Photographic Analysis System (PAS)

Operation Manual

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CANADA CENTRE FOR REMOTE SENSING

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NOTE: Because the Vidicon tube in the T.V. camera is very sensitive to sharp changes in illumination the following safety procedures must be observed.

1. Never expose the camera to the light table unless an image is in place.
2. Always mask the image so that the camera is not exposed to any bright areas.
3. Never open door of room or turn on room lights when shutter is open.

Also: Do not remove the two neutral density filters if the image being analyzed has very low density areas (approximately 0.6 D). Image retention (memory) of the Vidicon tube is damaging to the camera as well as causing false density readings. To minimize this, close the shutter or shift the image slightly, every 3-5 minutes.

THE PHOTOGRAPHIC ANALYSIS SYSTEM (PAS)

1. INTRODUCTION

The applications Division of CCRS has modified its density slicer to permit multispectral analysis of satellite and airborne photographic data. The system, briefly described below, is also available to outsider users.

The Photographic Analysis System (PAS) is a device for analyzing optical densities in a film transparency. The input image consists of a black and white (B&W) or a colour film. The image may be obtained from aircraft or satellite platforms and may be up to 30.5 x 30.5 cm (12 x 12 in.) in size. A uniformly illuminated light table and a continuously scanning vidicon T.V. camera of high quality are used to convert image values into an electrical video signal which is then displayed on both B & W and colour T.V. monitors, or recorded on a video disc for storage and a subsequent analysis. Multispectral images of the same scene can be input and stored on the video disc, thereby allowing a reconstruction of the original scene as a colour composite on the colour monitor. The registration of the various bands is accomplished manually with the aid of a light table and a registration punch. The images stored on disc can be ratioed together and their brightness and contrast can also be modified. Single band or ratioed images can be divided into up to 32 density levels, each coded in a different colour. A form of rectangular parallelepiped supervised classification by means of logic functions can also be accomplished.

Figures 1.1, 1.2A and 1.2B.

Additional features of the system include:

1. area measurement of one of more density levels by an electronic planimeter;
2. spot density measurement;
3. density profile display;
4. an edge enhancement display (B & W) which allows the detection and display of all locations on the image at which the image density gradient (rate of change with distance) exceeds a specified threshold value;
5. a video micrometer for measuring distances;
6. a keyboard for annotating images;
7. a second T.V. camera for overlaying a map onto the image being studied.

The map and image registration is done manually. Hard copy output is obtained by photographing the colour or B & W monitors or a gray level copy analogous to a digital binary map. A standard video colour recorder (cassette or reel-to-reel) can receive output from the PAS.

