

INSTRUCTION MANUAL
FOR
MODEL TV-MSM "TV MINI-SEM^R"
SCANNING ELECTRON MICROSCOPE

IT IS IMPERATIVE THAT ALL OPERATORS OF THE TV-MINI-SEM READ
THIS MANUAL CAREFULLY BEFORE OPERATING THE EQUIPMENT.

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1. INTRODUCTION

The TV MINI-SEM is a desk top scanning electron microscope. Its fundamental performance is similar to that of the larger SEM's, however, compact design, operational ease and simplicity of installation place it in a category by itself. The TV MINI-SEM functions on the following principle: An electron beam emitted from the electron gun is accelerated by a voltage of 10,000 volts, focused by a three-stage electro-magnetic lens system and scanned over the specimen surface in synchronization with the TV raster; the secondary electrons emitted from the surface of the specimen are collected by the secondary electron detector (scintillator-photomultiplier) and converted to an electrical signal to obtain the video information displayed on the TV monitor.

This manual contains instructions on the installation, operation, service, and trouble shooting of the instrument. It is arranged so that an inexperienced operator can understand all aspects with ease. It is imperative that all operators of the TV MINI-SEM read this manual carefully before operating the instrument. This will help prevent operational errors and assure the operator in obtaining optimum results from the TV MINI-SEM. The experienced microscopist should also read the manual as it will enhance their ability to obtain optimum results on a routine bases.

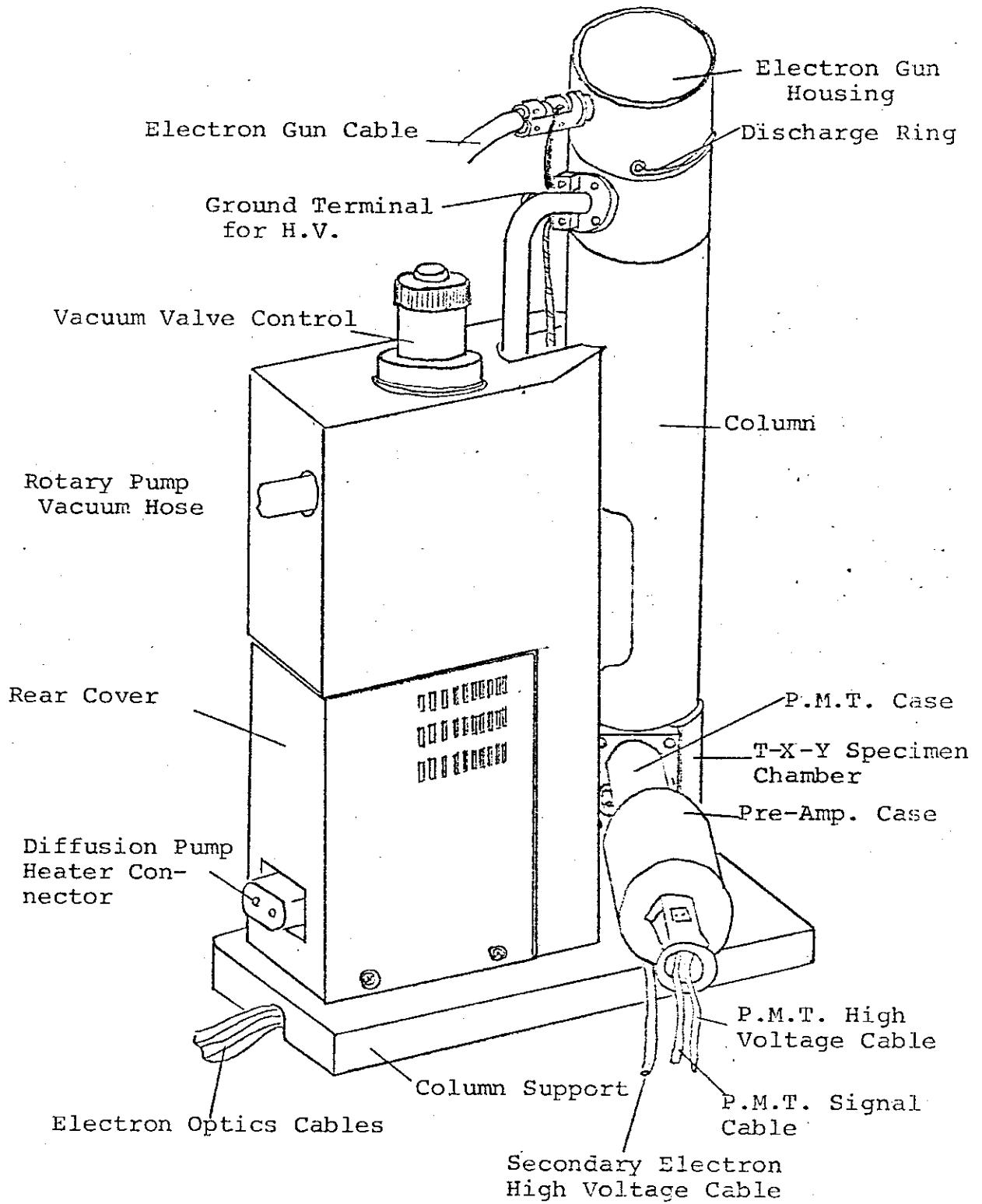


Fig. 4 REAR VIEW OF COLUMN

1-1 GENERAL VIEW OF INSTRUMENT

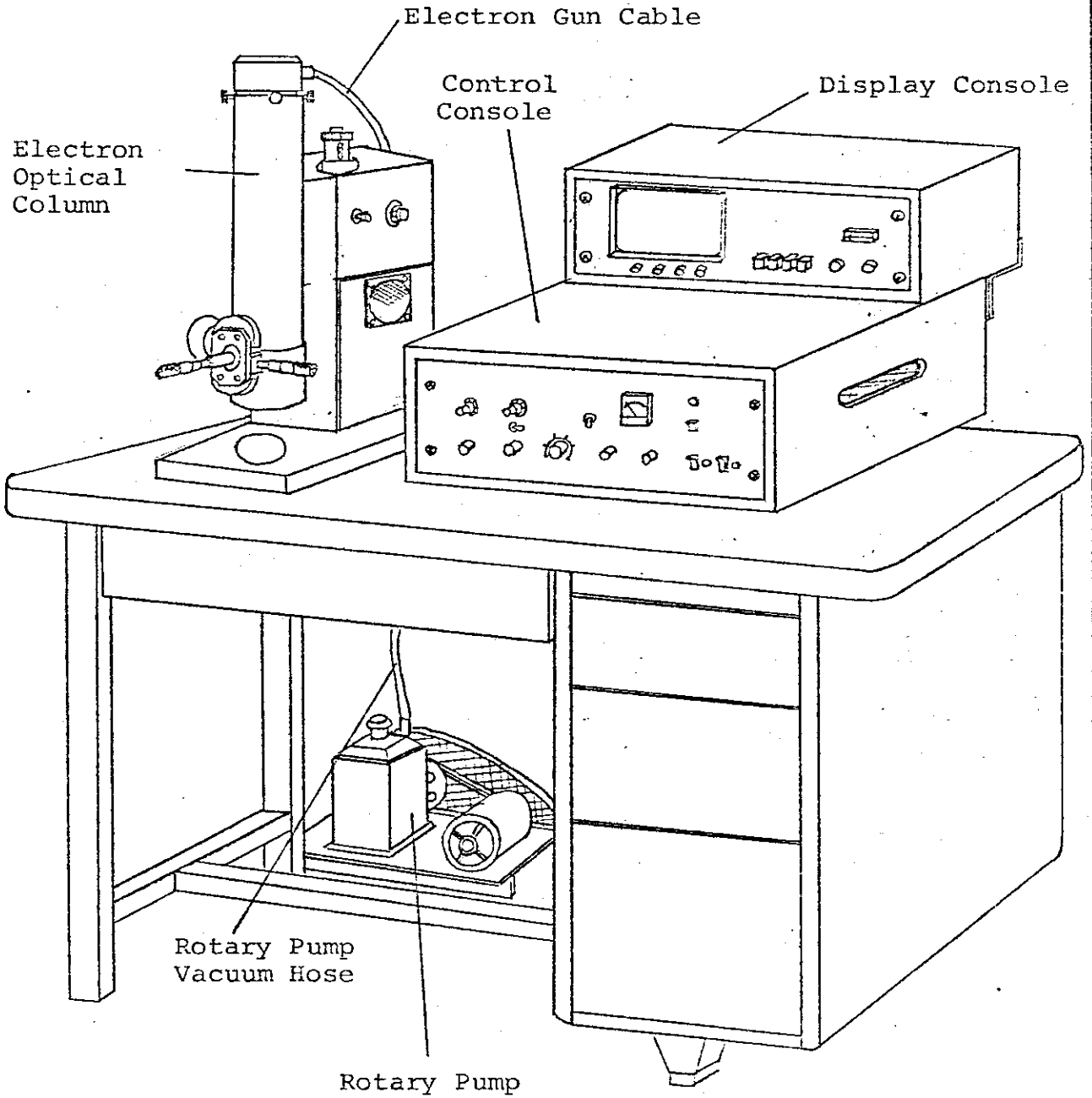


Fig. 1 GENERAL VIEW OF INSTRUMENT

1-2 ELECTRON OPTICAL COLUMN

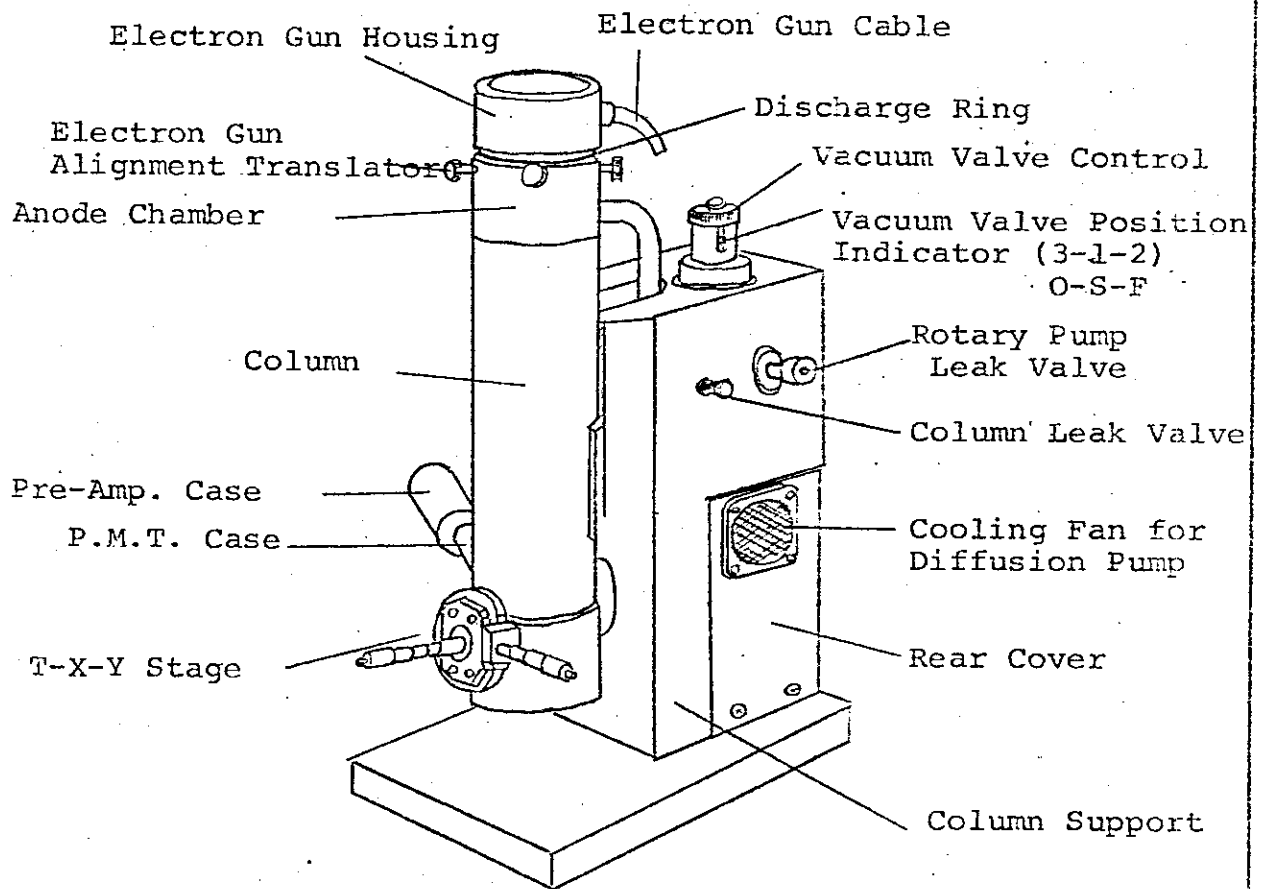
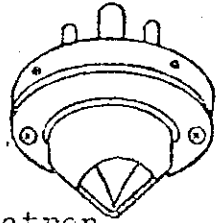


Fig. 3 FRONT VIEW OF COLUMN

STANDARD ACCESSORIES

1-3



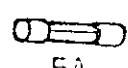
Electron Gun Cartridge



15A



10A

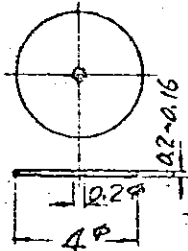


5A

Fuse



Screw Driver



Objective Aperture (200μ)



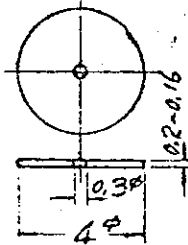
O-ring for D.P.



Vacuum Grease



Metal Polishing Paste



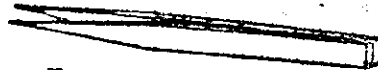
Objective Aperture (300μ)



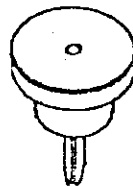
Objective Aperture Tool



Objective Aperture Holder Tool



Tweezers



Anode



Specimen Holder



Spring for R.P.



