

PHYSICAL IMAGING UNIT

346

VG MICROTECH

346 OPERATING INSTRUCTIONS

SEE SEPARATE FOLDER WITH
SCHEMATICS & SERVICE LOGS.

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.

C O N T E N T S

1. INTRODUCTION
2. FRONT PANEL CONTROLS
3. REAR PANEL OUTPUTS
4. CIRCUIT DESCRIPTION
- 5.1 TV RATE OPERATION WITH A PHOTOMULTIPLIER
- 5.2 SLAVED OPERATION
6. OPERATION WITH A FARADAY PLATE COLLECTOR
7. DRAWING LIST

FIGURES

- | | |
|--------|----------------------|
| FIG. 1 | 346 CONNECTIONS |
| FIG. 2 | FRONT PANEL CONTROLS |
| FIG. 3 | 346 SCHEMATIC |
| FIG. 4 | 346 P.C.B. LAYOUT |

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 - Accepts external control inputs for X and Y amplifiers respectively. To give full output, an input waveform from -5V to +5V is required.
- Y IN/OUT
- 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 $\pm 300V$ peak to peak, with a D.C. offset capability of approximately $\pm 100V$.
- 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 ' μ A').
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).

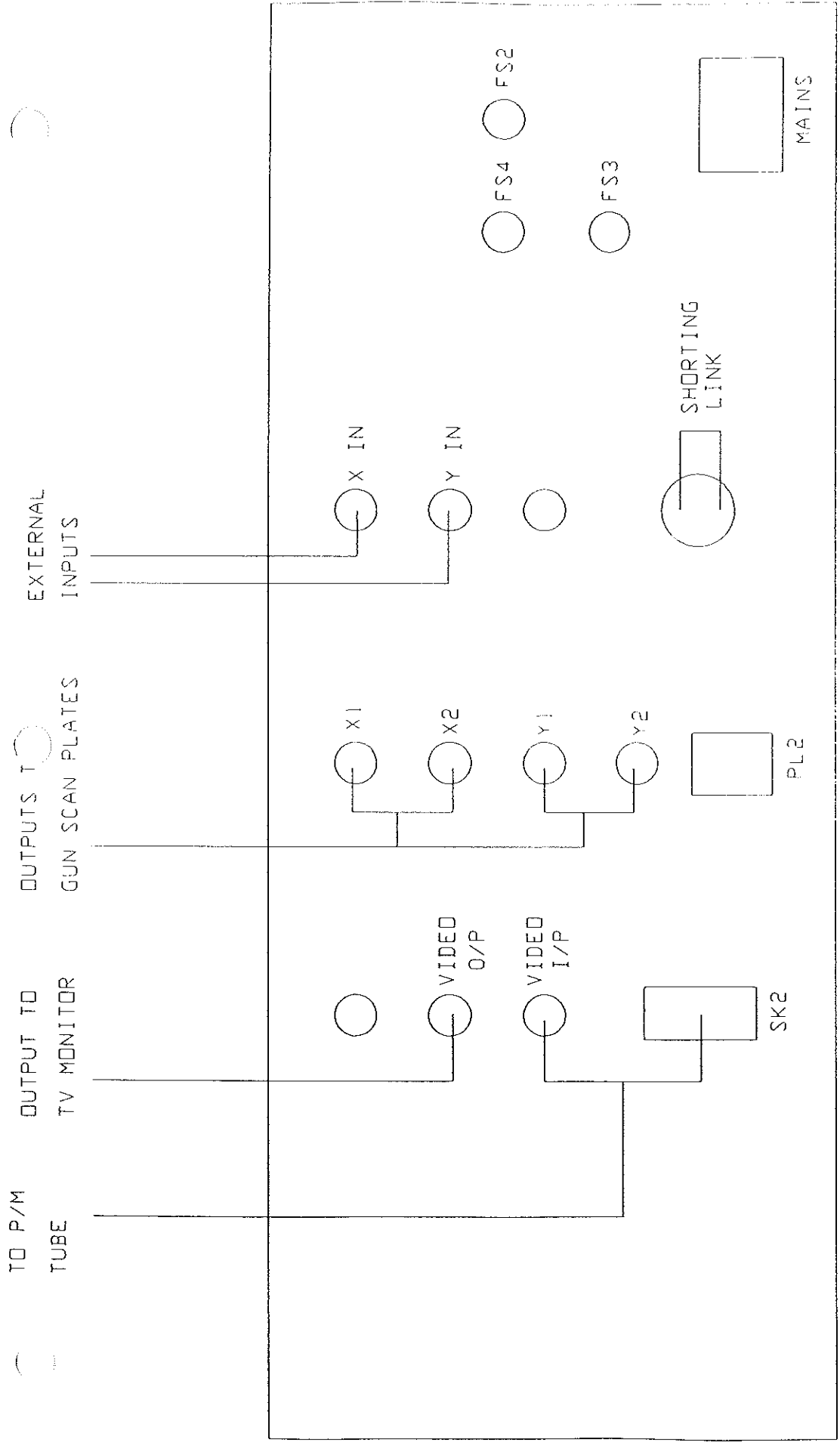
7. 346 DRAWING LIST

1. CIRCUIT DIAGRAMS

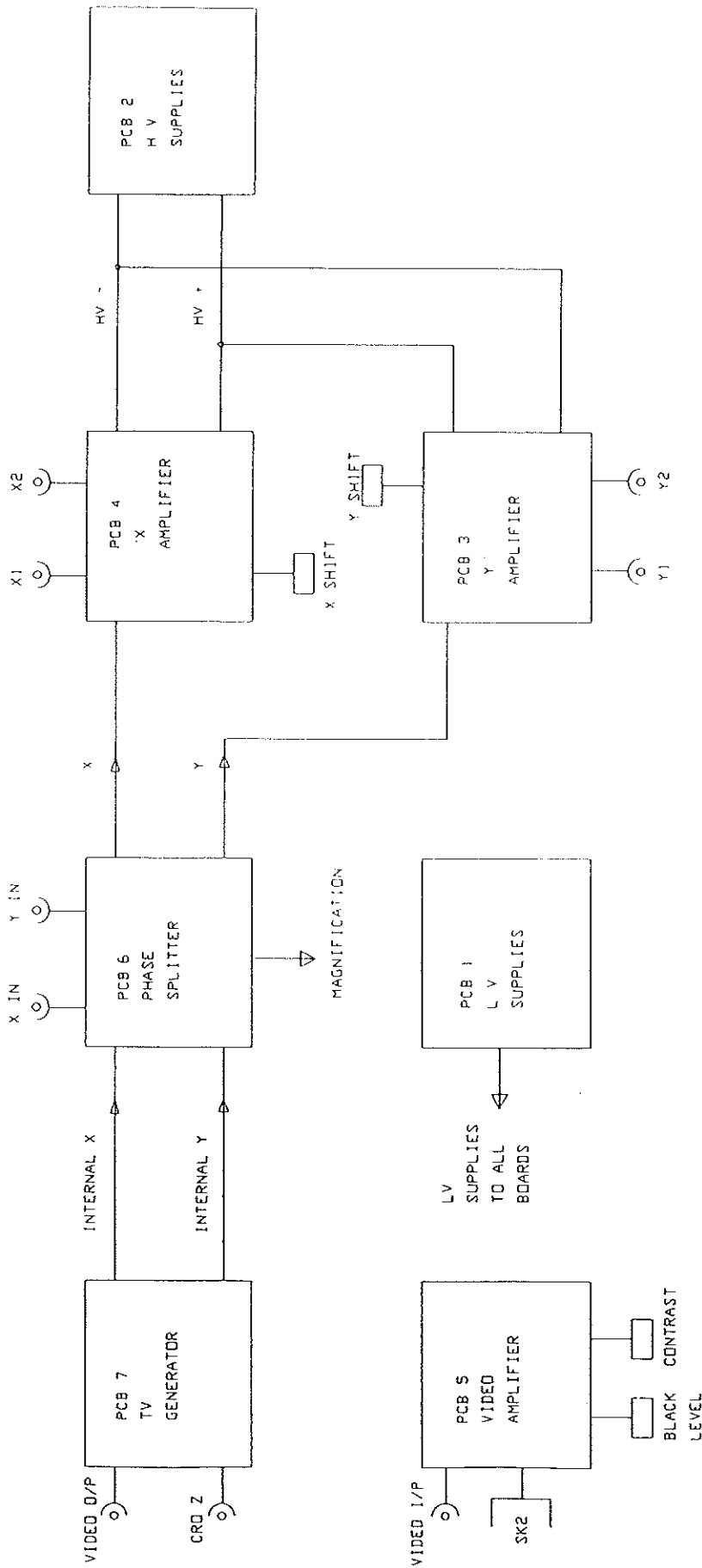
346-20-1	SHT 1	(PCB1, PCB2)
346-20-1	SHT 2	(PCB5, PCB7)
346-20-1	SHT 3	(PCB3, PCB4, PCB6)