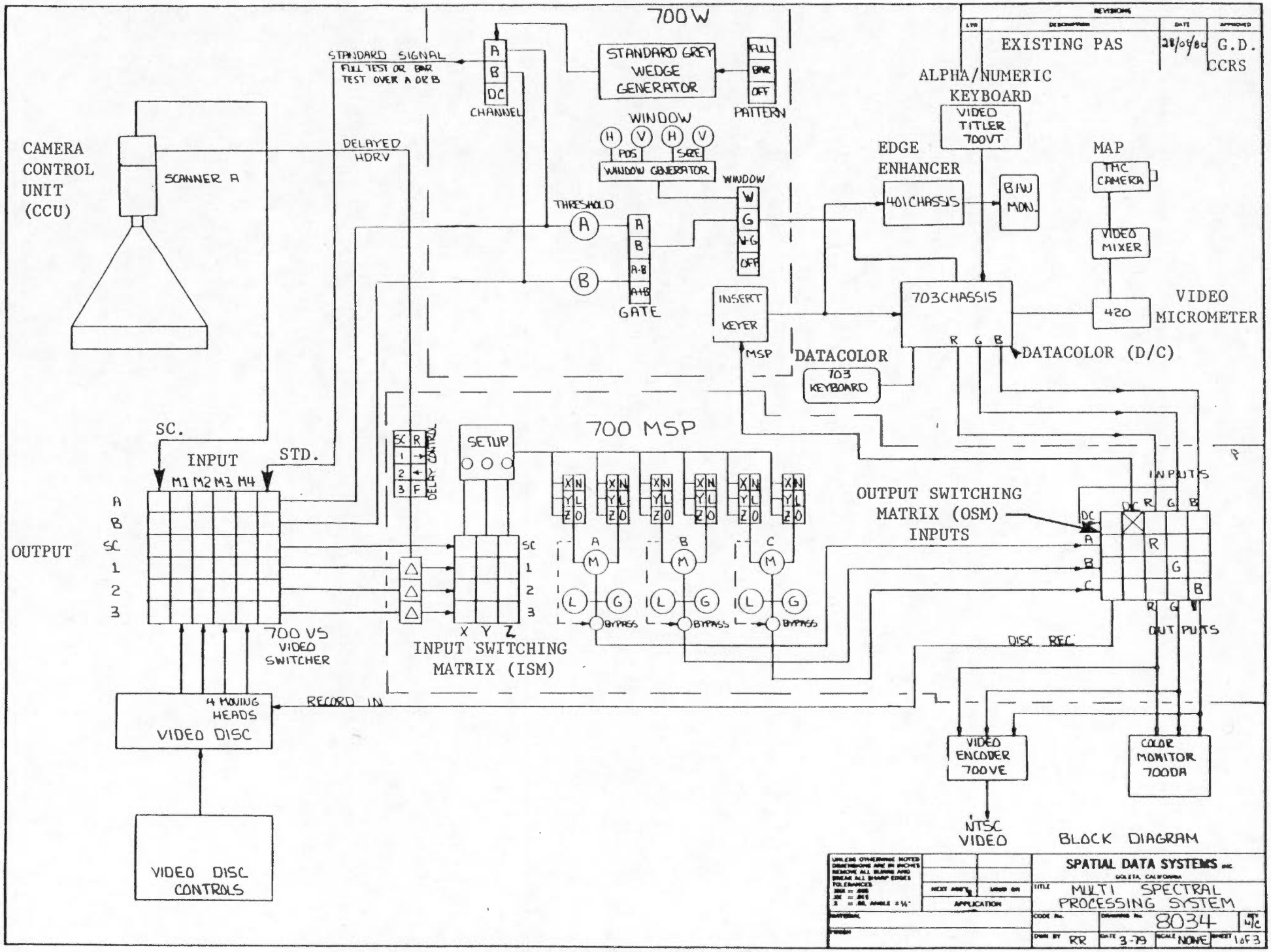

FIGURE 1.1 PHOTOGRAPHIC ANALYSIS SYSTEM (PAS) OVERVIEW.