Sleeve 1

Sleeve Joint 1

Sleeve 2

Aperture 1 (600μ)

Sleeve joint 2

Sleeve 3

Aperture 2 (1 mm)

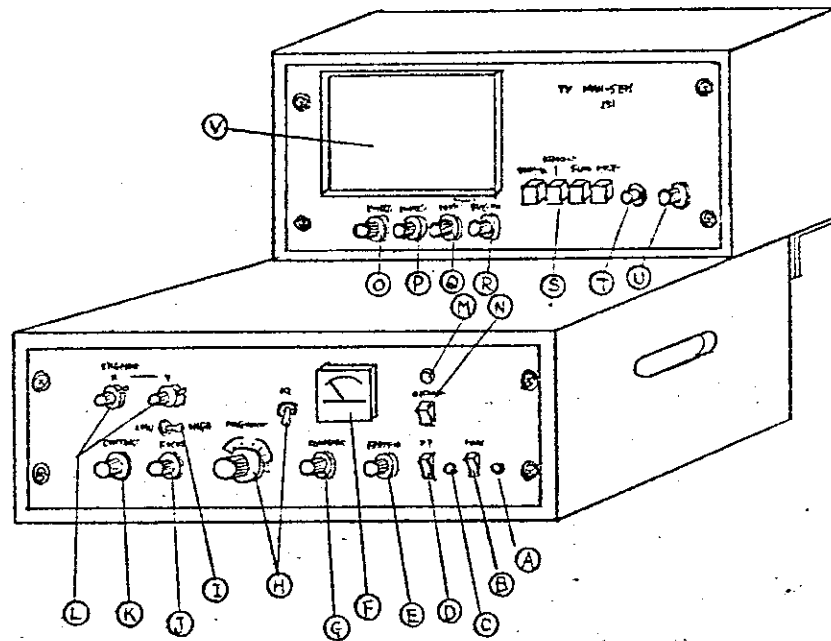
Sleeve joint 3

Sleeve 4

Objective Aperture Holder

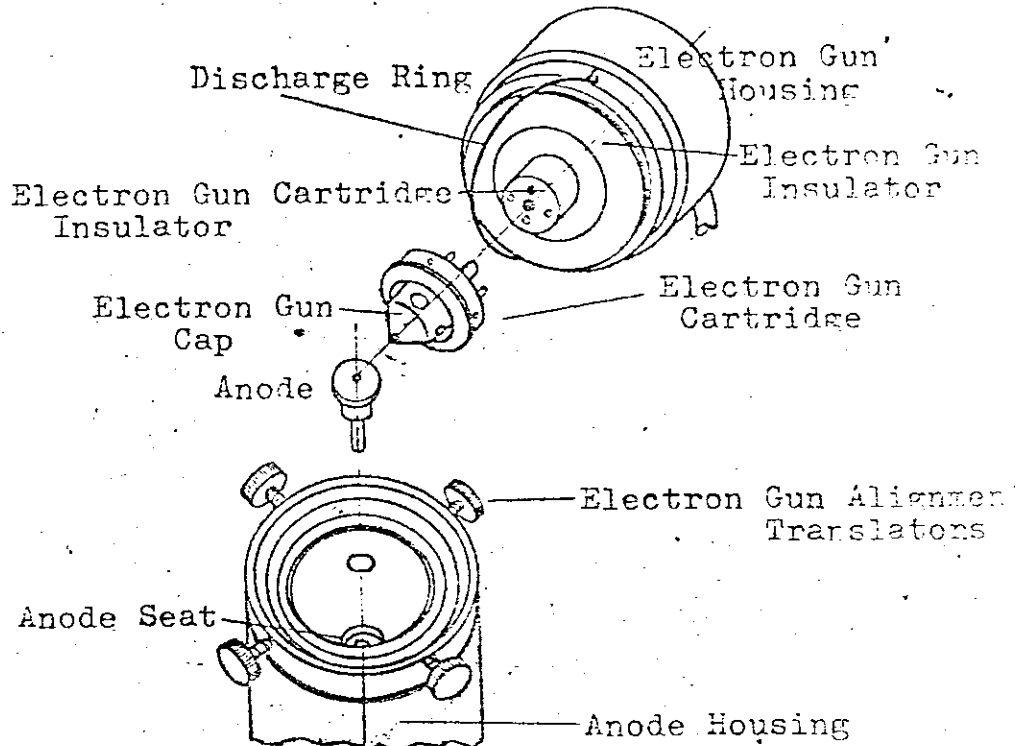
1-4

CONTROL CONSOLE & DISPLAY CONSOLE

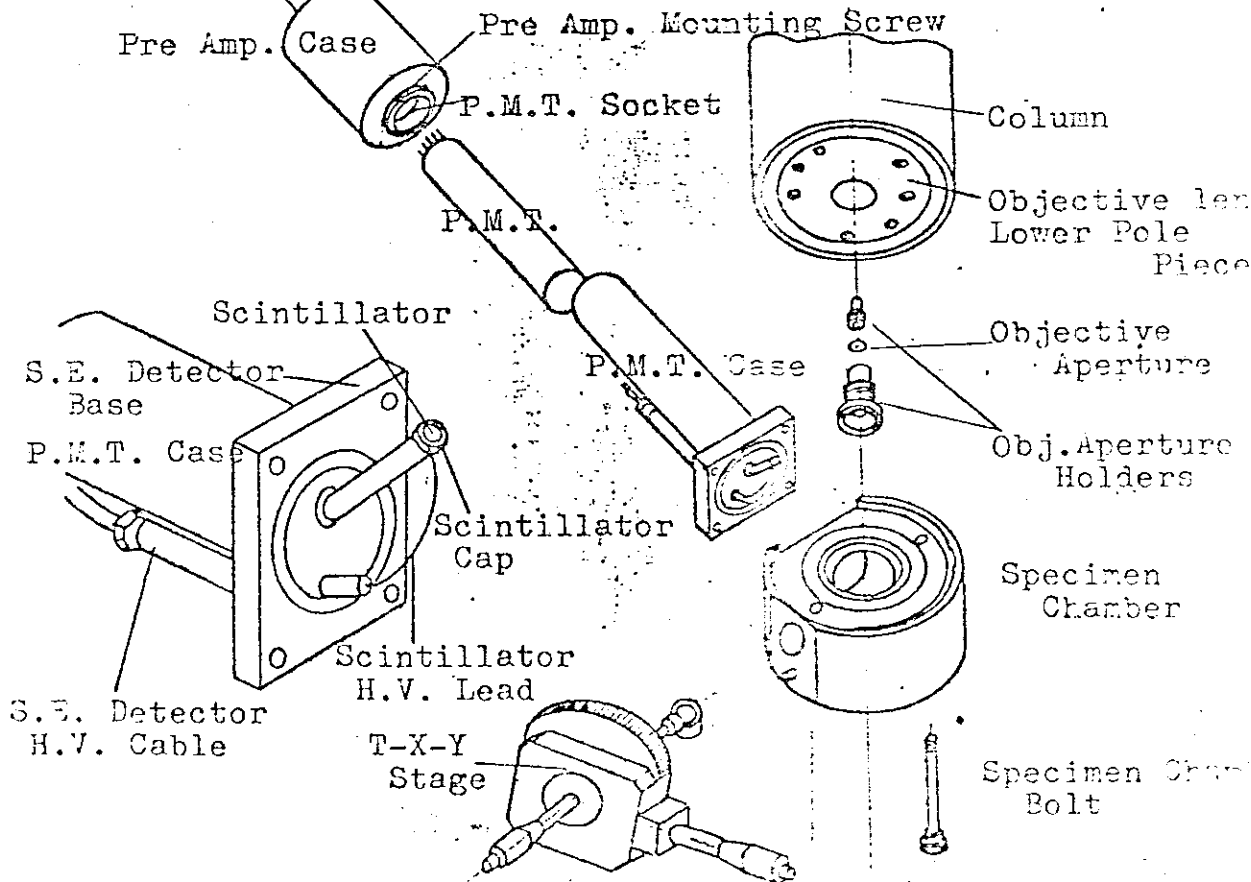


- | | | | |
|---|------------------------------|---|----------------------------|
| A | Main Lamp | B | Main Switch |
| C | D.P. Lamp | D | D.P. Switch |
| E | Emmission Control | F | Emission Meter |
| G | Condenser Lens Control | H | Magnification Selector |
| I | Focus Selector (High/Low) | | |
| J | Focus Control | K | Contrast Control |
| L | Stigmator | M | Operation Vacuum Indicator |
| N | Operation Switch | | |
| O | V. Synchro. Control (V-HOLD) | | |
| P | H. Synchro. Control (H-HOLD) | | |
| Q | Monitor Contrast Control | | |
| R | Monitor Brightness Control | | |
| S | Scan Mode Selector | | |
| T | Photo Start Button & Lamp | | |
| U | Brightness Control | | |
| V | Display Tube | | |

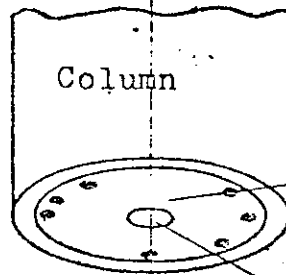
Fig. 8 FRONT VIEW OF CONTROL CONSOLE & DISPLAY CONSOLE



F 5 INNER VIEW OF ELECTRON GUN



F 6 INNER VIEW OF SPECIMEN CHAMBER



Objective Lens
Lower Pole Piece

Objective Lens
Lower Pole Piece Core

Sleeve 1

Sleeve Joint 1

Sleeve 2

Aperture 1 (600 μ)

Sleeve Joint 2

Sleeve 3

Aperture 2 (1 mm)

Sleeve Joint 3

Sleeve 4

Obj. Aperture Holder

Obj. Aperture

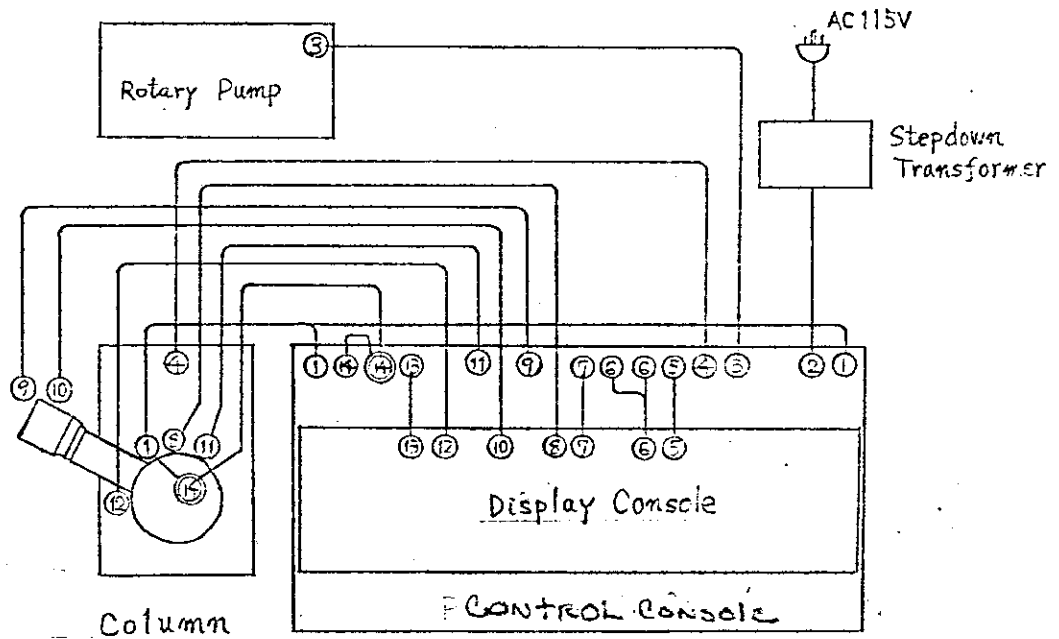
Obj. Aperture Holder

*small hole
UP*

shorter

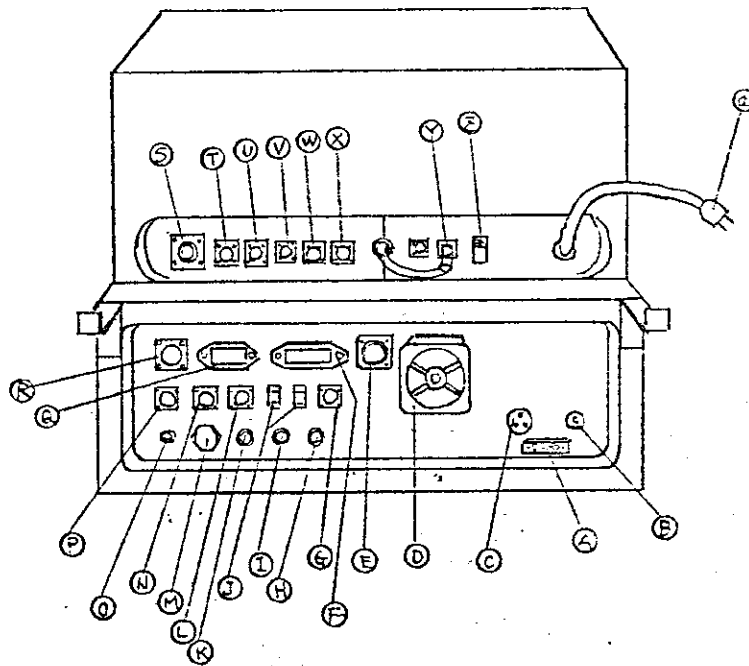
F 7 INNER VIEW OF COLUMN

TV MINI-SEM



- ① GND ——— (Column Earth)
- ② AC100V ——— (Stepdown Transformer) ——— AC115V
- ③ R.P. ——— (Rotary Pump)
- ④ D.P. ——— (D.P. Connector)
- ⑤ JM10 ——— JL1
- ⑥ SWEEP MONITOR > JL2
- ⑦ MONITOR ——— (AC100V for Display)
- ⑧ JL3 ——— (Scanning Coil)
- ⑨ PRE-AMP ——— (Pre-amp. Case)
- ⑩ JL6 ——— (Pre-amp. Out Put)
- ⑪ COLUMN ——— (Lens Power Supply)
- ⑫ JL5 ——— (Detector HV)
- ⑬ DETECTOR ——— JL4
- ⑭ GUN ——— (Electron Gun)

F2 CABLING & SERVICES DIAGRAM



- A Ground Terminal for H.V.
- B Scintillator & Display Tube H.V. Connector (DETECTOR)
- C Electron Gun Cable Connector (GUN)
- D Fan
- E Power Supply Connector for Display Console
- F Column Cable Connector (COLUMN)
- G Synchronized Signal Connector for Display Tube (MONITOR)
- H Operation Fuse (OPE. 5A)
- I D.P. Fuse (D.P. 5A)
- J AC 100V Plug Socket for Display Tube (MONITOR)
- K R.P. Fuse (R.P. 10A)
- L Diff. Pump Power Connector (D.P.)
- M Main Fuse (MAIN 15A)
- N Rotary Pump Power Connector (R.P.)
- O Ground Terminal (GND)
- P Main Power Connector (AC 100V)
- Q Pre. Amp. Cable Connector (PRE. AMP.)
- R Sweep Cable Connector (SWEEP)
- S Power Supply Cable Connector (JL1)
- T Sweep & Synchronized Signal Cable Connector (JL2)
- U Scanning Coil Cable Connector (JL3)
- V Signal Input Connector (JL6)
- W Scintillator & Display Tube H.V. Connector (JL4)
- X Scintillator H.V. Connector (JL5)
- Y Signal Input Connector (VIDEO IN)
- Z Input Impedance Selector (75Ω - HIGH)
- a Power Cable (AC 100V) for Display Tube

Fig. 9 REAR VIEW OF CONTROL CONSOLE & DISPLAY CONSOLE

2. INSTALLATION

Assembly and Cabling

2.1 The TV MINI-SEM consists of the following main units.

- A. Control Console
- B. Display Console
- C. Rotary Pump
- D. Electron Optical Column
- E. High Voltage and other Inter-connecting Cables, etc.
- F. Accessories

The column is delivered along with two major sub-assembly units. The electron gun cable and specimen stage assemblies are to be installed onto the column. The assembly of the column and cabling is explained in the following instructions. If the directions are followed, the TV MINI-SEM can be easily installed by anyone without SEM experience.

- 2.2 A desk or table top at least 3' wide x 2-1/2' deep is needed for the installation. Refer to F1 "General View of Instrument" and F2 "Cabling and Service Diagram" in placing and arranging the column, control console, display console and rotary pump.
- 2.3 Pull the leak valve (closest leak valve to column) on the column for a few seconds. This will admit air into the microscope column. A hissing sound will be heard and as soon as the sound has ended (1-2 seconds) the column has then been brought to atmosphere.
- 2.4 Loosen the four screws located at the upper part of the anode chamber. Remove the cover port from the upper part of the anode chamber. At the same time remove the vacuum seal (plug) from the specimen chamber.

2.5 Refer to F5 "Inner View of Electron Gun" and F2 "Cabling and Service Diagram". Place the anode in the anode slot. Then insert the electron gun cartridge into the electron gun cartridge socket. Place the entire electron gun assembly into the anode chamber and lightly tighten the four (4) alignment screws. Connect the ground wire of the gun housing (1) to the GND terminal of the column (14).

The electron gun cartridge may be inserted in any direction. Be sure that the discharge ring does not get caught between the anode chamber and electron gun housing during assembly.

2.6 Refer to F6 "Inner View of Specimen Chamber", and insert the specimen stage into the specimen chamber. Insert the P.M.T. (Photomultiplier tube) into the P.M.T. socket which is located in the preamplifier case. The P.M.T. case is then screwed on securely to the secondary electron detector base.

2.7 Carefully and slowly insert the P.M.T. and preamp assembly into the P.M.T. case. When the face of the P.M.T. comes in close contact with the light guide inside the P.M.T. case, tighten the pre-amplifier mounting screws.

2.8 Check and make sure that the following are in the OFF position:

1. Main Switch
2. Diffusion Pump Switch
3. Operation Switch

OFF position-lower half of button depressed. Refer to F8 "Front View of Display Console".

2.9 Refer to F2 "Cabling and Service Diagram". First of all, connect the ground lines, then connect all cables. All cables and connectors are numbered. Be sure to insert the proper cable into

proper connector by matching the number. After cabling is completed, re-check cabling to insure that the proper cable has been placed into the proper connector.

2.10 Connect the vacuum hose between Vacuum Port of the Rotary Pump and Evacuation Port of Valve.

You are now ready to turn the TV MINI-SEM "ON".

3. INITIAL START-UP PROCEDURE

- 3.1 Before placing the instrument in operating condition, check the items listed in the table below. Other controls and switches not mentioned in the table can be set in any position.

