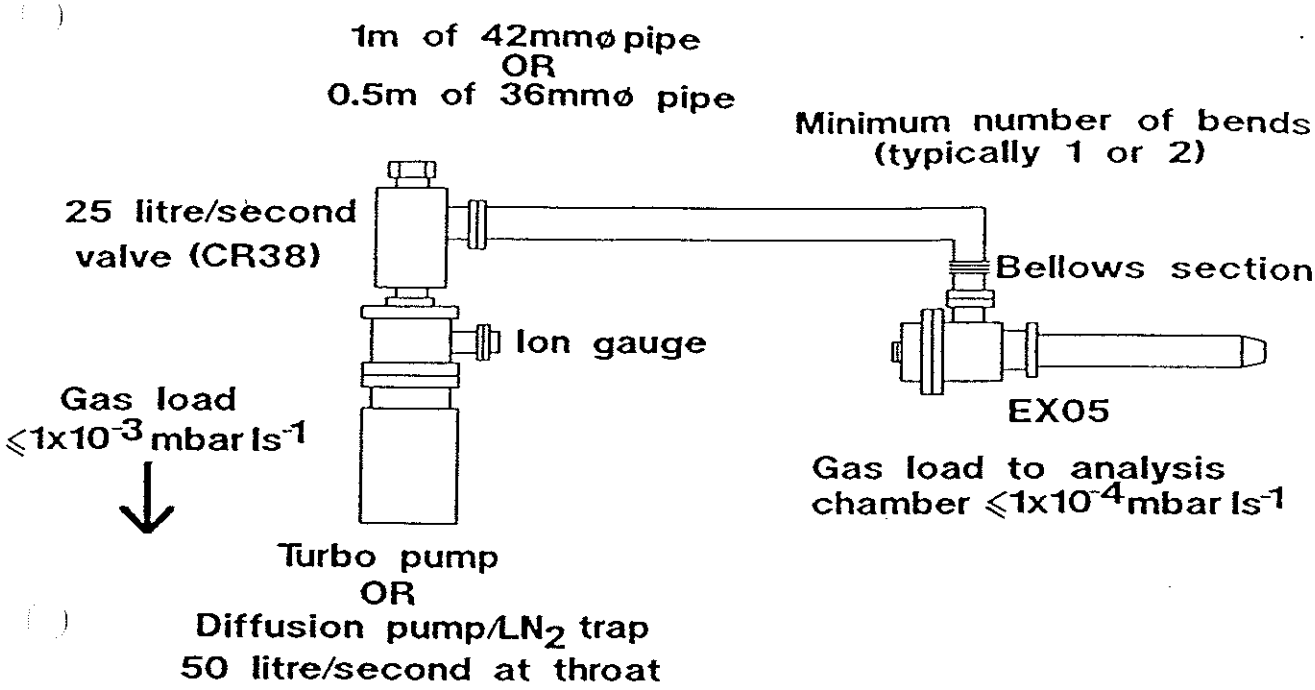
Figure10: EX05FVALVE LAYOUT




1m of 42mmø pipe
OR
0.5m of 36mmø pipe
Minimum number of bends
(typically 1 or 2)
25 litre/second
valve (CR38)
Bellows section
Ion gauge
Gas load
$\leqslant 1x10^{-3}$ mbar ls^{-1}
EX05
Gas load to analysis
chamber $\leqslant 1x10^{-4}$ mbar ls^{-1}
Turbo pump
OR
Diffusion pump/LN_2 trap
50 litre/second at throat

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346 OPERATING INSTRUCTIONS

ISSUE 1
JUNE 1990

W A R N I N G

High Voltages can be LETHAL. If power supply covers are removed, dangerous high voltages will be exposed. Covers should be removed only by qualified personnel.

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AMENDMENT

The 346 SAX Scan Unit is an updated version of the standard 346 and has a number of additional features.

INT/EXT Switch - This allows the scan unit to be driven internally (INT), or externally (EXT) by a computer and interface. When under computer control Xin and Yin on the back panel must be connected to the computer interface. The computer "video in" must be connected by a T-piece to the 346 "video in" and the photomultiplier "video in".

Auger/SAX switch - In normal operation to drive an electron or ion gun this would be set to AUGER. If scanning XPS is required switch to SAX.

X out/Y out - These are slave outputs which allow the 346 to drive another scan unit.