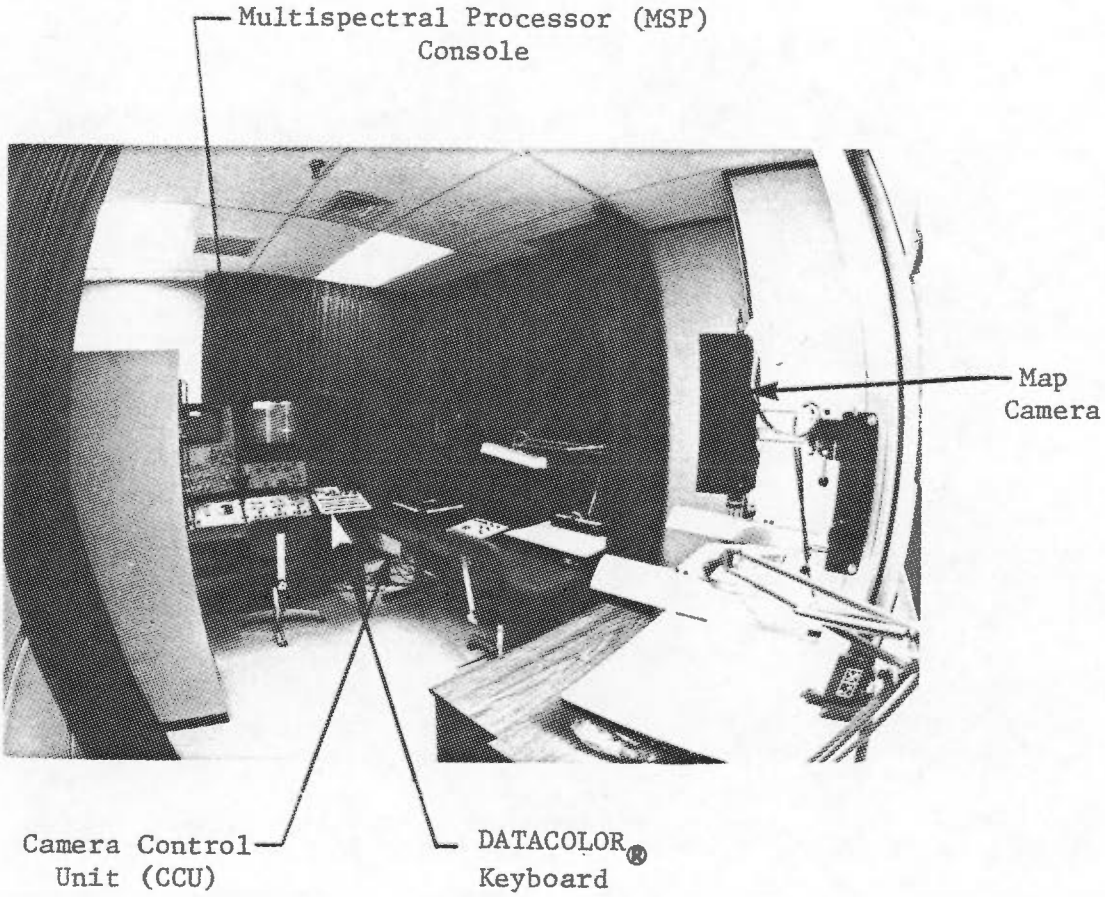

FIGURE 1.2A. Photographic Analysis System

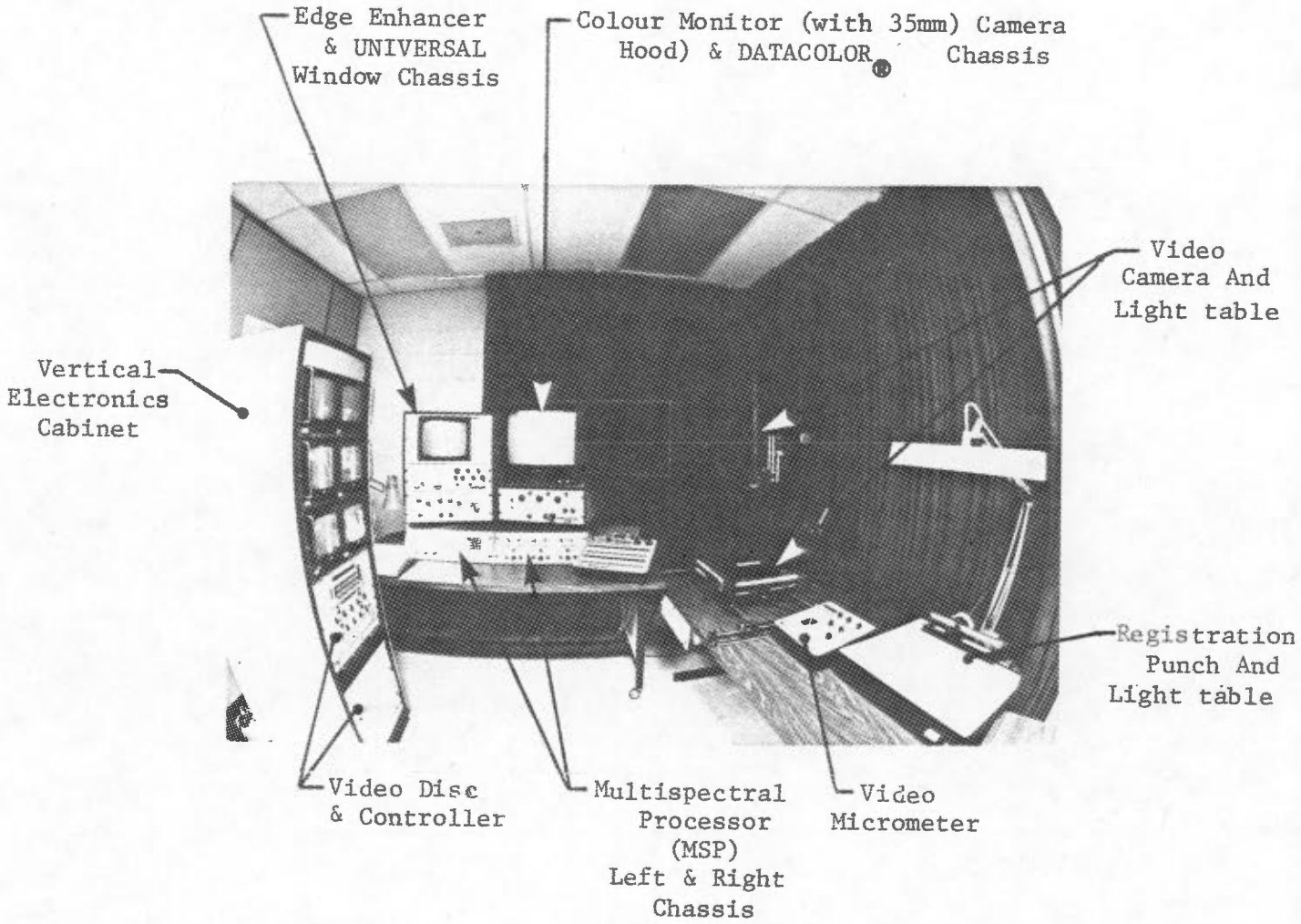

FIGURE 1.2B. Photographic Analysis System

Persons interested in seeing or using the PAS for 1 or 2 days may contact:

Grant Dixon,
Applications Division,
Canada Centre for Remote Sensing,
717 Belfast Road,
Ottawa, Ontario. K1A 0Y7
(613) 995-1210

Users of this system are provided with a manual and appropriate training for work lasting longer than 2 days. For shorter term users, an operator will be present.