<u>Main Unit</u>	<u>Control</u>	<u>Position</u>
Column	Vacuum Control Knob	Place in Position 1
Control Console	Main Power Switch	Off (lower half depressed)
	D.P. Switch	Off
	Operation Switch	Off
	Emission Control	Turned fully Counter-clockwise
	Condenser Lens Control	Set at 12:00 o'clock
	X Stigmator Control	Set at 5.0 on Vernier Dial
	Y Stigmator Control	Same as above
	Contrast Control	Set at 12:00 o'clock
Display Console	Scan Mode	Search-TV
	Contrast Control	Turned fully clockwise
	Brightness Control	Mid-position
	V. Hold	Position so that no rolling of the raster occurs
	H. Hold	Position so no diagonal lines occur in raster

- 3.2 Plug the AC Power Cable into 115VAC line receptacle.
Check to see that output voltage of stepdown transformer is 100V before connecting permanently to instrument.
- 3.3 Turn on Main Power Switch. The instrument now has power to the rotary pump and evacuation of the column has begun.
- 3.4 Wait about 20 seconds (10 seconds or so after rotary pump evacuation

noise ceases). Slowly turn the vacuum valve control knob to the 2 position. In this position the rotary pump may again be evacuating air. The evacuation sound of the rotary pump should be gone in approximately 20 seconds.

3.5 Wait for approximately 40 seconds. Then turn the vacuum valve control knob to the number 3 position (rotation is counterclockwise).

3.6 Turn on the D.P. Switch. Wait for approximately 15 minutes for the oil diffusion pump to warm up. When the Vacuum indicator lamp comes on the instrument is ready for operation.

3.7 REMEMBER - The vacuum valve MUST be moved from one position to another in sequence 1-2-3, 1-2-3,1-2-3. Also, the column vent and foreline vent valves must not be used unless the main valve is in the number "1" position.

The same procedure should be followed when the filament is changed, column sleeve changed, or specimen changed.

4. SPECIMEN

- 4.1 Check and see that the operation switch is OFF. If not, turn off operation switch.
- 4.2 Rotate the Vacuum Valve Control knob to the 1 position. This is achieved by clockwise motion from the number 3 position.
- 4.3 Pull the Column Leak Valve (closest one to the column) for a few seconds. Air will be admitted into the column. In a matter of 1 or 2 seconds the column will be at atmosphere.
- 4.4 Set the specimen position controls to 7.5mm.
- 4.5 Refer to F6 "Inner View of Specimen Chamber". Extract the specimen stage from the specimen chamber.
- 4.6 Loosen the specimen holder locking screw and place a specimen holder (on which a specimen or specimens have already been mounted) into the specimen stage. Each specimen should be attached to the specimen holder by methods best suited to the individual specimen. Non-conductive specimens must be coated to prevent charging.
- 4.7 The height of the sample should be adjusted to be at the same height as the top of the specimen stage (cup). Magnifications at this setting correspond to the magnification dial (1 to 1).
- 4.8 The specimen holder with specimen attached are adjusted as explained in 4.7 and locked in place by the locking screws.
- 4.9 Insert the specimen stage into the specimen chamber.
- 4.10 Turn the Vacuum Valve Control knob clockwise to Valve Position number 2. Wait for approximately 40 seconds (10 - 20 seconds after rotary pump becomes quiet). Then turn the Vacuum Valve Control knob counterclockwise to Valve Position 3. Wait for 1 or 2 minutes after the green vacuum indicator lamp comes on. The instrument is now ready for operation.

5. OPERATION

- 5.1 Be sure that all steps in Section 3 and 4 have been completed.
- 5.2 Set the Magnification Selector to 20X - 100X.
- 5.3 Turn the Operation Switch ON. The operation lamp will come on. Emission Meter will indicate approximately 33.3 μ A.
- 5.4 After a few seconds warm up, adjust the brightness control of the TV Monitor to a comfortable level with the Scan mode selector switch in the search-TV position.
- 5.5 Carefully turn the Emission Control clockwise. The emission meter will begin to deflect to the right from 33.3 μ A. Stop turning the emission control at a position where any further movement of the emission control does not give a higher emission meter reading (you have reached saturation of the filament). NOTES: (1) Be careful to make sure that the emission control is not turned way beyond saturation. Lifetime of the filament can be greatly shortened or the filament can be burned out. (2) If the emission meter does not deflect from 33.3 μ A when the emission control is turned clockwise, this means that the filament is burned out. Replace the electron gun cartridge.

Normal operating conditions will give a meter reading somewhere between 100-200 μ A with a new electron gun cartridge. As the electron gun cartridge ages lower meter readings are to be normally expected.
- 5.6 Adjust the 4 alignment screws located on the upper part of the anode chamber. These are the electron gun alignment screws. While observing

the CRT, loosen one screw and tighten the opposite screw. Repeat procedure with the two screws located at 90° from the other set of screws. Adjust in this manner carefully until maximum brightness signal is obtained on the CRT of the TV Monitor. Maximum brightness should be achieved in both directions by each set of alignment screws (2 each).

- 5.7 During the gun alignment procedure, if the CRT becomes too bright, the condenser lens control can be turned clockwise and/or the contrast control on the display console and brightness control of TV can be turned counterclockwise.

Section 5.6 should be repeated so that maximum brightness is achieved on the TV Monitor with each set (2 screws) of alignment screws.

- 5.8 Turn the emission control a little in the clockwise direction and check to see if the brightness on the TV monitor changes. If it does not change, decrease emission till image fades then increase till image just appears. If it changes, repeat steps 5.6 and 5.7.

- 5.9 Turn the Focus control in both directions until an image appears on the TV Monitor. If focus can not be achieved switch High-Low switch to the opposite position.

- 5.10 Turn OFF the Operation Switch.

- 5.11 If correct alignment has been achieved in the above steps, an image can be obtained again by simply turning ON the Operation switch and increasing emission current. However, it may be necessary in some cases to repeat step 5.6 and 5.7 above before obtaining an image with good quality.

CAUTION: If other control knobs are moved after the operation switch is turned OFF, it may be necessary to repeat the alignment procedure in order to obtain an image.

6. ASTIGMATISM CORRECTION

- 6.1 Check that steps 5.1 through 5.9 have been successfully completed
- 6.2 Set the magnification switch at the desired magnification position.
It is recommended that a magnification of 20X to 50X be used for locating the specimen on the specimen stub.
- 6.3 An image of any area of the specimen surface can be displayed on the TV Monitor by adjusting the X-control and Y-control of the specimen stage. The specimen can also be tilted by manipulating the tilting control to turn the entire assembly of the T-X-Y Stage. The tilting angle is indicated by the pointer on the specimen stage.
- 6.4 After the desired specimen area is located for observation and desired tilting angle is selected, focus by using the Focus Control. Exact focus is when the image on the TV Monitor is sharpest. It is easier to achieve exact focus if focusing is done at one or two magnification steps higher than the desired magnification required for viewing.
- 6.5 If the image is not sharp upon focusing or if the image shifts in one direction and then in another direction (almost perpendicular to the former) when focusing, it is necessary to compensate with the astigmatism controls.

To compensate for astigmatism, depress the reduced area button of the Scan Mode selector switch, adjust focus until the image on the TV Monitor is between the over focus and under focus shift, then adjust X and Y stigmator controls and Focus until the sharpest image is achieved. Repeat this step until you achieve the sharpest image when focusing. Astigmatism can also be corrected in the search-TV position if desired.
- 6.6 Repeat step 6.5 at a magnification one or two steps higher than the desired magnification required for your investigation.

6.7 If a sharp image cannot be obtained and either the X and/or Y stigmator control is turned to the) or 10 position, it is necessary to either change or clean the objective aperture and/or the column sleeve. See section 9 and 10.

Also check to see that opening of the electron gun grid cup is not excessively contaminated. If highly contaminated replace as instructed in section 8.

Be sure to check that the filament emission is properly set and the filament is saturated. See section 5.

It may be possible that an electronic instability is causing the inability to obtain a sharp image. Refer to the Service and Trouble Shooting Section of the Manual.

6.8 If the focusing steps described in 6.4, 6.5 and 6.6 are performed before the specimen is positioned and specimen tilted step 6.3, it may be necessary to repeat step 6.4 before good observation of the image is achieved. Specimens which are easily charged or magnetized by the electron beam may require repeating steps 6.5 and 6.6 before observing a good image on the TV Monitor when the specimen is moved.

6.9 To enhance the image contrast, turn the Contrast Control of the display console clockwise. Turning the brightness control of TV counterclockwise (lowering brightness) may also produce similar results if a bright image is being displayed on the TV Monitor. If the Contrast Control is turned much beyond the 12:00 position the image may become excessively noisy. Image contrast can be reduced by turning the contrast control counterclockwise.

6.10 To obtain more brightness turn the brightness control of the TV clockwise. To reduce brightness turn the brightness control counterclockwise.

6.11 If in turning the Contrast Control, as described in 6.9, a noisy image is obtained, enlarge the spot size to increase beam intensity by turning the Condenser Lens Control knob counter clockwise. Focusing as described in 6.4 should be repeated. If more brightness is necessary, change the objective aperture from 200 μ to 300 μ aperture.

This procedure is described in Section 9.

6.12 If contrast is too high, turn the Condenser Lens Control clockwise until desired contrast level is achieved. Repeat focusing step as described in 6.4.

When the Condenser Lens Control is turned fully clockwise, the electron beam is highly demagnified and the smallest spot size is achieved.

7. PHOTOGRAPHY

- 7.1 Before attempting to photograph the image, the operator should make sure that proper focus, astigmatism correction, selection of desired magnification, and the desired area is being displayed on the CRT.
- 7.2 The Polaroid Camera should be properly adjusted and loaded with film as described in the Polaroid Manual supplied. Polaroid film 4 x 5 type 52 or PN-55 are normally used. An F stop of F8 or F5.6 is normally used. The shutter is always open.
- 7.3 Select the desired area on the sample for photography in the Search-TV Mode.
- 7.4 Depress the slow button (approximately 7 seconds) of the Scan Mode selector switch for more detailed viewing of the selected area on the sample.
- 7.5 To select the proper contrast and brightness for photography leave the Scan Mode selector in the slow position. Turn contrast on control console fully counterclockwise. Adjust the brightness control on the display console until the blue raster line is at a comfortable level and note the reading on the photometer. Next rotate the contrast control on the control console clockwise until the intensity of the image on the CRT is at a comfortable level and again note the reading on the photometer.
- 7.6 Depress the Photo button of the Scan Mode selector switch. Position the camera in front of the CRT. Pull out the film cover as per instructions in the Polaroid Manual and press the Photo start button. A time delay is built in to leave the image on the CRT Decay before

recording begins. The light in the Photo start button will light indicating that the exposure is in process. Approximately 16 to 20 seconds later the photo light will go out indicating that the exposure is completed. Slide film cover in and turn Polaroid film-back handle to P and remove film. Refer to Polaroid Manual for detailed instructions.

- 7.7 Process film as per Polaroid instructions.
- 7.8 To determine exact conditions several micrographs may have to be exposed at various photometer settings to determine the desired exposure. When the desired contrast and brightness is achieved reproducing the photometer settings will produce good quality micrographs easily by an unskilled operator.

8. SHUTDOWN PROCEDURE

- 8.1 Turn emission control fully counterclockwise and turn off the Operation Switch by depressing the lower half of the operation button. The lamp will go out.
 - 8.2 Check to make sure that the Vacuum Valve Control knob is in the "0" (operation position), or "3" position.
Turn off the D.P. Switch. The lamp will go out.
Wait for 10 to 15 minutes or until the D.P. is cool.
 - 8.3 Turn the Vacuum Valve Control knob clockwise to the "S" position or "1" position.
 - 8.4 Turn off the Main Power Switch. The lamp will go out. All power is off, including rotary pump operation. Immediately push the Rotary Pump Leak Valve for a few seconds. Air is admitted into the pump. When hissing stops (3 - 5 seconds) release the valve.
- NOTE: REMEMBER - The vacuum valve must be moved from one position to another in sequence 1-2-3, 1-2-3, 1-2-3. Also, the column vent and foreline vent valves must not be used unless the main valve is in the number "1" position.

9. REPLACEMENT OF ELECTRON GUN CARTRIDGE AND ANODE

- 9.1 Check that the operation switch is turned off. The lower half of button is depressed and the lamp is not lit.
- 9.2 Turn the vacuum valve control knob to the "S" or "1" position.
- 9.3 Admit air into the column by pulling the column leak valve out until hissing stops (1-2 seconds).
- 9.4 Loosen the electron gun alignment translators. Lift out the electron gun. Make sure that the discharge ring makes immediate contact with the electron gun cartridge.
- 9.5 Remove the electron gun cartridge from its socket.
NOTE: When the electron gun cartridge is removed after being in operation it is extremely hot. To avoid being burned remove with cloth or heat resistant material.
- 9.6 Insert a new electron gun cartridge securely into the connector. The cartridge can be installed in any direction.
- 9.7 Lift the discharge ring up so that it does not get caught in between the electron gun housing and anode chamber. Insert the gun housing into the chamber and tighten the electron gun alignment translators.
- 9.8 Turn the Vacuum Valve Control knob to the "F" or "2" position. Wait for the mechanical pump to become quiet, approximately 20-30 seconds. Turn the Vacuum Valve Control knob to the "0" or "3" position. Wait 30 seconds to 1 minute after the green light (vacuum indicator) comes on. The operation switch can now be turned on.
- 9.9 To replace the anode, the above steps are to be followed, except for steps 8.5 and 8.6 which are replaced by the following instructions. With a set of tweezers remove the anode from its position and replace with clean new anode.

10. REPLACEMENT OF OBJECTIVE APERTURE, COLUMN SLEEVE AND SLITS

- 10.1 Check that the Operation Switch is turned OFF.
- 10.2 Turn the Vacuum Valve Control knob to the "S" or "1" position.
- 10.3 Pull the Column Leak Valve until hissing stops (1-2 seconds). Air is admitted into the column.
- 10.4 Remove the specimen chamber bolts. By slightly lowering the specimen chamber, remove it from the microscope column. The specimen chamber vacuum manifold is connected to the specimen chamber vacuum manifold joint. DO NOT apply excessive force to the cables attached to the electron detector. Disconnect the specimen chamber vacuum manifold by pulling the specimen chamber gently and slowly towards you. (See Figure 6).
- 10.5 Insert the objective aperture tool into the slot in the aperture holder and turn counterclockwise to loosen. The assembly consisting of the objective aperture holder, objective aperture and objective aperture stop can then be removed from the column. If the column sleeve does not drop out when objective aperture holder is removed, remove anode as described in Section 8, and insert small stick through anode hole in the gun chamber and push column sleeve out gently. The column sleeve can then be easily removed.
- 10.6 Replace column liner and objective aperture assembly in reverse order.
- 10.7 After connecting the specimen chamber vacuum manifold to the telescoping vacuum manifold joint, carefully raise the specimen chamber up to the microscope column and tighten the two specimen chamber bolts.

10.8 Turn the Vacuum Valve Control knob to the "F" or "2" position. After the rotary pump becomes quiet (20 - 30 seconds) turn the Vacuum Valve Control knob to the "0" or "3" position. Wait 30 seconds to 1 minute after the green light (vacuum indicator) comes on. The operation switch is ready to be turned on.

NOTE: REMEMBER - The vacuum valve must be moved from one position to another in sequence 1-2-3, 1-2-3, 1-2-3. Also, the column vent and foreline vent valves must not be used unless the main valve is in the number "1" position.

11. DETAILED CLEANING PROCEDURE FOR COLUMN

One of the most important requirements to obtain the best results from any electron optical column is cleanliness. Therefore, the TV MINI-SEM is no different in this respect. The following procedure is recommended for thorough and effective cleaning of the column parts.

- 11.1 Remove column liner as described in section 9. Disassemble the column liner, electron gun cartridge, and objective aperture holder. Save the objective aperture for cleaning using a different procedure.
- 11.2 Clean all parts with a metal polish such as Weno1. This polish is available from all microscope accessory suppliers. Use a cotton swab saturated with metal polish to clean the inside diameter of the sleeves, sleeve joints, etc. The smaller diameters can be cleaned by wrapping a little tissue such as kimwipes around a wooden stick. To clean the outer surfaces saturate tissue or cloth and polish till all contamination is removed. Clean the bores of the splash apertures with polish and a wooden stick shaved down to a small diameter. In the case of the electron gun cartridge and anode where the contamination may be quite heavy a cleaning agent such as Comet, Ajax, etc. can be used with water.
- 11.3 Remove all traces of the cleaning agent and place parts in a beaker of acetone or equivalent solvent in an ultrasonic cleaner for several minutes. As the ultrasonic cleaning action removes the remaining cleaning agent the solvent will discolor. Keep exchanging the solvent until it remains clean then follow up with a final rinse in alcohol and dry the parts thoroughly.