2. WIRING DIAGRAM

346-29-1



346 CONNECTIONS



346 SCHEMATIC

PCB3 Y AMPLIFIER

PCB4 X AMPLIFIER

PCB2
HIGH
VOLTAGE
SUPPLIES

PCB1
LOW
VOLTAGE
SUPPLIES

PCB 7
TV
GENERATOR

PCB 6
PHASE
SPLITTER

PCB 5
VIDEO
AMP

PCB LAYOUT 346

PHOTOMULTIPLIER SUPPLY AND DPM

This unit performs two distinct and separate functions.

a) The DPM section provides monitoring for the sample current using a positive bias voltage of 15 volts to suppress the emission of secondary electrons. This voltage is supplied by an internal battery which should last for several years in normal use. However, the battery may be depleted by grounding the sample connection with the DPM switched to read sample current. This should be avoided whenever possible.

b) The second function of this unit is to provide the high voltage and bias supplies for the scintillator assembly. The scintillator itself has two connections. One is the bias voltage of approximately 100V applied to the domed mesh in front of the scintillator to attract the secondary electrons into the assembly. This increases the detection efficiency of the scintillator, producing a much brighter image but it may also cause some distortion of the Auger map if switched on during chemical mapping because of the disturbance it introduces into the electric field inside the chamber. The other connection is approximately 8kV used to accelerate the electrons into the scintillator phosphor screen. This connection can be recognised on the scintillator assembly by its longer ceramic feedthrough insulation.

A switch on the unit allows the scintillator to be switched off, or on without mesh bias, or on with mesh bias.

SCINTILLATOR AND PHOTOMULTIPLIER WITH PRE-AMPLIFIER

The scintillator assembly should be handled with extreme care so as not to damage the domed mesh at the entrance to the assembly or the internal glass light guide. If the assembly is dismantled for any reason, the scintillator disk must not be disturbed except for replacement. The phosphor coating will be damaged by any attempt at cleaning no matter how gentle.

The assembly should be mounted using an annealed (soft) copper gasket and the cap-head bolts provided.