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C O N T E N T S

FIGURES

346 OPERATING INSTRUCTIONS

1. INTRODUCTION

The 346 physical imaging unit is an electrostatic scan unit designed to provide scan voltages to drive an ion or electron gun fitted with electrostatic scan plates. The scan voltages allow the ion or electron beam to be rastered over a sample surface.

The 346 output voltages can either be scanned at TV rate from an internal control board, or from an external control signal (in which case the output waveform will be determined by the input controls). The mode of operation can be selected from the front panel.

The 346 unit also incorporates a video amplifier circuit which can be used in conjunction with a photomultiplier or similar detector to generate SEM images. The output can be used to display the image on a TV monitor using the internal scan generator, or to bright up an oscilloscope in the external mode. The image contrast and intensity can be controlled from the front panel.

A typical configuration for the 346 unit is illustrated in Fig. 1.

2. FRONT PANEL CONTROLS

In this section, the function of the front panel controls of the 346 scan unit are described (Fig. 2).

SW1	-	Mains power ON/OFF switch.
LP1	-	Then illuminated indicates the presence of main power.
RV4	-	Black level control for a video input signal if SW2 is set to 'XI' or X10' (internal TV scan).
RV3	-	Contrast control for a video input signal if SW2 is set to 'XI' or 'X10'.

SW2 - Scan mode selection switch. This switch has 3 positions:

1. OFF/SLAVE. The scan unit is controlled by external ramp signals connected via the rear panel.

2. 'XI'. The scan unit is driven by internally generated TV scan signal.

3. 'X10'. Again the scan unit is driven by an internally generated TV scan signal, and the gain of the video amplifier is increased.

RV5 - 'X' magnification control when 'VAR' (variable) is selected with SW3.

SW3 - Magnification selector switch (for all positions of SW2).

RV1 - Controls the position about which the beam is scanned for the 'X' axis.

RV2 - Controls the position about which the beam is scanned for the 'Y' axis.

3. REAR PANEL INPUTS AND OUTPUTS

INPUTS

MAINS - Mains power input.

VIDEO IN - Accepts analogue input signal.

X IN/OUT
Y IN/OUT - Accepts external control inputs for X and Y amplifiers respectively. To give full output, an input waveform from -5V to +5V is required.

SK3 - Shorting link is required between Pins 2 and 4.

OUTPUTS

X1 - X-Scan plate outputs
X2 - " " "

Y1 - Y-Scan plate outputs
Y2 - " " "

SK2 - Outputs to photomultiplier pre-amplifier

PIN 1	-	+15v
PIN 2, 6	-	zero volts
PIN 5	-	black level
PIN 3	-	-15V

CRO-Z - video amplifier output signal
Video Out -

4. CIRCUIT DESCRIPTION

A schematic of the 346 unit is shown in Fig. 3, and P.C.B. layout in Fig. 4. The functions of each board are outlined in this section.

PCB1 - This PCB supplies the low voltage D.C. rails for the unit (+5V, +15V, -15V, +30V).

PCB2 - This PCB supplies positive and negative high voltage D.C. rails for the output amplifiers (-275V, +275V).

PCB3, PCB4 - These are the main amplifiers for the X and Y outputs. Both boards accept low voltage waveform from PCB6, and D.C. shift control voltage from the front panel (RV1, RV2 respectively). These signals are amplified to give positive and negative complementary outputs of approximately ± 300V peak to peak, with a D.C. offset capability of approximately ±100V.

PCB5 - This is a signal amplifier board, with front panel control of signal black level and contrast.

PCB6 - This board accepts inputs from either the internal TV board or external X and Y control signals, and provides outputs to drive the X and Y amplifier boards (PCB3, PCB4).

PCB7 - This board has two functions. It provides TV rate X and Y signals from PCB 5 to PCB6, and adds a synch. signal to the video input.

5.1 TV RATE OPERATION WITH A PHOTOMULTIPLIER

This section applies to the standard 346 fitted with a TV board. It will also be assumed that a VG photomultiplier assembly and 363 photomultiplier (P.M.) power supply is being used in conjunction with the 346.

The following steps below should be followed:-

1. With the mains power off to all units, ensure the scan cables (X1, X2, Y1, Y2), video o/p, video i/p and SK2 are connected as in Fig. 1.

   Ensure all other power supplies (e.g. gun supply, 363 P.M. supply) are also correctly connected.