- 11.4 Prior to assembling the parts inspect with a 5X to 10X magnifying lens. A speck of dust or lint in a critical area could defeat the entire cleaning procedure.
- 11.5 Depending on what they are made of, there are several procedures for cleaning apertures. A platinum aperture can be cleaned very effectively by holding in a carbon free flame such as an alcohol burner or propane torch with a pair of platinum tipped tweezers. The aperture should be heated until it is cherry red to orange color for 30-60 seconds. To clean molybdenum apertures place in tungsten boat in a vacuum evaporator. Again heat until cherry red to orange for a minute or two or until color of entire aperture is uniform. Turn off heat and let cool before letting air into the system. If air is let into the evaporator before the apertures cool down the apertures will oxidize.

When the column parts are cleaned successfully the stigmator controls should be near the center of the controls when the astigmatism is corrected.

Many times when the quality of the image deteriorates one has a tendency to over react and go through the entire cleaning process. Quite often this may not be necessary. If severe astigmatism is encountered and cannot be corrected with the controls generally the problem is dust or lint on the objective aperture or in the objective aperture holder. When the stigmator controls gradually shift towards one end, usually this is an indication of contamination build up. In either case cleaning or replacing the objective aperture and/or cleaning the objective aperture holder may be all that is required. However, when the astigmatism is corrected and the controls are near the center but the quality of the image is poor usually the column liner is the cause and required cleaning.

12. PROCEDURE FOR CHANGING SCINTILLATOR

Periodically the scintillator has to be changed to maintain optimum performance of the TV MINI-SEM. If bright spots or horizontal lines are observed on the CRT this is an indication that the aluminum coating on the scintillator is deteriorating. When the condenser control has to be positioned past 9 o'clock (in counter-clockwise direction) to maintain a sufficient noise free signal is an indication that the efficiency of the scintillator plastic is deteriorating. Also, it must be kept in mind that rotating the condenser control counterclockwise increases the electron beam spot size which will result in a decrease in resolution. When any of the mentioned symptoms occur the scintillator must be changed to regain optimum performance.

The following is the recommended procedure for changing the scintillator.

- 12.1 Vent column as when changing a sample.
- 12.2 Remove sample chamber as described in 9.4.
- 12.3 Loosen both small screws that secure preamp to photomultiplier tube cover and gently remove preamp/photomultiplier and set aside.
- 12.4 Unscrew photomultiplier tube cover.
- 12.5 Remove secondary detector from specimen chamber. Hold the detector in position till the last screw is removed to avoid bumping the light pipe against the chamber wall.
- 12.6 Carefully slide the scintillator retaining ring off the light pipe.
- 12.7 Remove the scintillator from the retaining ring.
- 12.8 Carefully pick up new scintillator by the edge with fine tweezers and place in retaining ring with aluminum facing out (away from light pipe.)

- 12.9 Slide retaining ring with new scintillator on to light pipe.
Extreme caution must be taken when handling the scintillator.
Finger prints, scratches, and etc. will damage the scintillator.
Also, the scintillator can not be cleaned. Wiping the scintillator
with a cotton swab, tissue, and etc. will damage the aluminum coating.
- 12.10 Apply a small drop of silver conductive paint at the edge of the
scintillator so it makes contact with the retaining ring. The
silver paint must not be too viscous to prevent flowing between the
scintillator and the light pipe.
- 12.11 Install the secondary electron detector, preamp, and etc. in reverse
order.

To check the scintillator high voltage contact, turn on the instrument
and leave the emission control in the counterclockwise position. Adjust
brightness to a comfortable level and turn contrast control clockwise. If
proper high voltage contact has been made to the scintillator no noise
(bright spots on CRT) should appear on the CRT till the contrast control
is in the 3-4 o'clock position. Should noise appear before this position
is reached with the contrast control indicates a problem in the high voltage
contact to the scintillator.

TROUBLE SHOOTING SECTION
FOR
TV MINI-SEM
SCANNING ELECTRON MICROSCOPE

INTRODUCTION

The service section of the TV MINI-SEM manual is divided into two sections. The first section is a general trouble shooting guide and the second is a more detailed section with emphasis on the TV MINI-SEM electronics.

During normal operation of the TV MINI-SEM, routine operation problems can occur such as dirty apertures, burned out filaments, etc. When some abnormal symptom occurs that deviates from the normal operation of the instrument it is suggested that the operator check the list of possible problems as outlined in the General Trouble Shooting Guide. If a definite failure of the TV MINI-SEM should occur, it is still wise to go through the General Trouble Shooting Guide first, then proceed to the detailed section of the manual.

By referring to TABLE I & detailed trouble shooting guide, one can, in most cases, determine the appropriate section to begin trouble shooting. However, one should keep in mind that there is some interaction between the various sections. The detailed Trouble Shooting Guide indicates this when applicable.

Also provided is a master diagram of TV MINI-SEM circuitry. This used in conjunction with the information provided in the Trouble Shooting Guide should provide enough information to solve any problem that should arise with the use of a volt-ohm-meter and/or oscilloscope. In most cases, with the exception of the main power supplies and magnification circuit, the circuits are of the plug in type and repairs can be made if necessary, by exchanging the circuit boards. All of the items that may be needed for repair are readily available from International Scientific Instruments, Inc.

TABLE I

<u>Circuit No.</u>	<u>Plug In</u>	<u>Chassis Mounted</u>	<u>Description</u>
N76MA02P	X		Oscillator, H-Sweep H.V. Stabilizer, Electron Gun H.V. drive, Filament DC Supply, Filament Drive.
N76MB02P	X		Photomultiplier H.V.
N76MC02P	X		Lens power source, Stigmator power source.
N76MD02P	X		$\pm 14V$, +65V. V-Sweep.
N76ME01P		X ⁺	Scintillator H.V. Drive.
N76M02P		X	Magnification.
N76BA01P		X ⁺	Preamplifier.
N76H01		X ⁺	High Voltage.
N76LG01P	X		Slow H-Sweep, Image Amp.
N76LH01		X ⁺	Monitor CRT, TV Sweep, Video Amp.

Note: X⁺ - easily exchangeable.

GENERAL TROUBLE SHOOTING GUIDE

<u>Problem</u>	<u>Possible Cause</u>
G-1 No response when power switch is turned on.	Fuse F1 MAIN (15A) on back of Power Supply Console.
G-2 Vacuum pump does not operate when main switch is turned on.	Fuse F2 RP(10A) on back of Power Supply Console.
G-3 Vacuum pump does not quiet down after about 30 sec. of rough pumping.	Loose Vacuum seals or dirty O-rings in specimen chamber and gun area.
G-4 No response when diffusion pump switch is turned on.	Fuse F3 DP(5A) on back of Power Supply console. Adjustments of thermostat on diffusion pump.
G-5 Vacuum indicator light does not light after about 15 minutes of pumping with diffusion pump on.	Burned out indicator lamp. Small vacuum Leak most probably in gun or specimen chamber area.
G-6 No response when operation switch is turned on.	Poor vacuum, green lamp must be lit indicating that vacuum is better than 10^{-3} Torr before operation can be obtained. Fuse F4 OPE(5A) on back of Power Supply Console.
G-7 No emission current(from 33.3 μ A). when control is at approximately the 3 o'clock position.	Burned out filament, replace electron gun cartridge.
G-8 Abnormally high emission current (Over 300 μ A)	Filament shorted to grid cup on badly contaminated electron gun cartridge. Poor vacuum in gun area.

<u>Problem</u>	<u>Possible Cause</u>
G-9 Unstable emission current	Arcing in electron gun caused by badly contaminated electron gun cartridge or filament touching grid cup - replace cartridge.
G-10 Brightness of image decreases when emission is rotated clockwise beyond the point where saturation is observed on emission current meter.	Electron gun misaligned - align gun as described in Instruction Manual Section 5.
G-11 Maximum brightness of image can not be obtained.	Electron gun not aligned and/or filament not saturated.
G-12 Image brightness and/or focus changing.	Emission current fluctuating. See G-9
G-13 Image can not be focused.	Sample mounted either too high or too low in specimen stage. Obstruction in column. Excessive astigmatism - See G-14.
G-14 Cannot compensate for astigmatism.	Contaminated aperture and/or column sleeve and slit.
G-15 Image vibration	Sample loose in specimen stage.
G-16 Very bright areas on image and/or streaking or smearing of image.	Sample charging because of non-conductive area such as improper coating of sample or contamination on sample.
G-17 Poor image quality because of the following: a. poor contrast b. excessive noise or grain c. bright spots on CRT d. bright horizontal lines on CRT.	Scintillator.

PREFACE TO DETAILED TROUBLE SHOOTING GUIDE

Prior to proceeding with detailed trouble shooting the input line voltage should be checked. The correct voltage must be between 100 - 105 Volts. If the input voltage is less than 100 volts abnormal operation could occur. After the correct input line voltage is confirmed the power supply voltages must be checked before proceeding. If a problem is detected in one or more of the power supplies refer to the following out line for possible causes:

A. +15 volt supply (+14V acceptable) - CP8 on circuit board N76MD02P.

If incorrect check the following for possible causes.

A-1 IC8 (741) circuit board N76MD02P

A-2 TR11, 12 (2SC484) circuit board N76MD02P

A-3 Power transistor TR2 (2SD110) in power supply console N76LE02.

B. -15 volt supply (-15V acceptable) CP9 on circuit board N76MD02P.

If incorrect, check the following for possible causes.

B-1 IC9 (741) circuit board N76MD02P

B-2 TR15, 16 (2SA484) circuit board N76MD02P

B-3 Power transistor TR1 (2SA663) in power supply console N76LE02.

C. +65 volt supply CP7 in circuit board N76MD02P. If incorrect, check the following for possible causes.

C-1 IC7 (741) circuit board N76MD02P

C-2 TR9 (2SC484) Circuit board N76MD02P

C-3 TR6, 7 (2SC484) circuit board N76MD02P

C-4 Power transistor TR3 (2SD110) in power supply console N76LE02.

NOTE: When parts are replaced in the power supplies be sure the correct trim pots are used to adjust the voltages. Refer to the drawings at the end of the manual for the correct locations.

<u>I.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
1.	Instrument is not energized by depressing MAIN Switch	a. Power failure b. Fuse MAIN (15 A) blown c. Switch	a. Restore power to instrument b. Replace fuse MAIN (15 A) c. Replace switch
2.	Rotary pump does not operate	a. Fuse RP (10 A) blown b. Belt slips c. Leak valve knob not depressed in previous shutdown. Oil in foreline.	a. Replace fuse RP (10 A) b. Adjust belt 1/2" play is normal c. Remove foreline hose drain and clean
NOTE: TURN OFF MAIN SWITCH BEFORE CHECKING A THRU C.			
3.	Rotary Pump does not quiet down after 15-20 seconds of pumping in the number 2 position.	a. specimen stage not inserted correctly b. Specimen chamber mounting bolts loose. c. Electron gun housing positioned improperly on anode chamber. d. Defective o-ring in specimen chamber or gun area. e. Rotary pump defective	a. Reseat specimen stage correctly in specimen chamber. b. Tighten while evacuating. c. Seat correctly after loosening all gun alignment translators. d. Replace O-ring. e. Check springs in Rotary Pump.
4.	Vacuum valve knob does not turn easily.	a. Valve O-rings defective	a. Replace valve o-rings

<u>I.S. NO.</u>	<u>Symptom.</u>	<u>Possible Causes</u>	<u>Remedy</u>
5.	Diffusion pump cooling fan inoperative	<ul style="list-style-type: none"> a. Fan defective b. Other causes 	<ul style="list-style-type: none"> a. Replace fan b. Defective capacitor in fan circuit or broken wire.
6.	Diffusion pump does not heat	<ul style="list-style-type: none"> a. Fuse DP (5 A) blown b. Diffusion pump cooling fan inoperative c. Diffusion pump heater open (40Ω) 	<ul style="list-style-type: none"> a. Replace fuse DP (5 A) b. See T.S.5 above c. Replace diffusion pump heater.
7.	Vacuum pilot lamp does not light after valve is in #3 position	<ul style="list-style-type: none"> a. Lamp filament open b. Vacuum detector tube defective c. Vacuum leak d. Vacuum circuit defective N76MD02 	<ul style="list-style-type: none"> a. Replace Lamp b. Replace vacuum detector tube c. See T.S. 3 above d. IC6 (741) TR5 (2SC484) or Relay Y1
8.	Vacuum pilot lamp does not go out when leak valve is pulled to admit air into column,	<ul style="list-style-type: none"> a. Vacuum detector tube defective or broken. b. Leak valve clogged (air is not admitted into column) c. Vacuum circuit defective N76MD02 	<ul style="list-style-type: none"> a. Replace vacuum detector tube b. Check leak valve and clean if necessary. c. IC5 (741)
9.	Instrument is not energized by depressing OPERATION SWITCH.	<ul style="list-style-type: none"> a. Fuse OPE (5A) blown. b. Poor vacuum in column. c. Switch. 	<ul style="list-style-type: none"> a. Replace fuse OPE (5A). b. See T.X. 7 c. Replace operation switch.

<u>T.S. NO.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
10.	Horizontal scanning unstable on CRT in SEARCH-TV, REDUCED AREA mode.	<p>a. Oscillator circuit defective. Check Point (7*) CP-7 GROUND.</p>	<p>a. IC7 (709) or IC3 (709) defective on printed circuit board N75MA02P.</p> <p>NOTE: If horizontal scanning is not stabilized after replacement of IC7 (709), oscillator frequency may be slightly unstable. Stabilize horizontal sweep by turning potentiometer RV5 on N76MA02P.</p>
		<p>b. Delay circuit for horizontal synchronization defective Check point no. 6* CP6-GROUND.</p>	<p>b. IC6 (709) defective on printed board N76MA02P.</p>
		<p>c. Monitor defective (TV)</p>	<p>c-1. turn H-HOLD control, check to see if horizontal scan can be stabilized.</p> <p>c-2 In TV monitor N76LH01, TR105 (2SA564) on p.c. board SD-824 and/or IC202 (AN202) on P.C. Board SD-825 defective.</p>
11.	No horizontal scanning SLOW or PHOTO mode.	<p>a. Printed circuit board N76LG01P defective. Check point (34) CP2-GROUND, (38) CP6-GROUND</p>	<p>a-1 IC2 (741) and/or IC3 (709) defective</p> <p>a-2 IC9 (741) defective</p> <p>a-3 Replace P.C. Board N76LG01P</p>

* Check points are at the end of the detailed trouble shooting section.

<u>I.S. NO.</u>	<u>Symptom</u>	<u>Possible Causes</u>	<u>Remedy</u>
12.	Vertical scanning unstable on CRT	<ul style="list-style-type: none"> b. +10V defective in display console N76L03. a. Vertical sync circuit defective Check point (17)* CP2-GROUND b. TV Monitor defective 	<ul style="list-style-type: none"> b. Power transistors TR1, TR2 (2SC643A). a. IC1 (709), IC2 (741) or IC3 (709) defective on PC board N76MD02P b.1 Turn V-HOLD control check to see if vertical scan can be stabilized. b.2 In TV monitor N76LH01, IC202 (AN202) defective on printed circuit board SD-825.
13.	Scan line is not bright on CRT.	<ul style="list-style-type: none"> a. CRT high voltage defective. Check point (23*) CP7-GROUND (\approx+65V) (32*) JH5 Pin 5 - GROUND b. CRT grid voltage (+400V) too low. Check point JL8-1 - GROUND (\approx+400 V) in display console. 	<ul style="list-style-type: none"> a-1 IC7 (741) defective on printed circuit board N76MD02P. a-2 Power supply console N76LE02, power transistor TR16 (2SC643A) defective. a-3 High voltage unit N76H01 defective. b-1 When instrument is set in SEARCH-TV, REDUCED AREA mode, PC board SD-825 and/or SD-826 defective in TV Monitor. N76LH01. b-2 When instrument is set in SLOW, PHOTO mode, Zener diode ZD1, ZD2, (IN3709) defective in display console N76L03.