For projects involving more than 2 days of PAS time a project proposal and estimations for time should be submitted to:

Committee for Image Equipment Utilization (CIEU),
717 Belfast Road,
Ottawa, Ontario
K1A 0Y7
(613) 995-1210

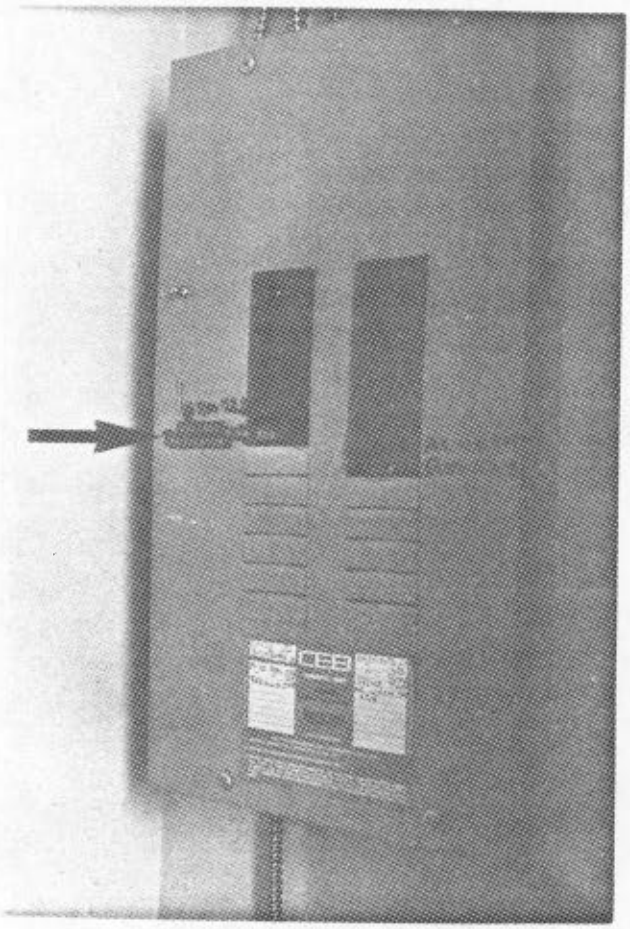

FIGURE 2.1. Circuit Panel

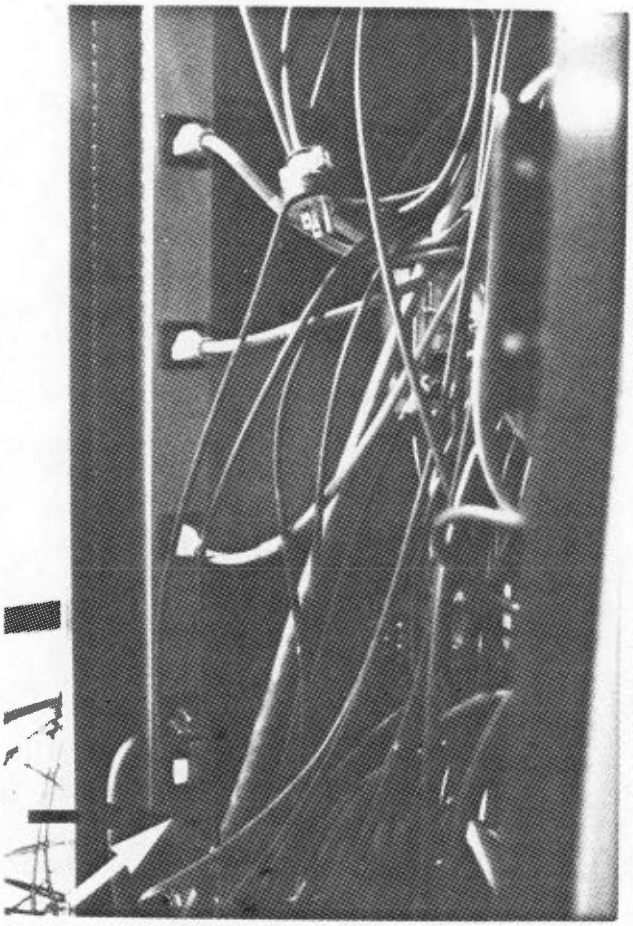

FIGURE 2.2. Plug Strip Location For The Vertical Electronics Cabinet

2. START-UP

1. Switch on the regulated power supply. This switch can be found in an electrical panel located in the janitorial/ electrical room on the second floor. The switch, actually a circuit breaker, is marked "**Voltage Regulator Rm. 228**" and is located in the third electrical panel from the door on the right side of the room (Figure 2.1).
2. Check the air conditioner thermostat located on the wall by the door inside room 228. It should be set at 20-22°C. If the room is not being properly cooled, i.e. the room temperature is 23° or higher, and adjusting the thermostat makes no change, then the Department of Public Works should be contacted. The cover of the thermostat can be removed by means of a key and then the controls can be adjusted.
3. Open the back of the free standing vertical electronics cabinet. Turn on the switch at the bottom of the electrical plug strip on the right hand side of the cabinet (orange light appears) (Figure 2.2). The five small monitors marked **Sc, M1, M2, M3 & M4** are now on. Switch on video disc with push button on lower front right of cabinet (red light appears in push button).
4. Switch on the chassis, of the edge enhancer (EH), the Multispectral Processor (MSP) and the 703 Datacolor® (D/C) and also the 19" colour and 12" edge enhancer monitors (CRTS). The switch to do this is located under the front right hand

side of the analysis console table and is at the front of electrical plug strip (Figure 2.3). On each of the above units, except for the E.H.'s monitor, lights should appear indicating that each unit is on. If any light fails to come on check to see if switch on that particular unit is on. The switches may be the toggle type (703 chassis and EH's monitor) or push button (all others). Contact the technical advisor if the units still do not start up.

5. When the voltage regulator is switched on, two units in the vertical electronics cabinet are turned on simultaneously. These two units are the Video Switcher that has two lighted numerical displays, and a NTSC sync generator on which a red light appears. They are located directly above and below the disc Controller respectively (Figure 2.4A and 2.4B).