2. Set the "video gain" (SW2, Fig. 2) is set to 'X1', and the magnification (SW3) to '5'.

3. Ensure that all other power supply settings are correct for power up.

4. Position the sample in the analysis position.

5. Ensure all vacuum system windows are covered, and all light sources switched off.

6. Switch on the 346 scan unit, 363 P.M. supply, electron/ion gun power supply and TV monitor.

7. Set the electron/ion gun to the desired energy and current (which may be measured on the 363 with the meter switch (S2) switched to 'nA' or 'µA').

8. Switch the 363 P.M. supply meter switch (S2) to 'P.M. volts', and the switch (S1) to 'Bias on/scintillator on' position.

9. Increase the 'P.M. volts' (RV1) to approximately 550V.

10. Adjust the 346 'black level' (RV4) and 'contrast' (RV3), 363 'P.M. volts (RV1) and electron/ion gun focus to optimise the image. Use the 346 magnification switch (SW3), and X, Y shift controls (RV1, RV2) to select the viewed sample area.

11. During chemical analysis, ensure the 363 switch S1 is switched to one of the "bias off" positions so that the scintillator mesh bias does not give rise to an electric field at the sample.

5.2 SLAVED OPERATION

In this section, it will be assumed that the 346 scan unit is being slaved from the VG 384 electrostatic scan unit.

The steps below should be followed:-

1. With the mains power off to all units, ensure the gun scan cables (X1, Y1, X2, Y2) and external inputs are connected as in Fig. 1.

   The external X and Y inputs should be connected to the 384 X and Y amplifier slave o/ps. The TV monitor and P.M. tube connection should not be connected to the 346, but should instead be connected to the 384 scan unit.

2. The 346 video gain switch SW2) should be switched to the "slave" position.

   Set the 384 scan switch to 'TV'.

3. A TV rate image may then be obtained as in Section 5.1, but using the black level control on the 384 unit instead of the 'black level' and 'contrast' controls (RV4, RV3) on the 346. The image magnification and X, Y position are still controlled from the front panel of the 346 (SW3, RV1, RV2 respectively).

4. If the 384 scan switch is set to any position other than TV, the 346 follows the 384 waveform. The magnification and beam position are still controlled from the front panel of the 346.

If the 346 is to be slaved from a master unit other than the 384 scan unit, the X and Y internal inputs require an input range from -5V to +5V to give full scan outputs.

6. OPERATION WITH A FARADAY PLATE COLLECTOR

The 346 scan unit may be operated with a Faraday plate collector in place of the photomultiplier tube, although the image quality obtainable with a photomultiplier tube cannot be expected in this case.

To obtain a TV rate SEM image with a Faraday plate:-

1. Connect the Faraday plate pre-amplifier to 'SK1' and 'video i/p', TV monitor to 'video o/p', and gun scan cable to X1, X2, Y1, Y2 (Fig. 1).

2. Ensure the sample is connected to ground potential.

3. Follow the procedure in Section 5.1, using the 'black level' and 'contrast' controls to obtain the optimum image quality. Disregard all references to the 363 P.M. supply. (This supply is not required with a Faraday plate collector).