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
14.	Brightness is not adjustable by turning BRIGHTNESS control on display console.	<p>c. When instrument is set in SLOW, PHOTO mode, CRT blanking defective. Check point (36*) CP4-GROUND.</p> <p>d. When instrument is set in SLOW, PHOTO mode, image amplifier defective (no signal) Check point (40*) CP8-GROUND.</p> <p>e. CRT heater open</p>	<p>c-1 IC7 (709) defective on P.C. Board N76LG01P</p> <p>c-2 P.C. Board N76LG01P defective.</p> <p>d.1 P.C. Board N76BA01P IC1 (733) and/or TR1 (2SC510).</p> <p>d.2 IC10 (709) defective on P.C. Board N76LG01P.</p> <p>e. Replace CRT (C935P7).</p>
15.	Scanning line abnormally bright in SLOW, PHOTO mode.	<p>a. Image amplifier defective. Check point (40*) CP8-GROUND</p> <p>b. Pre-amplifier defective</p> <p>c. Photomultiplier tube defective.</p> <p>a. CRT grid voltag- (+400 V) too high Check point JL8 pin 1 - GROUND in display console N76L03.</p> <p>b. Image amplifier defective</p> <p>c. Pre-amplifier defective</p> <p>d. Photomultiplier tube defective</p> <p>e. Light leak around photomultiplier tube.</p>	<p>a. Refer to 13d.</p> <p>b. Refer to 13d.</p> <p>c. Replace photomultiplier tube (R268)</p> <p>a. Zener diode ZD1, ZD2 (IN3709) defective in display console.</p> <p>b. See T.S. No. 14 a.</p> <p>c. See T.S. No. 14 b.</p> <p>d. See T.S. No. 14 c.</p> <p>3. Check PM tube cover for light leaks.</p>

* Check points are at the end of the Detailed Trouble Shooting Section.

<u>T.S.No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
16.	Retrace line appears on CRT in SLOW, PHOTO mode.	a. P.C. board N76LG01P defective Check point (36*) CP4-GROUND	a.1 IC7 (709) defective, replace.
17.	EMISSION meter reading lower than 30 μ A (normal reading 30~35 μ A)	a. Oscillator circuit defective. Check point (7*) CP7-GROUND b. Negative feedback circuit (for H.V. stabilization) defective. Check Point (4*) CP4-GROUND. c. Power supply for negative feedback circuit (for H.V. stabilization) defective. Check point (23*) CP7-GROUND (\approx +65V) d. H.V. drive circuit. Check point (3*) CP3-GROUND. e. H.V. power supply defective Check point (31*) JH4-1 - GROUND	a. IC7 (709) or IC3 (709) defective on P.C. board N76MA02P. b. IC4 (741) defective on P.C. board N76MA02P. c. IC7 (741) defective P.C. board N76MD02P.
18.	EMISSION meter reading exceeds 35 μ A or reading unstable without turning EMISSION control	a. Oscillator circuit defective Check point (7*) CP7-GROUND b. Negative feedback circuit (for H.V. stabilization) defective Check point (4*) CP-4 - GROUND c. H.V. power supply defective Check c. point (31*) JH4 pin 1 - GROUND	d.1 IC3 (709) and/or TR4 (2SC510) circuit board N76MA02 d.2 TR12 (2SC643A) N76LE02 e. Replace H.V. unit N76H01. a. IC7 (709) or IC3 (709) defective on P.C. Board N76MA02P b. IC4 (741) defective on P.C. Board N76MA02P.

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
19.	No EMISSION meter reading beyond 35 μ A by turning EMISSION control clockwise (meter should normally indicate 100 μ A \sim 220 μ A)	<ul style="list-style-type: none"> d. Discharge due to contamination on electron gun cartridge e. Discharge due to contamination in anode chamber f. Poor vacuum in anode chamber g. Anode not seated properly in chamber 	<ul style="list-style-type: none"> d. Clean electron gun cartridge e. Clean anode chamber f. See T.S. 3. g. Seat anode correctly in chamber.
		<ul style="list-style-type: none"> a. Gun filament open b. Oscillator circuit defective c. Frequency converter circuit defective d. Voltage regulator e. Filament power supply rectifier circuit defective f. Poor contact between electron gun cable and electron gun cart-ridge. g. Electron gun cable open 	<ul style="list-style-type: none"> a. Replace electron gun cartridge. b. IC7 (709) or IC3 (709) defective on P.C. Board N76MA02P c. IC1 (709) defective on P.C. Board N76MA02P d. IC2 (741) defective on P.C. board N76MA02P e. Replace H.V. unit N76H01 f. Clean and tighten filament pin sockets in H.V. gun cable. g. Replace electron gun cable

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
20.	EMISSION METER reading exceeds 220 μ A by turning EMISSION control clockwise and filament current is not saturated at maximum clockwise position of the control.	<ul style="list-style-type: none"> a. Base of filament in electron gun cartridge badly contaminated b. Short between filament tip and electron gun grid cap. 	<ul style="list-style-type: none"> a. Replace electron gun cartridge b. Replace electron gun cartridge
21.	Unstable emission when filament is saturated.	<ul style="list-style-type: none"> a. Badly contaminated electron gun cartridge b. Defective bias resistor in electron gun high voltage supply c. Poor vacuum in anode chamber d. Electronic instability 	<ul style="list-style-type: none"> a. Replace electron gun cartridge b. Replace H.V. unit N76H01 c. See T.S. 3. d. See T.S. 18.
22.	Image on CRT can not be maximized by turning electron gun alignment translators	<ul style="list-style-type: none"> a. Electron gun cartridge tilted b. Filament tilted and/or misaligned in electron gun cartridge. 	<ul style="list-style-type: none"> a. Firmly press electron gun cartridge against electron gun insulator b. Align filament tip with center of electron gun cap bore. Or replace electron gun cartridge
23.	Insufficient contrast on CRT with contrast control turned fully clockwise	<ul style="list-style-type: none"> a. Photomultiplier H.V. control circuit defective (8*) CP3-GROUND b. Photomultiplier H.V. power supply defective 	<ul style="list-style-type: none"> a. IC1 (741) defective on P.C. board N76MB02P b. TR3 (2SC1004A) and/or D2 (1S1517A) on circuit board N76MB02P

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
		c. Photomultiplier oscillator Check point (7*) CP1-GROUND	c. TR1 (2SC643A) and/or TR2 (2SC510)
		d. Pre-amplifier circuit defective	d. Refer to T.S. No. 14
		e. Photomultiplier deteriorated	e. Refer to T.S. No. 14
		f. When instrument is set in SEARCH- TV, REDUCED AREA mode, amplifier defective in TV Monitor N76LH01	f. Replace P.C. Board SD-824
		g. When instrument is in SLOW, PHOTO mode, defect in P.C. board N76LG01P Check point (40*) CP8 - GROUND	g. IC10 (709) defective on P.C. board N76LG01P. Or replace P.C. board N76LG01P
24.	Image brightness and con- trast does not change on CRT by turning CONDENSER control	a. 1st condenser lens circuit defec- tive check point (13*) CP7 - GROUND	a. IC3 (741) TR13 (2SC484) or 2SD234 defective on P.C. Board N76MC02P
25.	Image abnormally bright on CRT when CONDENSER control is turned fully clockwise	a. 2nd condenser lens circuit defec- tive Check point (14*) CP9-GROUND	a. IC4 (741) TR15 (2SC484) or TR16 (2SC234) on P.C. Board N76MC02P
26.	Image abnormally weak on CRT when CONDENSER control is turned fully counter- clockwise	a. Scintillator H.V. drive circuit defective b. Scintillator H.V. power supply defective Check point (32*) JH5 pin 5 - GROUND	a. Replace P.C. board N76ME01P b. Replace H.V. unit N76H01

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
		<ul style="list-style-type: none"> c. Opening between scintillator connection and cable connector d. 2nd condenser lens circuit defective Check point (14*) CP9-GROUND 	<ul style="list-style-type: none"> c. Replace secondary electron detector assembly d. Refer to T.S. No. 25 a.
27.	Image can not be focused by turning FOCUS control thru entire range	<ul style="list-style-type: none"> a. Objective lens circuit defective Check point (15*) CP11 - GROUND b. Specimen height either to high or too low c. Electron gun high voltage too low d. Excessive astigmatism 	<ul style="list-style-type: none"> a. IC5 (741) TR17 (2SC484) or TR18 (2SD234) on P.C. board N76MC02P b. Adjust specimen surface to the same height as top of specimen holder. c. If EMISSION meter does not read 30 ~ 35μA when EMISSION control is fully CCW see T.S. 17 and 18 d. See T.S. 29
28.	Image focus unstable	<ul style="list-style-type: none"> a. Defective objective lens circuit Check point (15*) CP11 - GROUND b. Electron gun high voltage unstable Check point (4*) CP4 - GROUND c. Emission current too high or unstable d. Filament current not saturated 	<ul style="list-style-type: none"> a. Refer to T.S. No. 27 a. b. Refer to T.S. No. 21 c. See T.S. 20 and 21 d. Refer to section 5.5 of the instruction manual

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
29.	Excessive astigmatism. Astigmatism can not be corrected by using STIGMATOR X, Y, controls	<ul style="list-style-type: none"> a. Objective aperture (200μ) badly contaminated b. Specimen severely magnetized c. Stigmator circuit defective d. Sleeve, Sleeve joint, apertures, objective aperture holder contaminated 	<ul style="list-style-type: none"> a. Refer to section 11.5 of the instruction section of the manual b. Demagnetize sample c. See T.S. 30, 31 d. Clean or replace <p>Refer to section 11 of the instruction section of the manual.</p>
30.	STIGMATOR X control is ineffective	<ul style="list-style-type: none"> a. STIGMATOR X circuit defective Check point (9*) CP1-GROUND (10*) CP2 - GROUND 	<ul style="list-style-type: none"> a. IC1 (741) and/or any of the other transistors on P.C. Board N76MC02P
31.	STIGMATOR Y control is ineffective	<ul style="list-style-type: none"> a. STIGMATOR Y circuit defective Check point (11*) CP4 - GROUND (12*) CP5 - GROUND 	<ul style="list-style-type: none"> a. IC2 (741) and/or any of the other transistors on P.C. Board N76MC02P
32.	CONTRAST control is ineffective	<ul style="list-style-type: none"> a. Photomultiplier H.V. circuit defective Check point (8*) CP3-GROUND 	<ul style="list-style-type: none"> a. Refer to T.S. 23
33.	Both image brightness and focus unstable	<ul style="list-style-type: none"> a. 1st condenser lens circuit defective Check point (13*) CP7-GROUND b. 2nd condenser lens circuit defective Check point(14*) CP9-GROUND c. Objective lens circuit defective Check point (15*) CP11 - GROUND 	<ul style="list-style-type: none"> a. Refer to T.S. 24 b. Refer to T.S. 25 c. Refer to T.S. 27

* Check points are at the end of the Detailed Trouble Shooting Section

<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
34.	Horizontal elongation of image or abnormal horizontal magnification	IN SEARCH-TV, REDUCED AREA mode: a-1 Horizontal scanning circuit defective Check point (5*) CP5-GROUND a-2 Horizontal scanning drive circuit defective Check point (26*) (27*) (28*) (29*) DRIVE 1 - GROUND a-3 Magnification control	a-1 IC5 (741) defective on P.C. board N76MA02P or TR10 (2SD110) defective in power supply console N76LE02 a-2 IC7 (709) and/or TR9 (2SC510) or P.C. Board N76MA02P or TR9 (2SC643A) defective in power supply console N76LE02 a-3 Magnification switching circuit defective. Replace P.C. board N76M02P and MAGNIFICATION SWITCH
		In SLOW, PHOTO mode:	
		b-1 Horizontal probe sweep defective Check point (37*) CP5-GROUND	b-1 IC8 (741) or other transistors defective on P.C. Board N76LG01P. TR3 (2SD110) or TR4 (2SA663) in display console N76L03
35.	Vertical elongation of image or abnormal vertical magnification	a. Vertical scanning circuit defective Check point (18*) (19*) (20*) (21*) CP3 - GROUND	a. IC4 (741) TR3 (2SC484) and/or TR4 (2SA484) defective on P.C. Board N76MD02P
36.	Extreme light and dark areas in image	a. Sample charging	a. Gold coat sample

* Check points are at the end of the Detailed Trouble Shooting Section

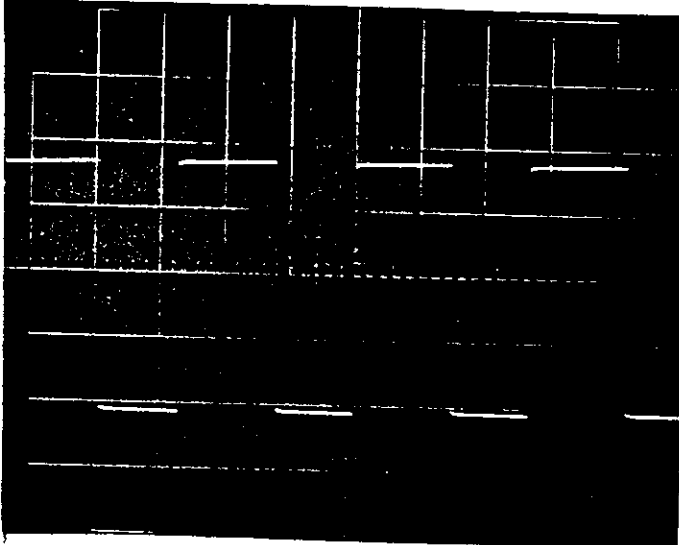
<u>T.S. No.</u>	<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
37.	Bright white lines or dots horizontally on image (lines or dots may run vertically in SLOW, PHOTO mode)	<ul style="list-style-type: none"> a. Discharge in scintillator area b. Defective scintillator c. Discharge in scintillator H.V. cable d. Photomultiplier deteriorated 	<ul style="list-style-type: none"> a. Polish cap of scintillator holder or clean inner wall of specimen chamber b. Replace scintillator c. Replace secondary Electron Detector assembly d. Replace photomultiplier
38.	Several balck broad bands run horizontally on image (bands may run vertically in SLOW, PHOTO mode)	<ul style="list-style-type: none"> a. Interference due to heavy-duty power source located near column 	<ul style="list-style-type: none"> a. Relocate instrument or remove interfering power source
39.	PHOTOMETER meter pointer does not deflect when BRIGHTNESS or CONTRAST control is turned	<ul style="list-style-type: none"> a. Pre-amplifier, image amplifier, photomultiplier defective b. Photomultiplier high voltage abnormal c. Photometer circuit defective 	<ul style="list-style-type: none"> a. See T.S. 14 b. See T.S. 23 a, b, c c. IC12 (741) defective on P.C. board N76LG01P
40.	Scanning can not be started by depressing PHOTO START button (exposure pilot lamp does not light	<ul style="list-style-type: none"> d. Meter defective a. Horizontal scanning circuit defective b. PHOTO START circuit defective c. Check point (39*) CP7-GROUND c. Poor contact at lamp or lamp filament open 	<ul style="list-style-type: none"> d. Replace meter a. See T.S. 11 b. IC11 (741) defective on P.C. board N76LG01P c. Tighten or replace lamp

* Check points are at the end of the Detailed Trouble Shooting Section

REFERENCE GUIDE
FOR
TROUBLE SHOOTING SECTION OF MRS-2-2

TV MINI-SEM

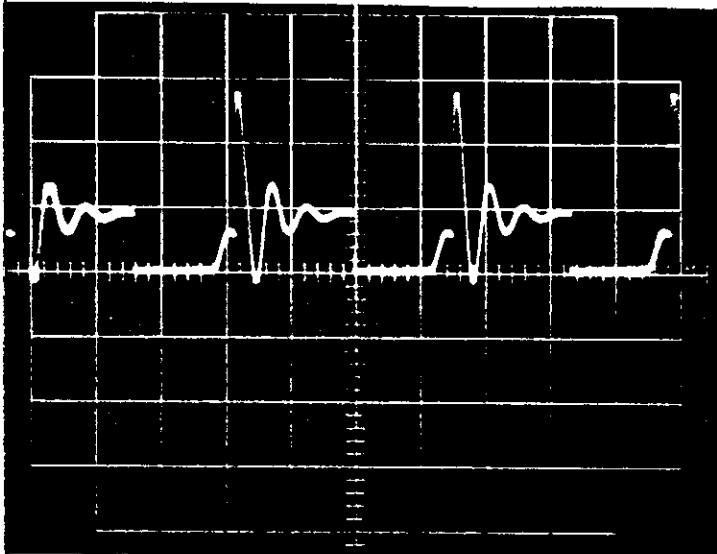
47231



(1)

(1) N76MA02P CP1 - CPE
FIL. $15.75/2$ KHZ

5V/cm

50 μ sec/cm

(3)

(2) N76MA02P CP2 - CPE
FIL. VOL.