6. To shut down the PAS, repeat steps 4, 3 and 1 in that order.

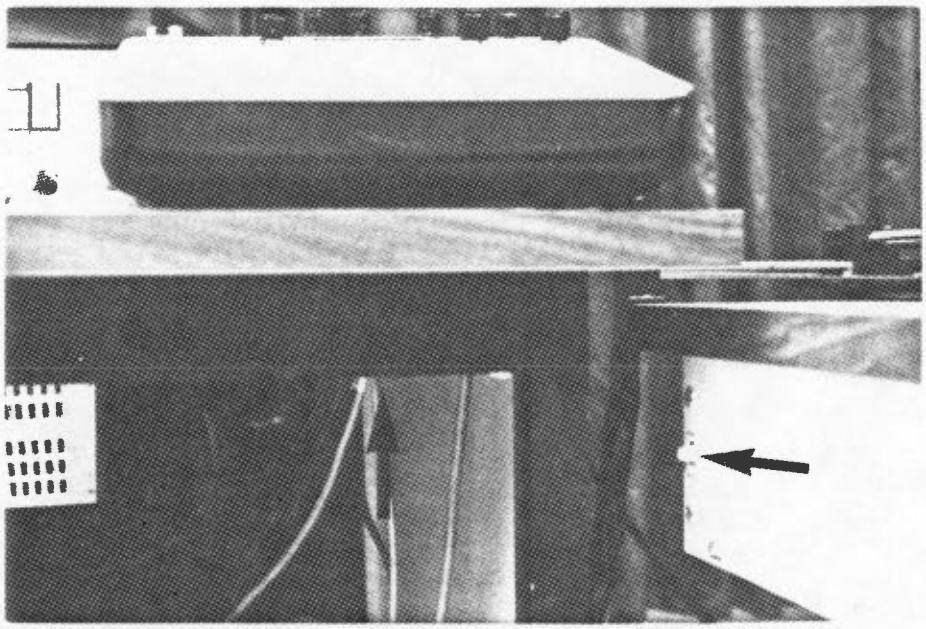

FIGURE 2.3. Plug Strip Location For The Analysis Console

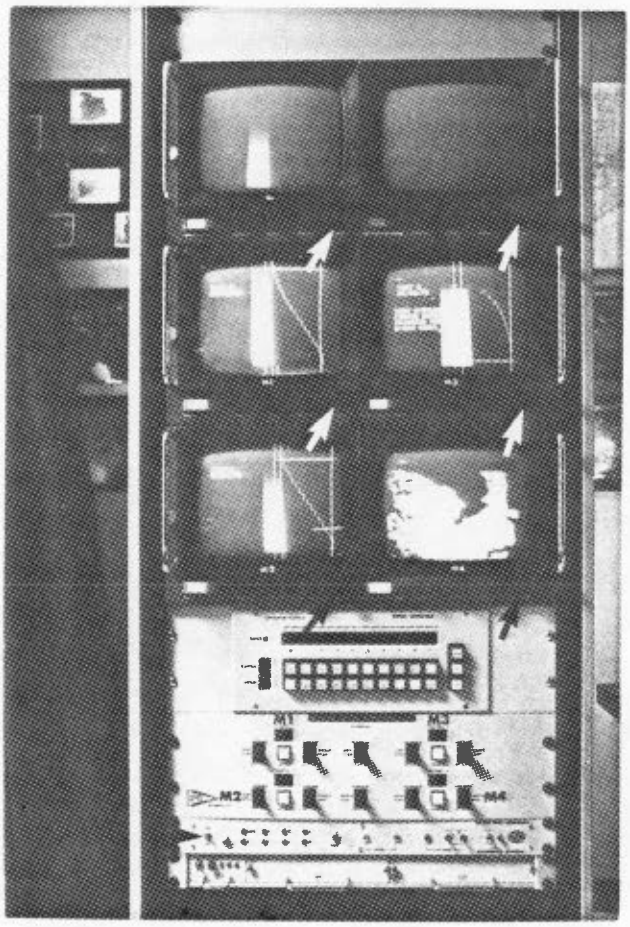

FIGURE 2.4A. Location of Power ON Switches and Lights

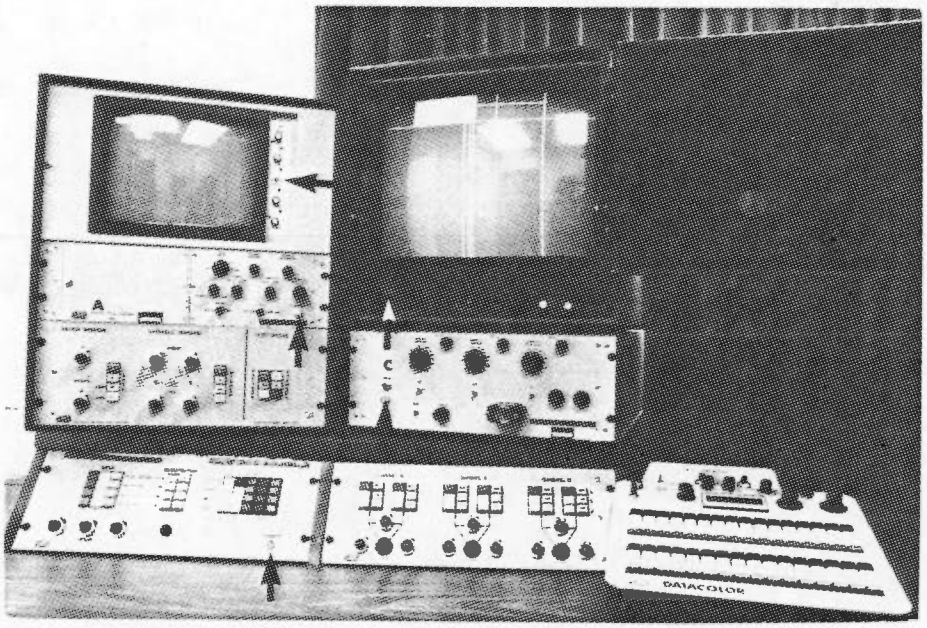

FIGURE 2.4B. Location of Power ON Switches and Lights

3. VIDEO SWITCHER

3.1. General

The video switcher allows access between the Multispectral Processor (MSP) and the video disc controller. The MSP can utilize a maximum of only 3 channels, however, the video disc has 4 channels and also it may be advantageous to have a test wedge standard combined with the image being stored or analyzed. Therefore a device is required to funnel the right data to the proper processing unit. This is the function of the video switcher.

The switcher comes on when the voltage regulator is turned on. With the unit on, illuminated numbers will appear in both the "**input/output**" (**I/O**) and the "**on-line**" (**O/L**) displays (Figure 3.1). To ensure the video switcher is functioning correctly, push the test button and the number "8" should appear in all positions in both displays. If this fails to occur, notify the technical advisor.