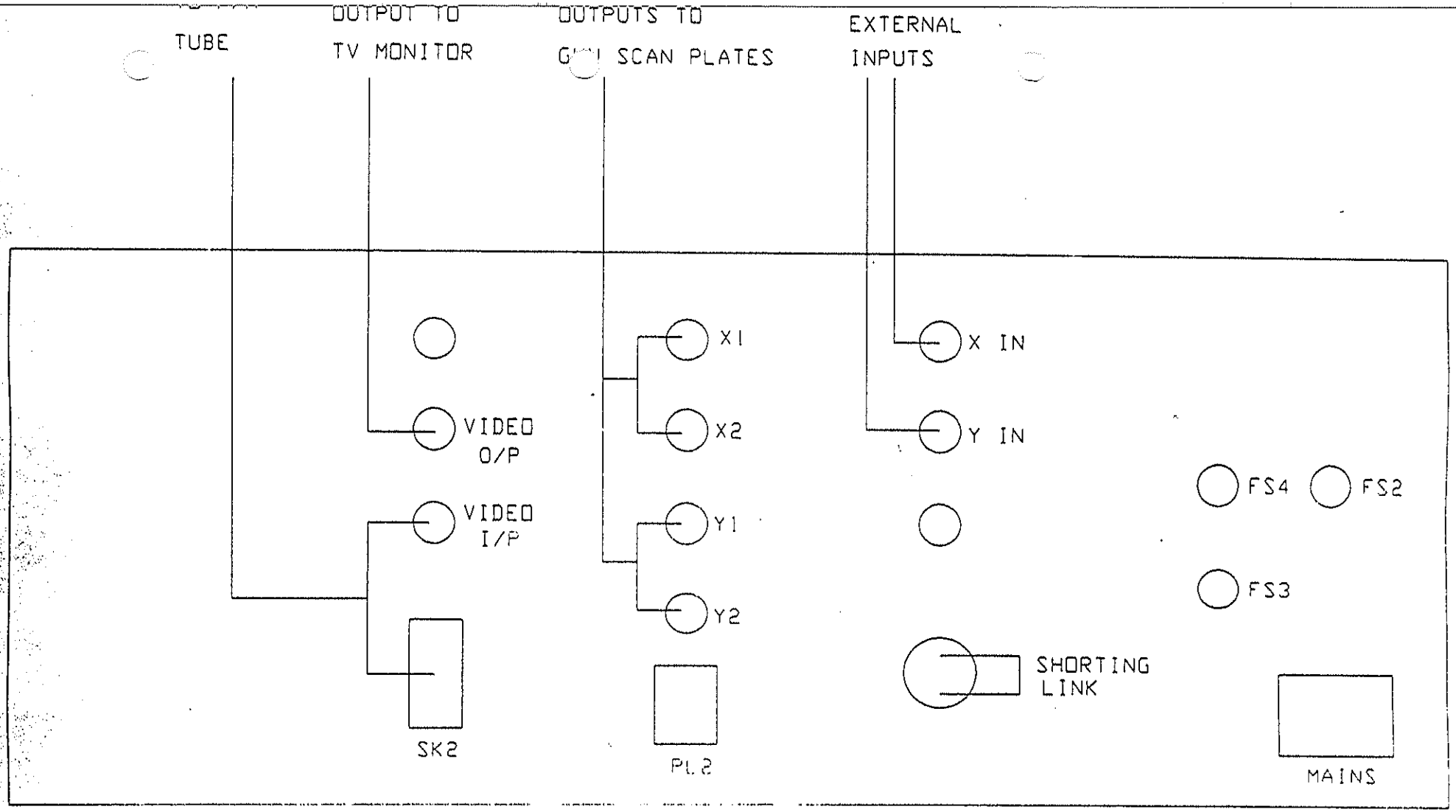
7. 346 DRAWING LIST

1. CIRCUIT DIAGRAMS

346-20-1	SHT 1	(PCB1, PCB2)
346-20-1	SHT 2	(PCB5, PCB7)
346-20-1	SHT 3	(PCB3, PCB4, PCB6)