EMISSION MIN ~ MAX
0 ~ +29.6V

(3) N76MA02P CP3 - CPE

EG HV DRIVE

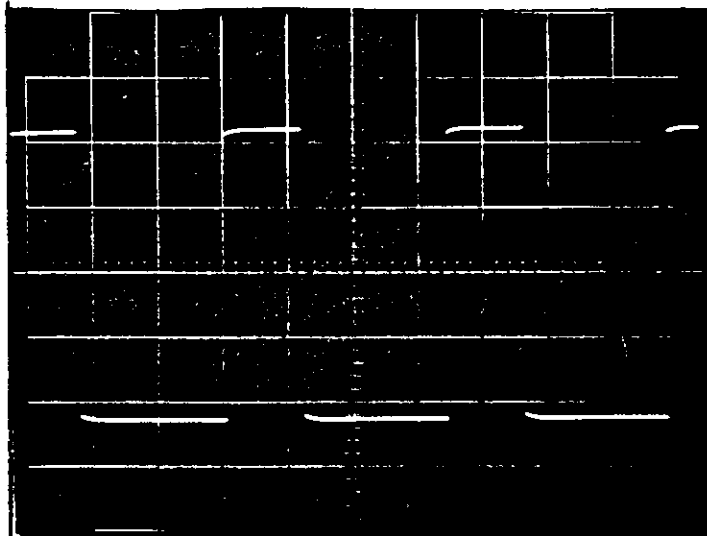
10V/cm

20 μ sec/cm

(4) N76MA02P CP4 - CPE

EG HV SUPPLY VOL.

+475V (NO LOAD)

+52V (LOAD 140 μ A)

(6)

(5) N76MA02P CP5 - CPE

PROBE SCAN HOR. SUPPLY VOL.

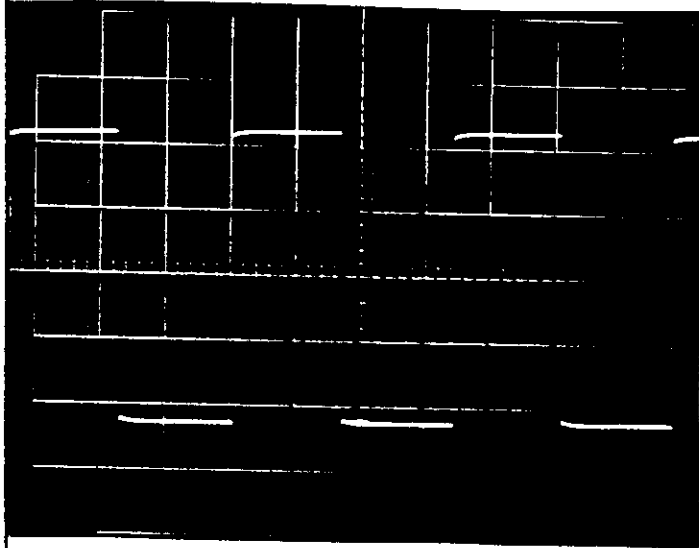
+32V at TV (x1), +15.3V at TV (x2)

+4.66V at RED. (x1), +2.32V at RED. (x2)

(6) N76MA02P CP6 - CPE
HOR. SIGNAL FOR MONITOR

5V/cm

20 μ sec/cm



(7)

(7) N76MA02P CP7 - CPE

15.75 KHZ OSC.

5 V / cm

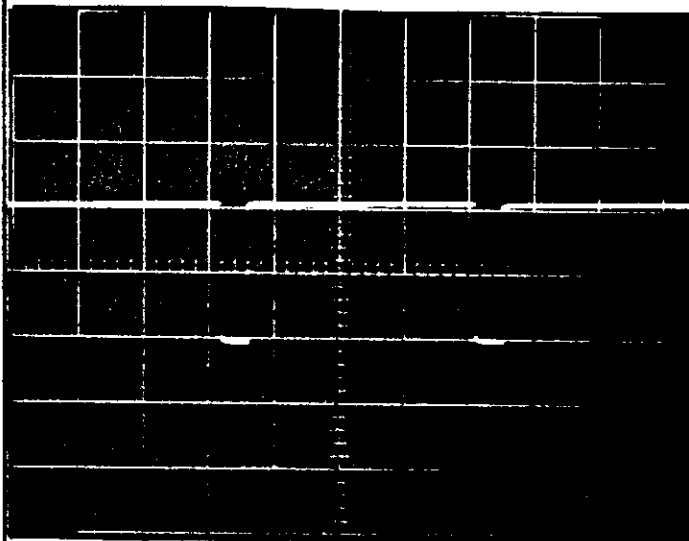
20 μ sec / cm

(8) N76MB02P CP3 - CPE

Pm HV

CONTRAST MIN. ~ MAX.
-270V ~ -650V

- (9) N76MCO2P CP1 - CP3 (GND) STIG. X OUT
-4.9V ~ +4.5V
- (10) N76MCO2P CP2 - CP3 (GND) STIG. X REF. VOL.
-4.2V ~ +3.8V
- (11) N76MCO2P CP4 - CP6 (GND) STIG. Y OUT
-5.0V ~ +4.6V
- (12) N76MCO2P CP5 - CP6 (GND) STIG. Y REF. VOL.
-4.2V ~ +3.9V
- (13) N76MCO2P CP7 - CP8 (GND) 1st CONDENSER
CONDENSER MIN. ~ MAX. +1.6V ~ +3.5V
- (14) N76MCO2P CP9 - CP10 (GND) 2nd CONDENSER
+3.5V
- (15) N76MCO2P CP11 - CP12 (GND) OBJ.
HIGH +2.2V ~ +2.6V
LOW +1.9V ~ +2.3V



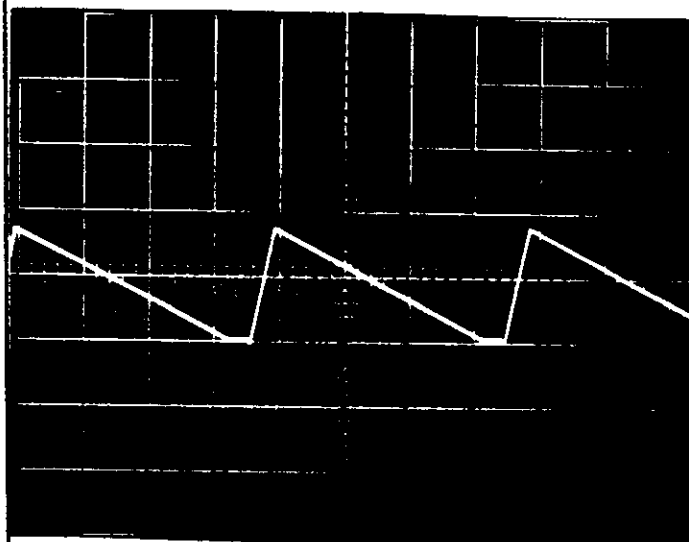
(16)

(16) N76MDO2P CP1-CP4(GND)

FLIP FLOP

10 V/cm

5 msec/cm



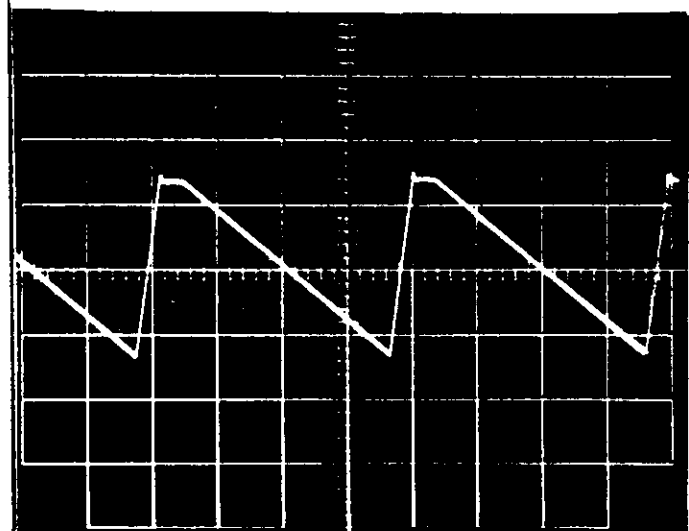
(17)

(17) N76MDO2P CP2-CP4(GND)

VER. SWEEP

10 V/cm

5 msec/cm



(18)

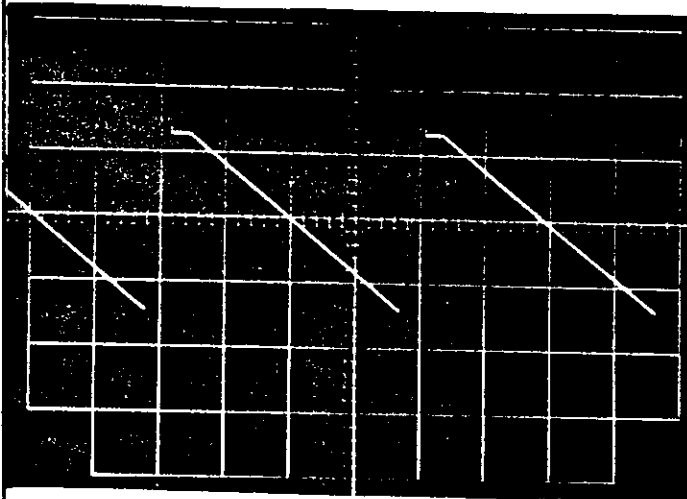
(18) N76MDO2P CP3-CP4(GND)

PROBE SCAN VER.

at TV (Mag. x1)

2 V/cm

5 msec/cm



(19)

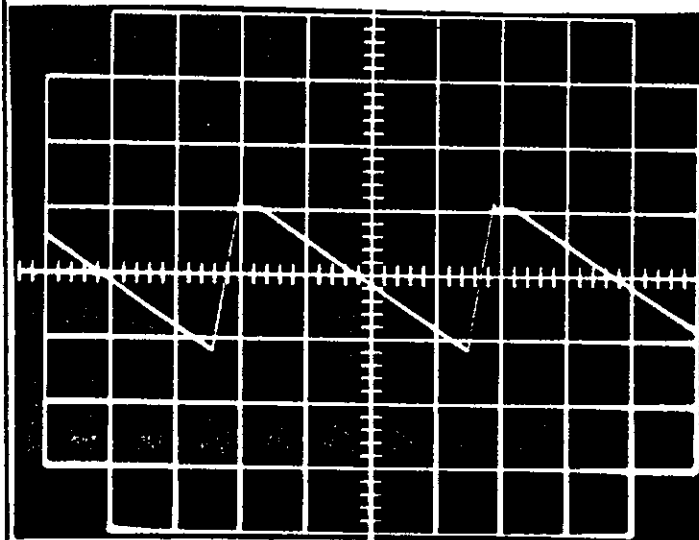
(19) N76MDO2P CP3-CP4(GND)

PROBE SCAN VER.

at TV (Mag. x2)

1 V/cm

5 msec/cm



(20)

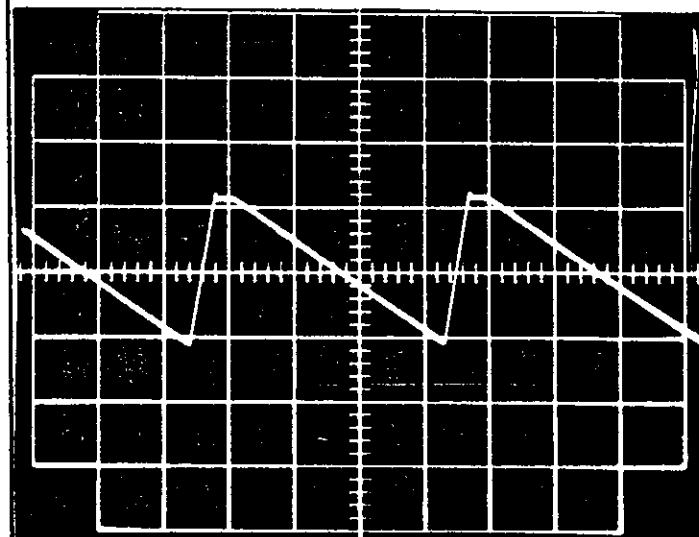
(20) N76MDO2P CP3-CP4(GND)

PROBE SCAN VER.

at RED. (Mag. x1)

1 V/cm

5 msec/cm



(21)

(21) N76MDO2P CP3-CP4(GND)

PROBE SCAN VER.

at RED. (Mag. x2)

0.5 V/cm

5 msec/cm

(22) N76 MD02P CP5 - CP6 (GND) VACUUM

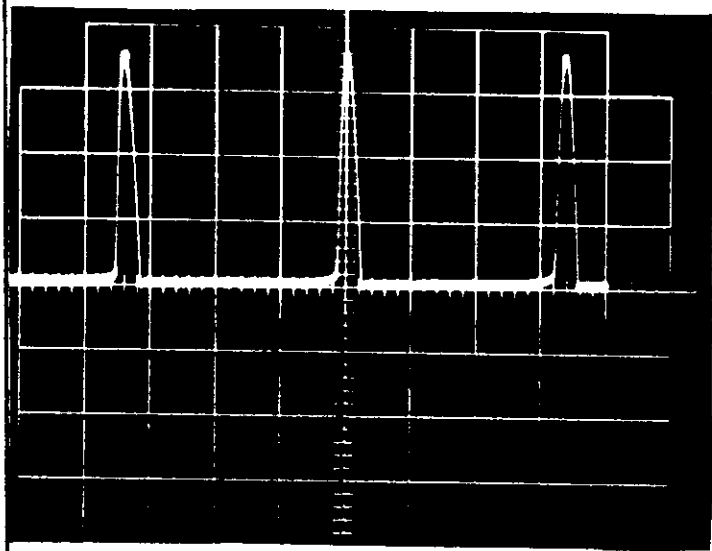
0 V at air in column

-3.0V at vacuum indicated lamp on

(23) N76 MD02P CP7 - CPE +65V

(24) N76 MD02P CP8 - CPE +15V

(25) N76 MD02P CP9 - CPE -15V



(26)

(26) N76 M02P DRIVE 1
- HOR. GND

PROBE SCAN HOR.
at TV (Mag. x1)

100 V / cm

20 μsec / cm



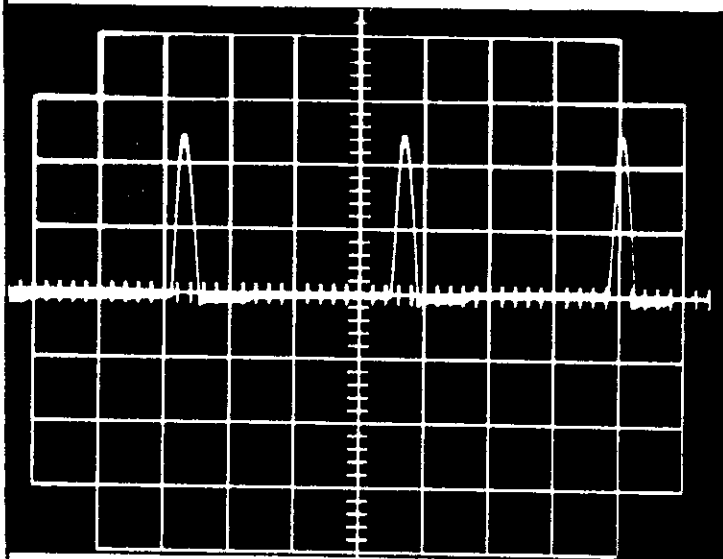
(27)

(27) N76 M~~00~~02P DRIVE 1
- HOR. GND

PROBE SCAN HOR.
at TV (Mag. x2)