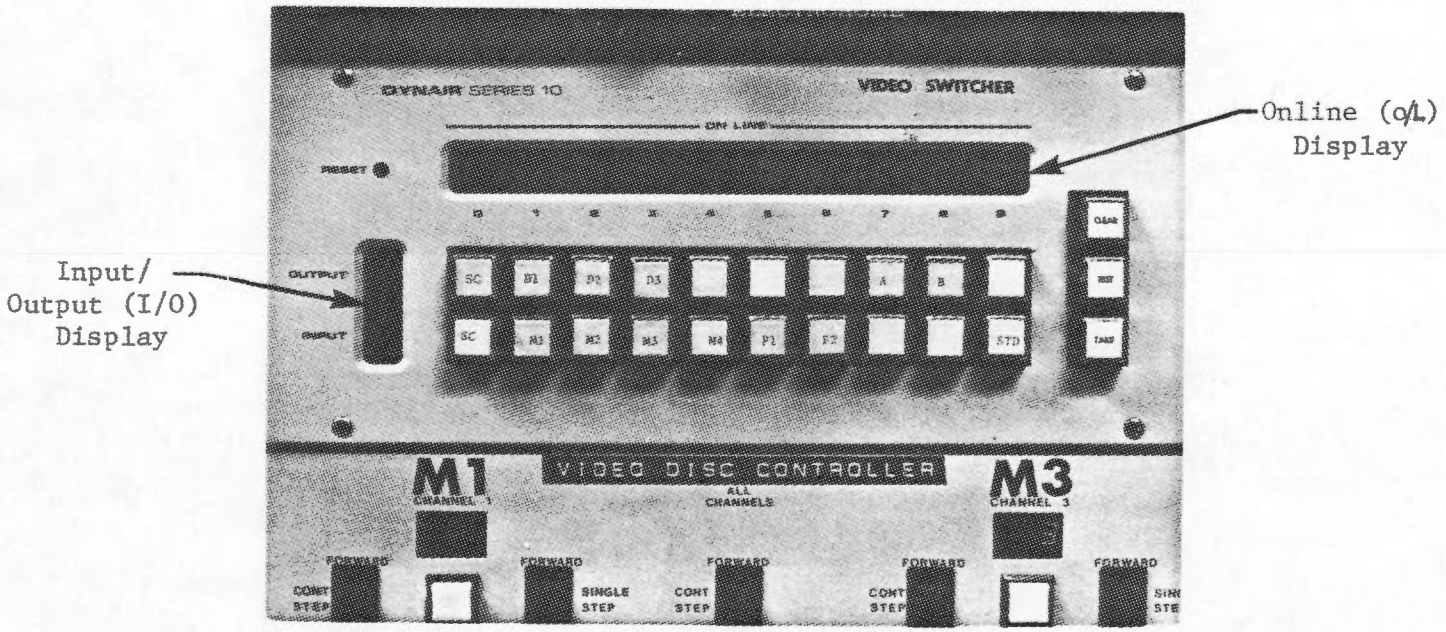

FIGURE 3.1. Video Switcher

3.2 Normal Switching Sequence

1. Push the **CLEAR** button and **C's** will appear on the **I/O** display.
2. On the output row of buttons, push **SC**; on the input row of buttons, push **STD** and follow by pushing the **TAKE** button. A "**0**" will appear in the top of the **I/O** display when **SC** is pushed and a "**9**" will appear in the bottom of the **I/O** display when **STD** is pushed. When the **TAKE** button is pushed, **C's** will appear in the **I/O** display and a "**9**" will appear in the "**0**" position above the **SC** button on the **O/L** display.
3. Repeat step 2 for D1, by pushing **D1**, **M1** and then **TAKE.** Intially "**1**" appears in the top of the **I/O** display with **D1** pushed and then when **M1** is pushed "**1**" appears on the bottom of the **I/O** display. When **TAKE** is pushed the "**1's**" in the **I/O** display are replaced with **C's** and "**1**" appears in the **O/L** display in position "**1**" above **D1.**
4. Repeat step 3 for **D2**, **D3** and **M2**, **M3** respectively.
5. To allow the internally generated test wedge or standard to be recorded with an image push **A** on output row ("**7**" appears in the top of the **I/O** display) and then push **SC** on the input row ("**0**" appears in the bottom of the **I/O** display). Push the **TAKE** button and "**0**" will appear in the 7th position on the **O/L** display.
6. Repeat step 5 for **B** on the output row.