2. WIRING DIAGRAM

346-29-1



346 CONNECTIONS

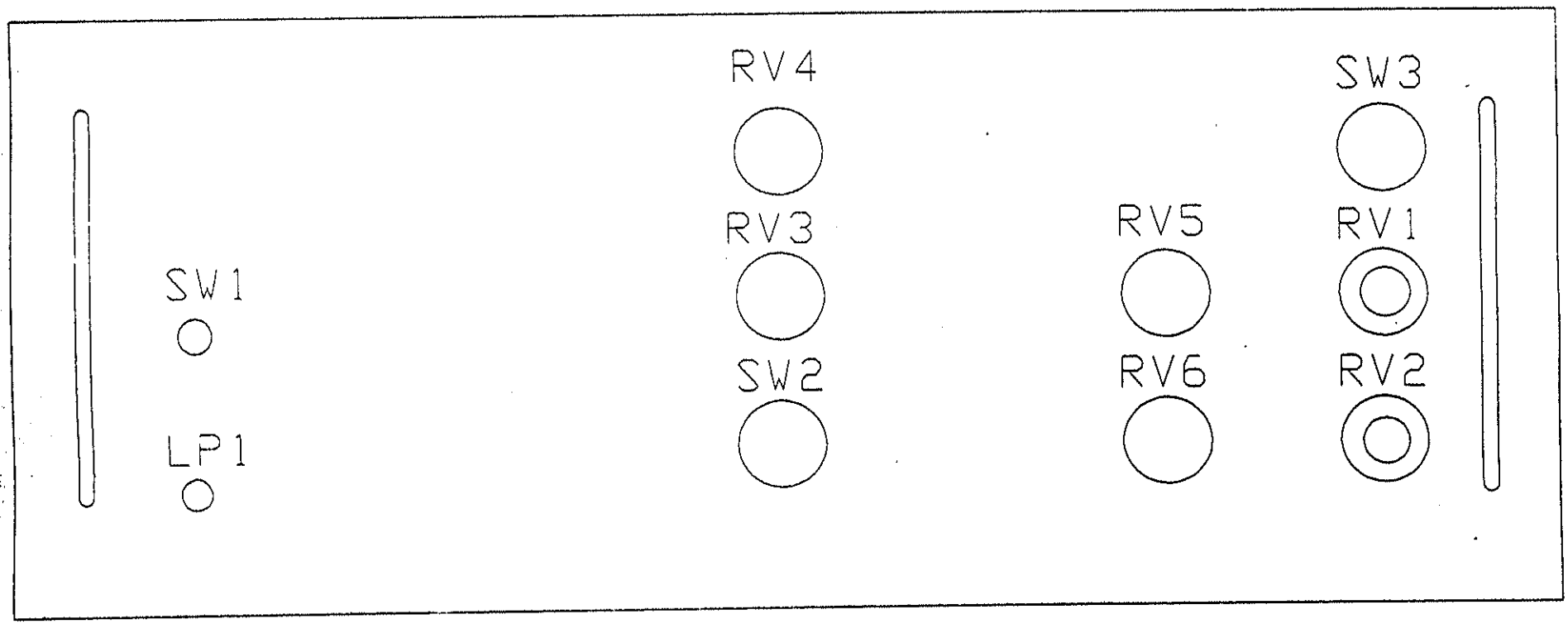