100 V / cm

20 μsec / cm



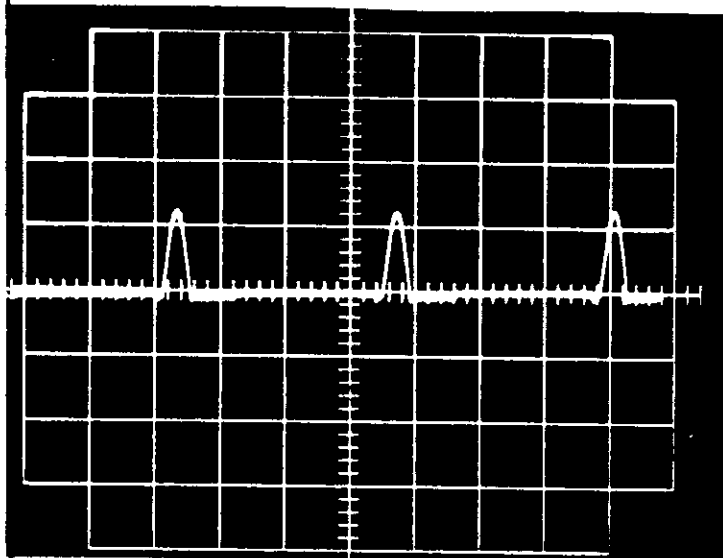
(28)

(28) N76M02P DRIVE 1
—HOR.GND

PROBE SCAN HOR.
at RED. (Mag. x1)

20 V/cm

20 μ sec/cm



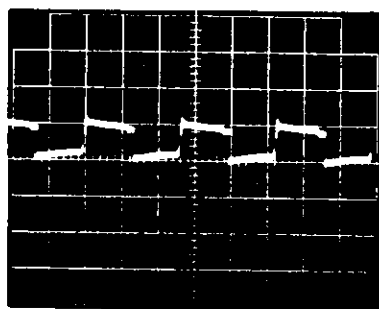
(29)

(29) N76M02P DRIVE 1
—HOR.GND

PROBE SCAN HOR.
at RED. (Mag. x2)

20 V/cm

20 μ sec/cm



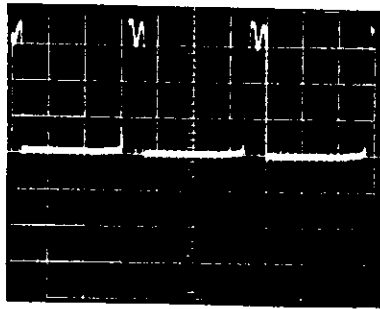
(30)

(30) N76H01P-B
JH3-3 — GND

FIL. DRIVE

50 V/cm

50 μ sec/cm



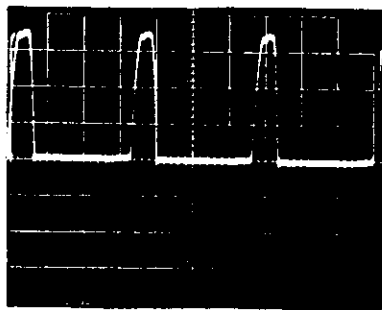
(31)

(31) N76H01P-B
 JH4-1 — GND

EG HV DRIVE

100 V / cm

20 μsec / cm



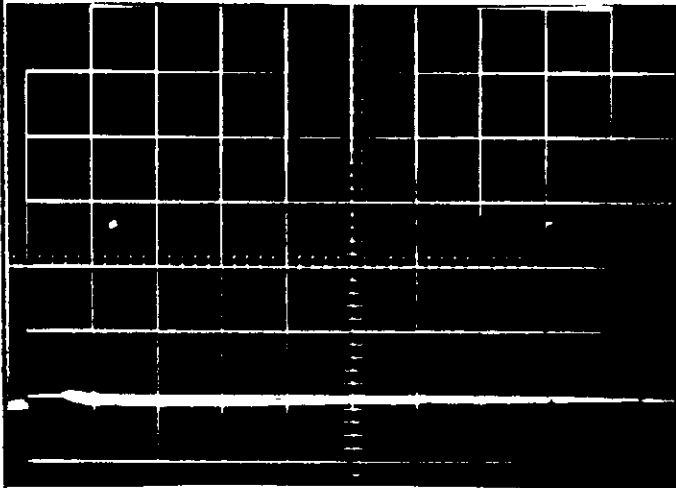
(32)

(32) N76H01P-B
 JH5-5 — GND

SCINT. & CRT HV DRIVE

100 V / cm

20 μsec / cm



(33)

(33) N76LG01P CP1 - GND

SLOW SWEEP FLIP FLOP

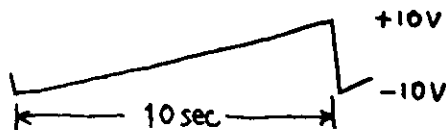
5 V / cm

1.5 sec / cm at SLOW

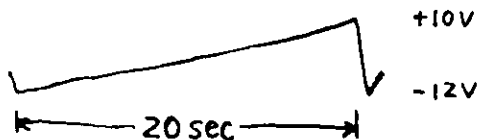
(34) N76LG01P CP2 - GND

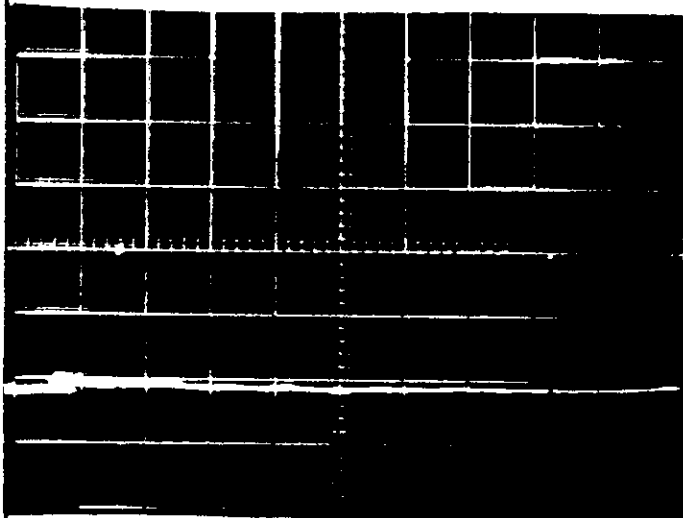
SLOW SWEEP

at SLOW



at PHOTO





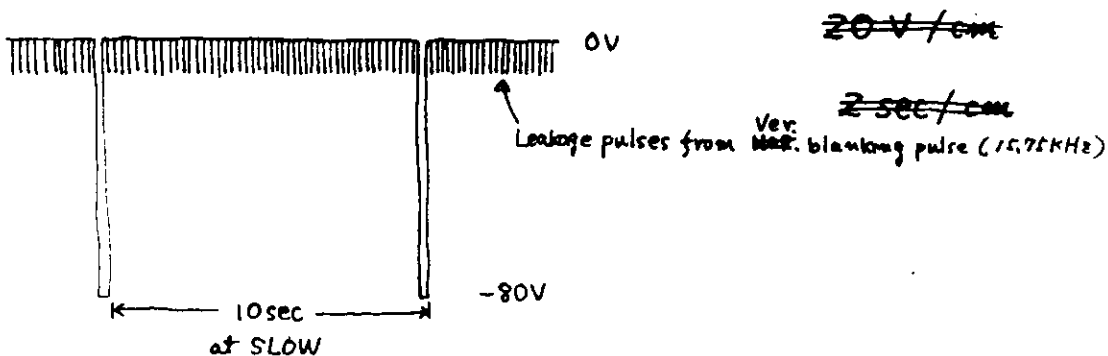
(35) N76LG01P CP3 - GND.
SLOW SWEEP BL.

5 V / cm

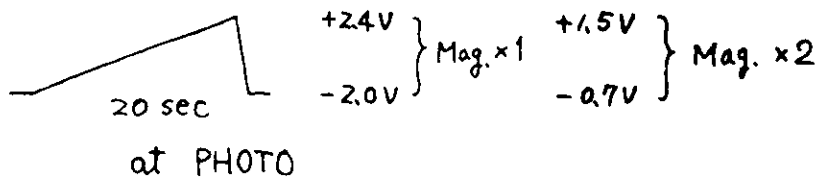
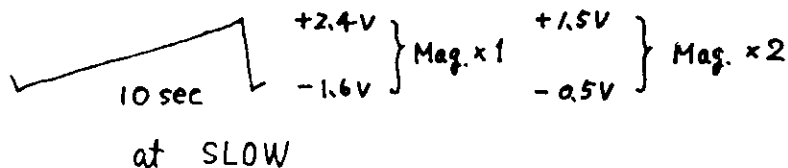
$\frac{1}{1.5}$ sec / cm at SLOW

(35)

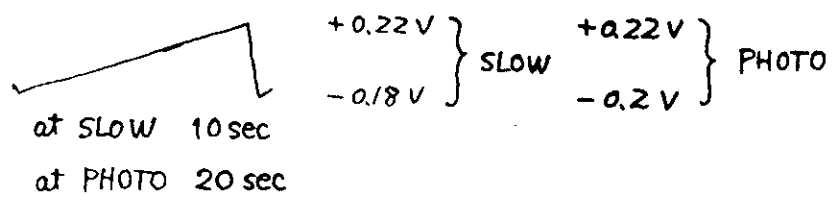
(36) N76LG01P CP4 - GND
SLOW SWEEP BLANKING



(37) N76LG01P CP⁵ - GND PROBE SCAN HOR.



(38) N76LG01P CP6 - GND CRT SCAN HOR.

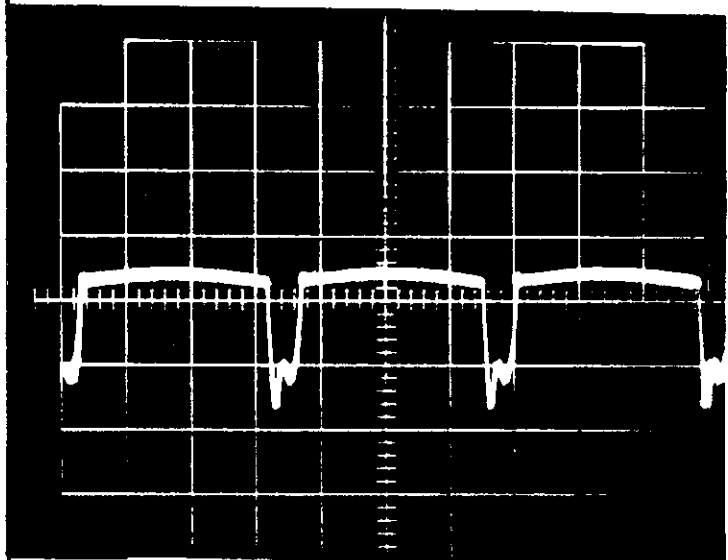


(39) N76LG01P CP7 - GND. PHOTO LAMP

+3.0 V at lamp on

(40) N76LG01P CP8 - GND IMAGE OUT at SLOW SCAN

BRIGHTNESS MIN. ~ MAX. +58.0V ~ +35.5V



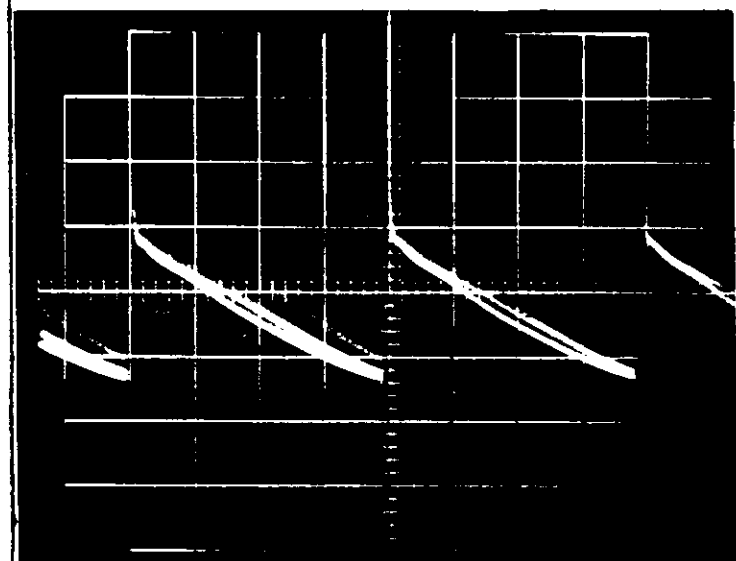
(41)

(41) N76LH01 (MONITOR TV)

DEFLECTION YOKE HOR.
at TV

50 V / cm

20 μsec / cm



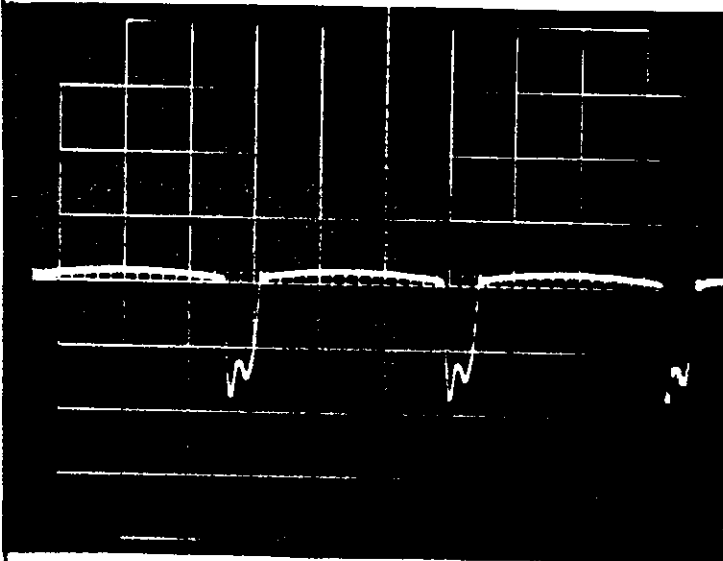
(42)

(42) N76LH01 (MONITOR TV)

DEFLECTION YOKE VER.
at TV

5 V / cm

5 msec / cm



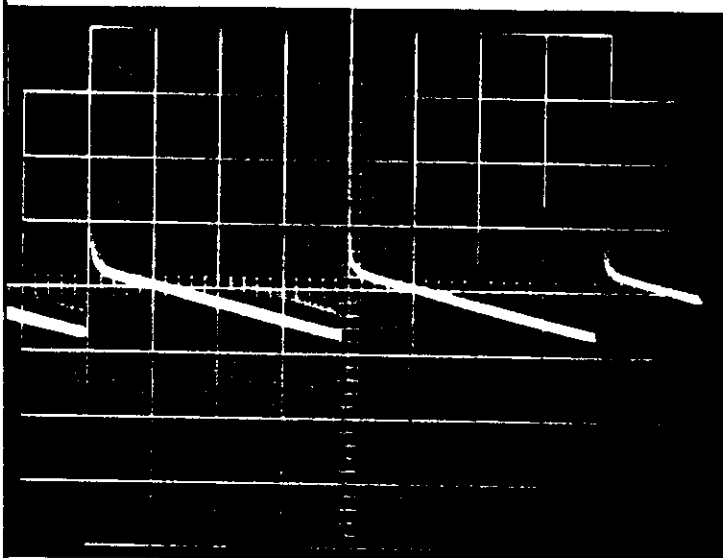
(43)

(43) N76LH01 (MONITOR TV)

DEFLECTION YOKE HOR.
at RED.

50 V / cm

20 μ sec / cm



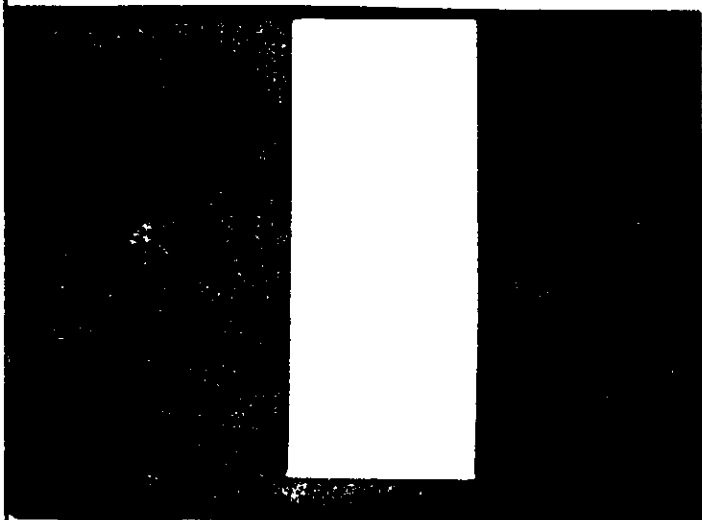
(44)

(44) N76LH01 (MONITOR TV)

DEFLECTION YOKE VER.
at RED.