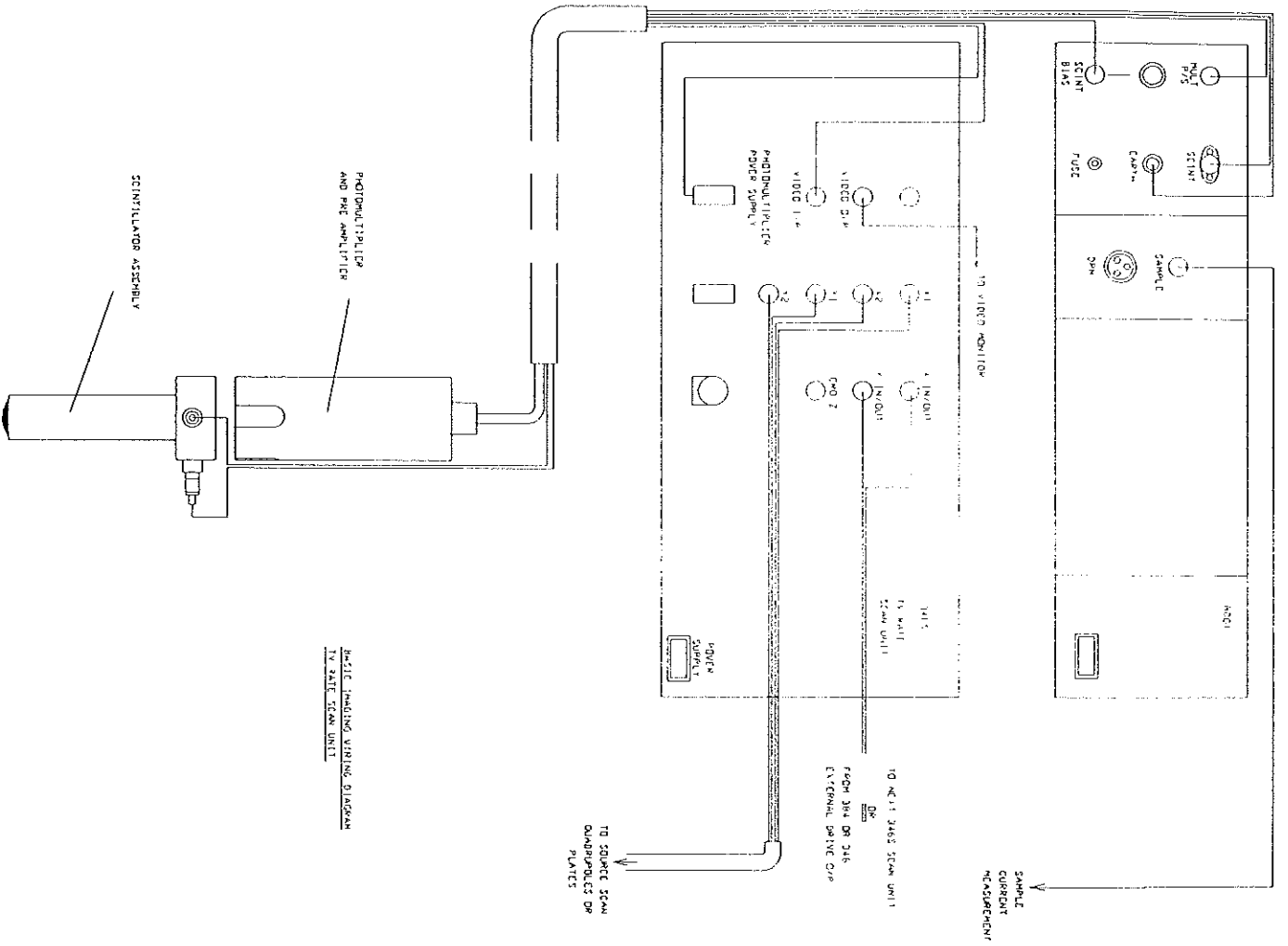
The photomultiplier tube is supplied already mounted inside the pre-amplifier assembly. This assembly should also be handled with care so as not to damage the photomultiplier tube.

The Pre-amplifier assembly should be pushed onto the scintillator and the two locking screws tightened to hold the assembly in place. The electrical connections are:-

High voltage (marked 'Scint Hi') connects to the feedthrough with the longer ceramic insulation.

Low voltage bias (marked 'Scint low') to the other feedthrough.

At the other end of the cable, the scintillator voltages are taken from the DPM unit but the pre-amplifier power supply and video signal processing are handled by the scan unit. The cable therefore divides to connect to both of these units. All connections are marked on the cable to show where they should go.



ANODE IMAGING VIEWING DIAGRAM
TV RATE SCAN UNIT