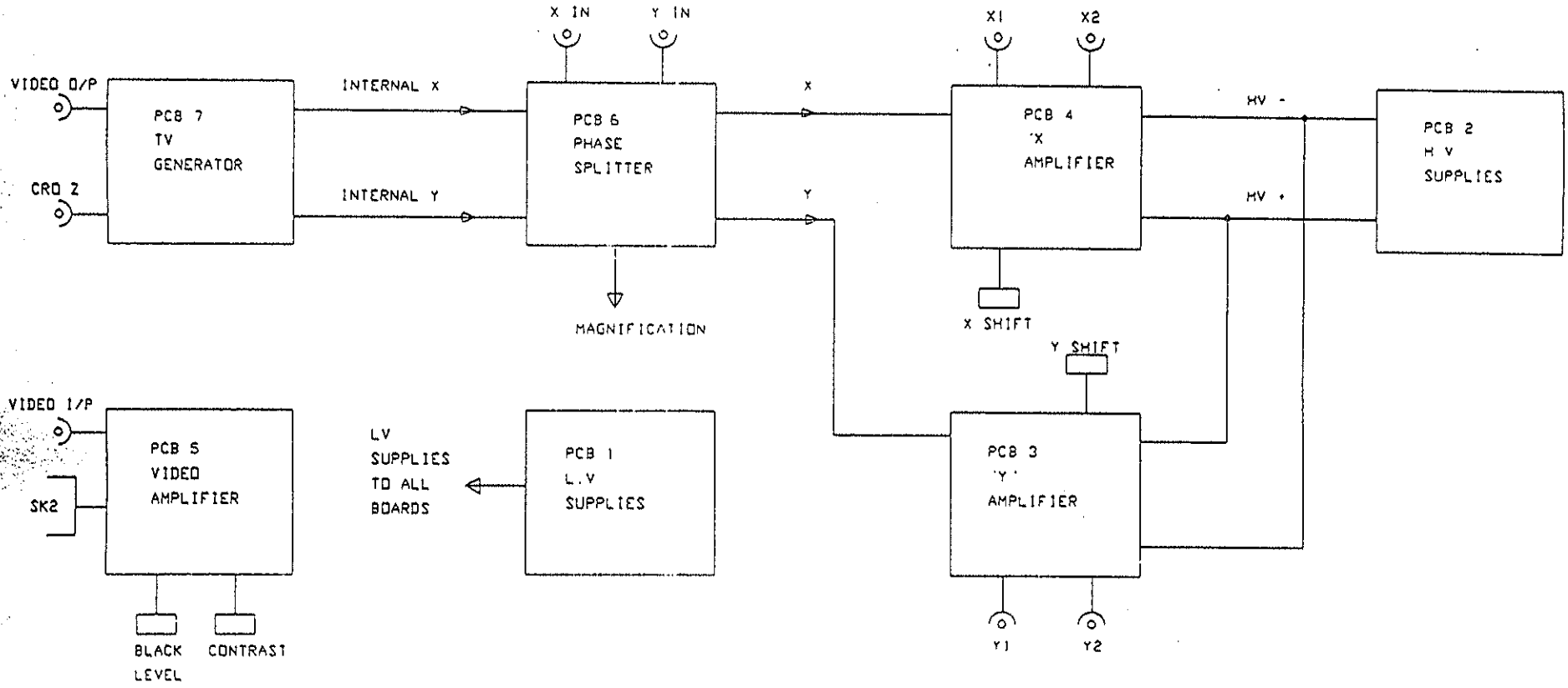
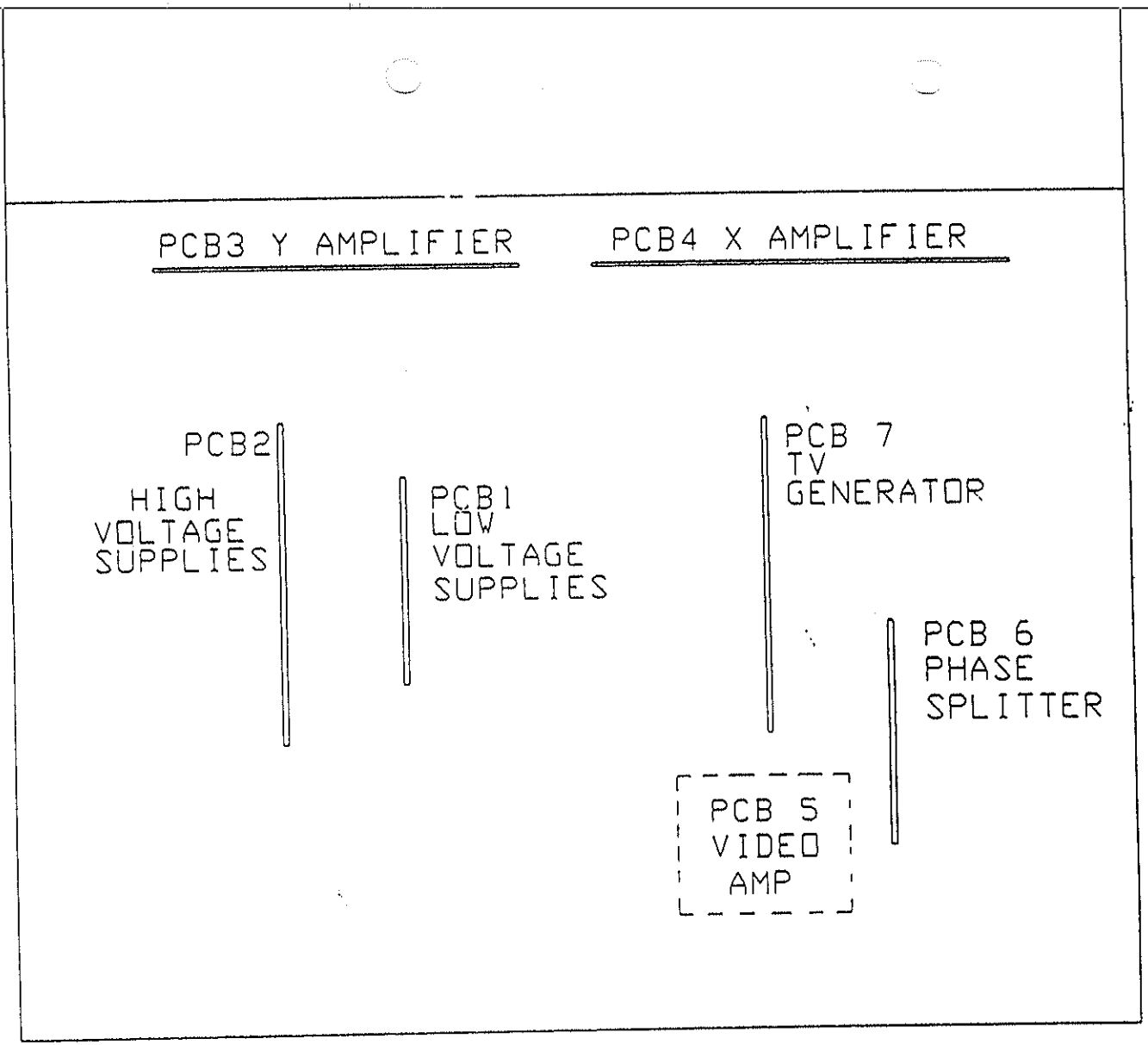