5 V / cm

5 msec / cm



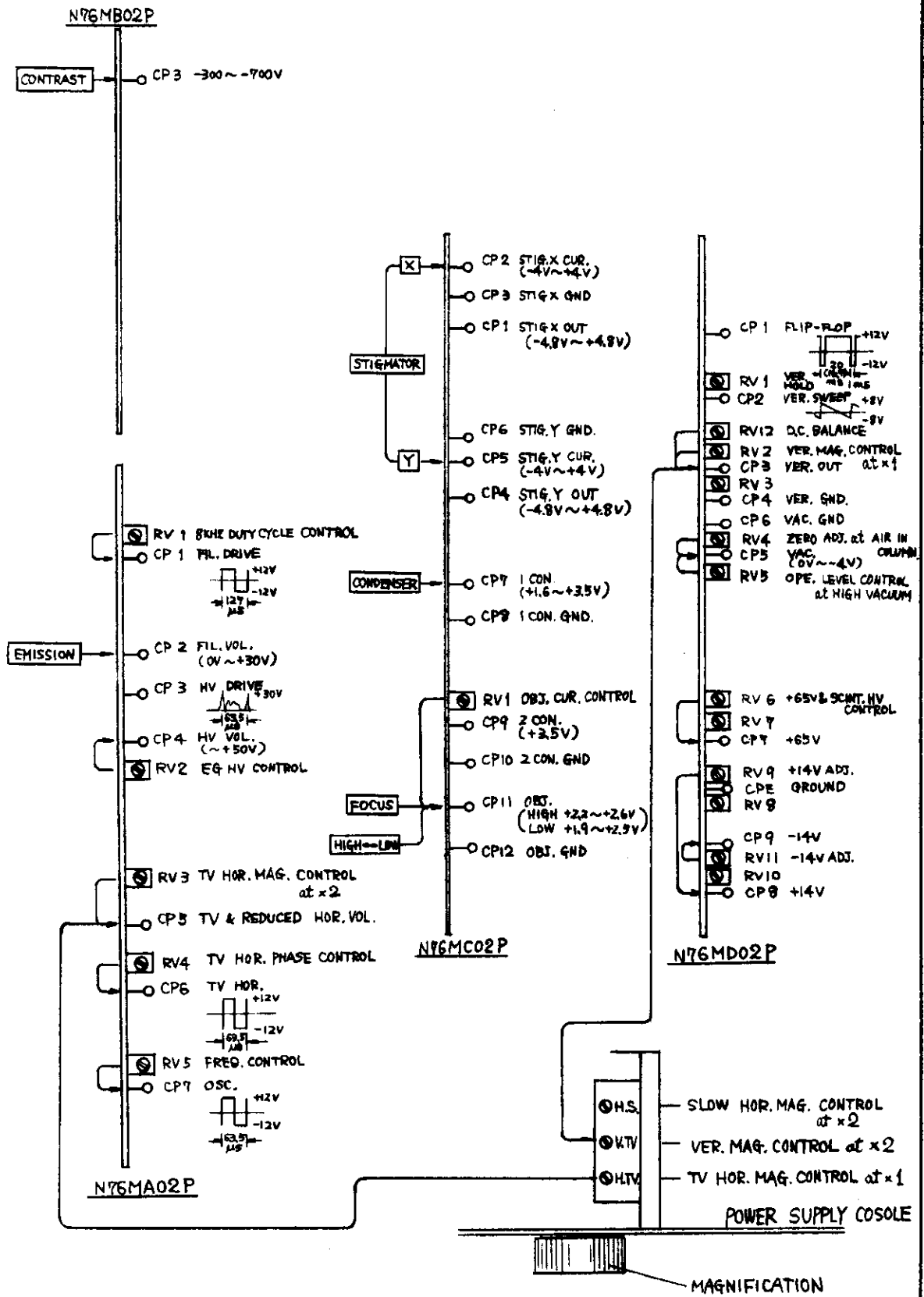
(45)

(45) ~~N76LH01~~
REDUCED AREA

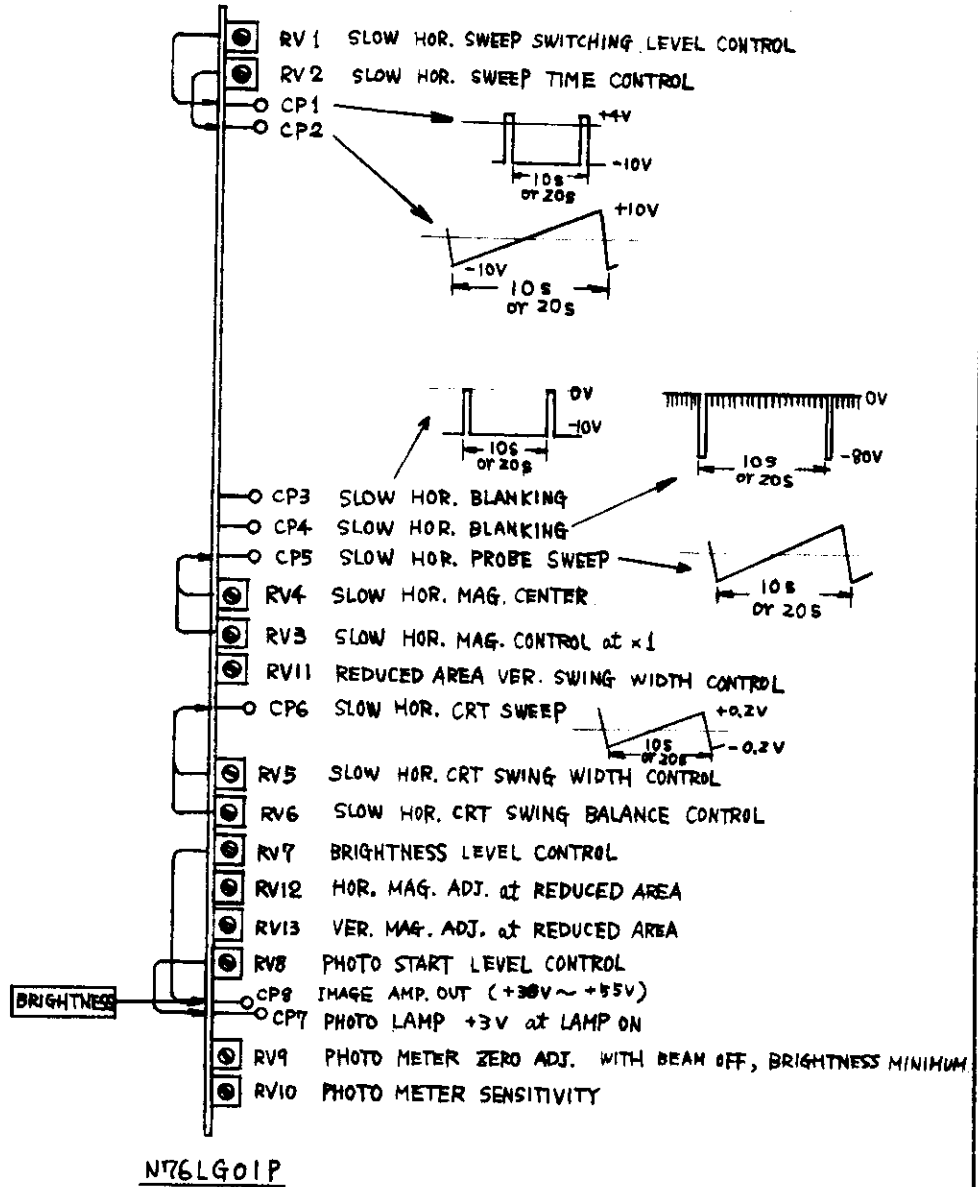
60 mm x 25 mm

MRS-2-2 Printed Circuit Board Check Points

1. Power Supply Console

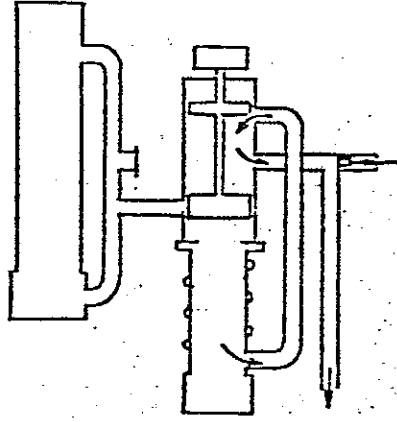


2. DISPLAY CONSOLE

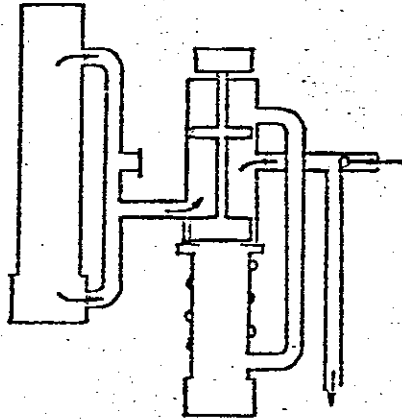


VACUUM SYSTEM SCHEMATIC

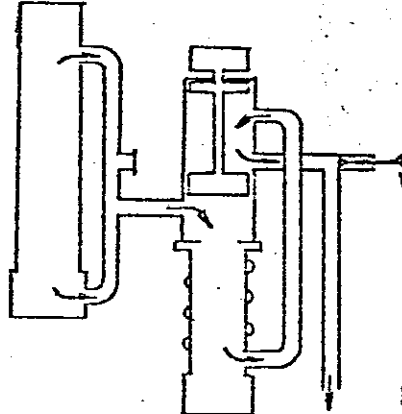
VALVE POSITION 1 S-STOP
Initial Start-up



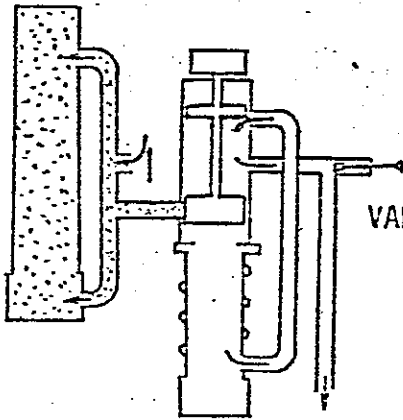
VALVE POSITION 2 F-FOREPUMP
Column Rough Vacuum



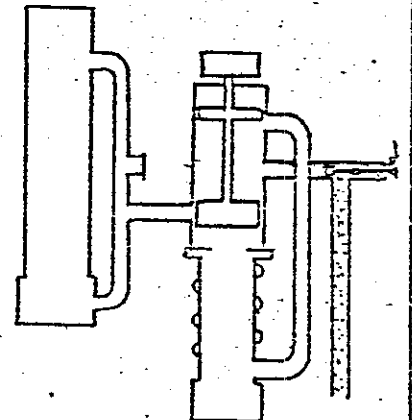
VALVE POSITION 3 O-OPERATE
Column High Vacuum



VALVE POSITION 1 S-STOP
Specimen Change

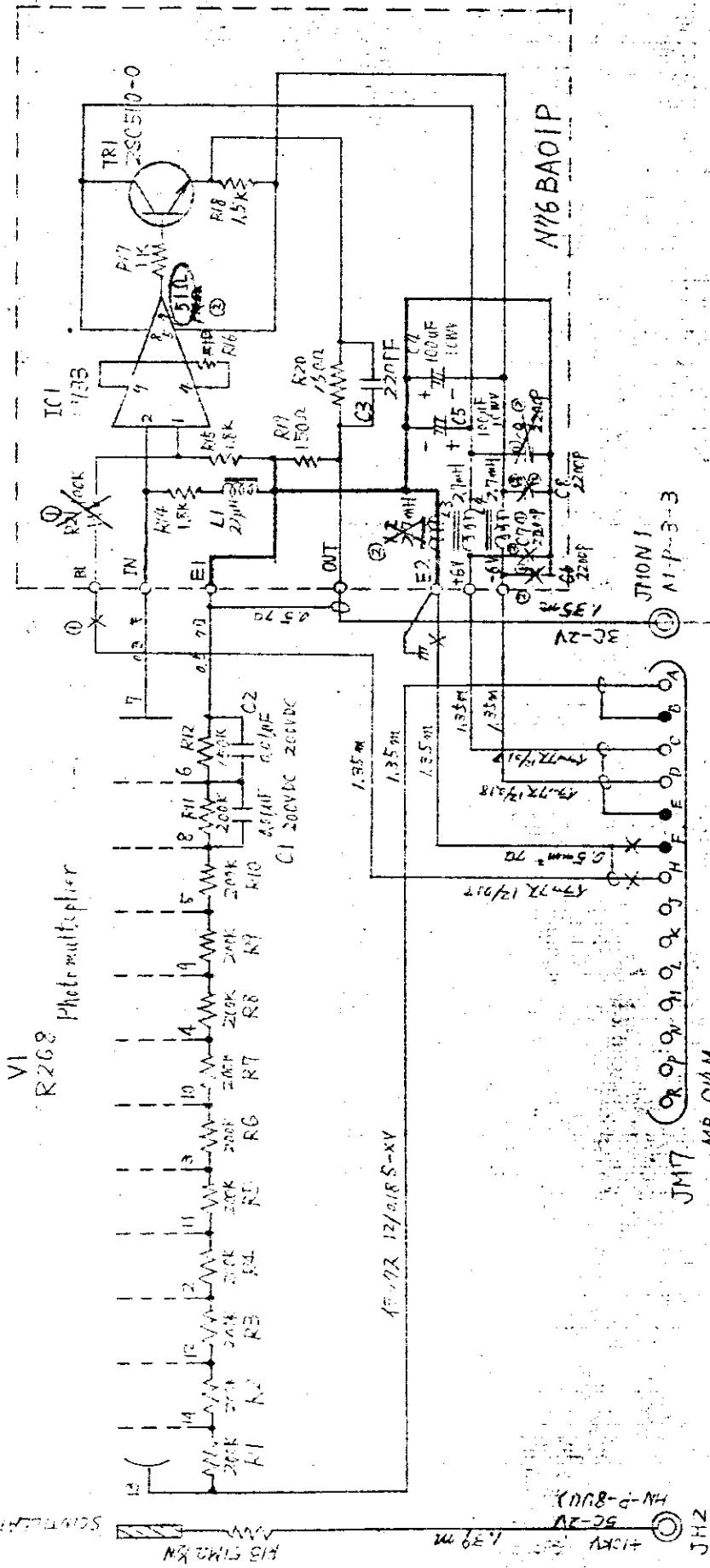


VALVE POSITION 1 S-STOP
Shut Down



REMEMBER - Follow the arrows - The vacuum valve must be moved in sequence 1-2-3.

注 E2ハガスへオストク



N76 BA01P

JTH011
MIP-3-3

JM17 (9P) MB-Q14M
(MB-Q14-LS (F))

②	49.2.6
①	48.10.4

訂正理由	氏名	日付
MRS-1	7月27日	部
名称	図番	
度計		
検		

熱処理	塗装	表面処理	鍍金
個数			

昭和47年5月23日 明石製作所



WARRANTY AGREEMENT

Important Information

ISI warrants its products to be free from defects in materials and workmanship for a period of one year from the date of receipt of the instrument by the purchaser.

Expendable and spare parts are not included in the warranty. Expendable parts are defined as filaments, apertures, scintillators, o-rings, fuses, and pump oils.

Upon prompt notification by the purchaser, ISI will correct any defects in the instrument, either by repair in our facility, supplying of replacement parts to the purchaser, or by supplying the services of a qualified ISI Service Engineer.

ISI provides for operator training during installation of equipment. However, ISI is not responsible for the retraining of operators. When personnel changes are made it is the purchasers responsibility to retrain operators. ISI will provide operator retraining at standard service rates.

This warranty does not include routine operator maintenance. Operator maintenance is defined as column cleaning, changing scintillators, filaments, pump oils, lamps, fuses and etc. If service is requested during the warranty period because of improper performance of the instrument and the cause is due to what is defined as operator maintenance, standard service rates will apply.

ISI must decide to its own satisfaction that the equipment is defective and has not developed malfunction as a result of misuse, modification or abnormal conditions of operation.

Any special test or requirement placed upon ISI products must be mutually agreed upon in writing by ISI and the purchaser prior to the date of shipment.

ISI reserves the right to make changes in design or construction of its products at any time without incurring any obligation to make any changes whatsoever on units previously purchased.

This warranty is expressly made by ISI and accepted by purchaser in lieu of all other warranties, including warranties of merchantability and fitness for particular purposes, whether written, oral, express, implied or statutory. ISI neither assumes nor authorizes any person to assume for it other liabilities with respect to its products. ISI shall not be liable for normal wear and tear, not for any contingent, incidental or consequential damage or expense due to partial or complete inoperability of its products for any reason whatsoever. In no event shall ISI's liability exceed the original purchaser's price of the equipment.