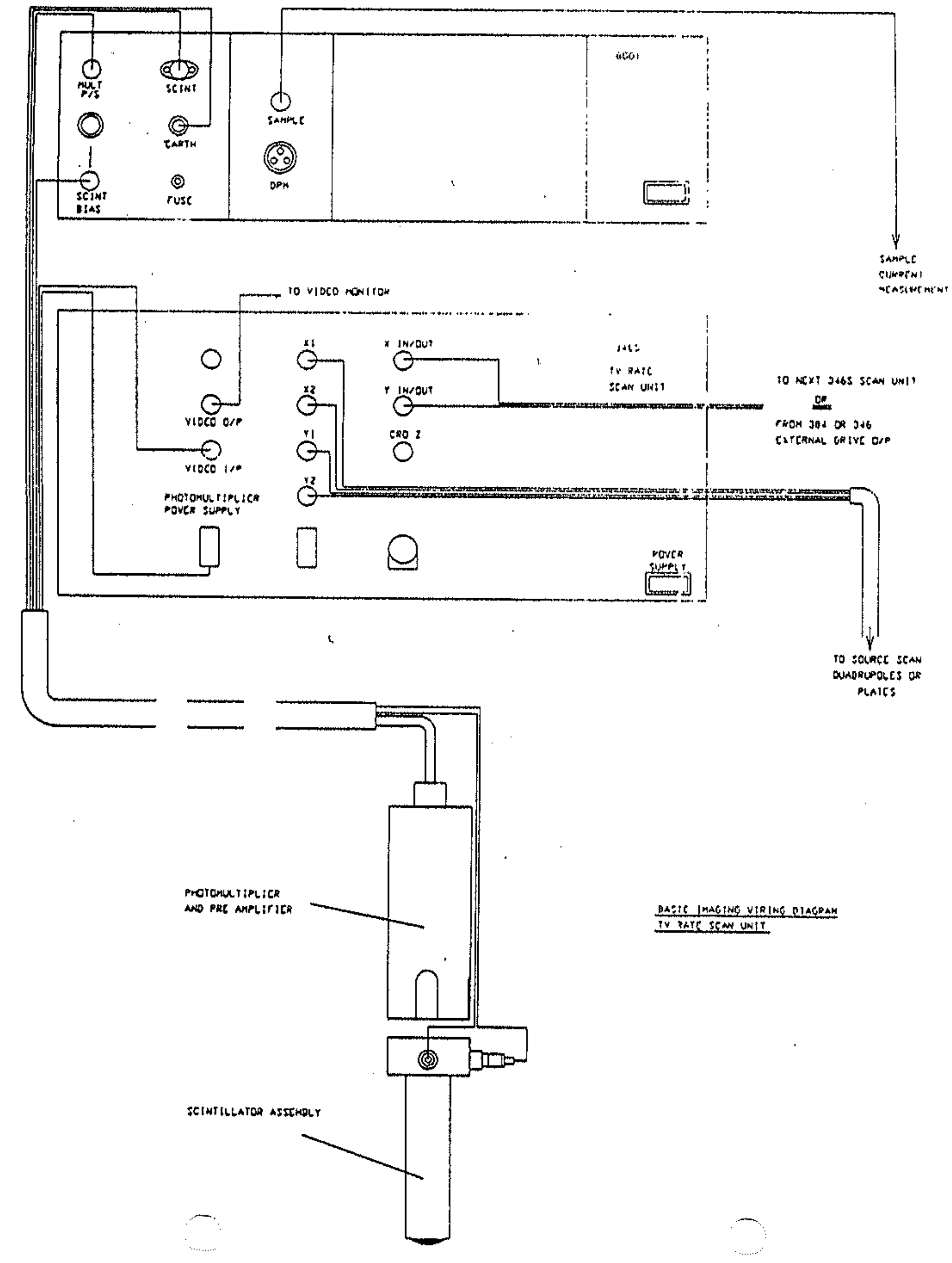
FIGURE 2



346 SCHEMATIC



PCB LAYOUT 346



BASIC IMAGING WIRING DIAGRAM
TV RATE SCAN UNIT