3.3 Variations to the Normal Switching Sequence

Generally, to allow the MSP or Window chassis to read from only the input device, i.e. EYECOM® Scanner (**SC**), Disc (**M1, M2, M3,** or **M4**) or Standard (**STD**), through the video switcher, push the desired output row button, i.e. **SC, D1, D2, D3, A,** or **B** followed by <u>any</u> input row button, i.e. **SC, M1, M2, M3, M4,** or **STD,** and subsequently push the **TAKE** button. When ratioing bands, producing colour composites or using the Gated Window option, the input/output reading sequence may be considerably different than the normal sequence.

4. VIDEO DISC CONTROLLER

4.1 Introduction

The video disc controller accesses the video disc by moving the disc's read/write devices to the proper location on the disc. The video disc itself has four channels (i.e. 4 read/write heads or devices) and 100 tracks per channel. The disc's heads can be moved together in a continuous or step mode or each head can be moved independently in a continuous or step mode.

4.2 Controls and Procedures

1. When the disc is switched on (Section 2 on PAS Start-Up) the lighted displays showing the track number on **M1, M2, M3,** and **M4** will come on (Figure 4.1).
2. Each channel has its own switches and buttons for: record; continuous step-forward or reverse; single step-forward or reverse; and also a lighted digital display indicating the track being read.
3. In the centre of the panel are continuous and step motion switches to control all four channels simultaneously.
4. When starting to use the disc let all channels read the zero track position by pushing down the "**continuous step-all channels**" switch. All displays should show "**0**".

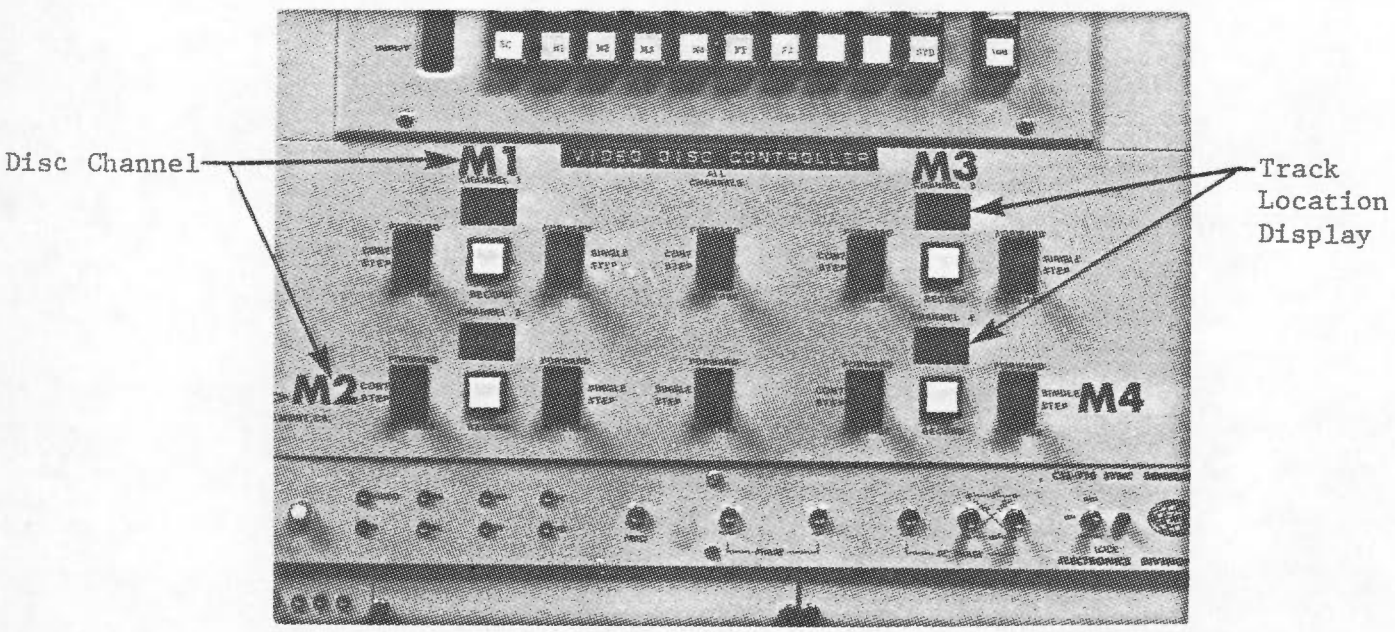

FIGURE 4.1. Video Disc Controller

5. If the four small black and white CRT's labelled M1 to M4 (Figure 4.2) are not identical (the same image) on track 0 then switch the **NTSC** sync generator, directly below the controller, off (red light off) and then on again (red light on). If this action does not correct the problem contact the technical advisor.

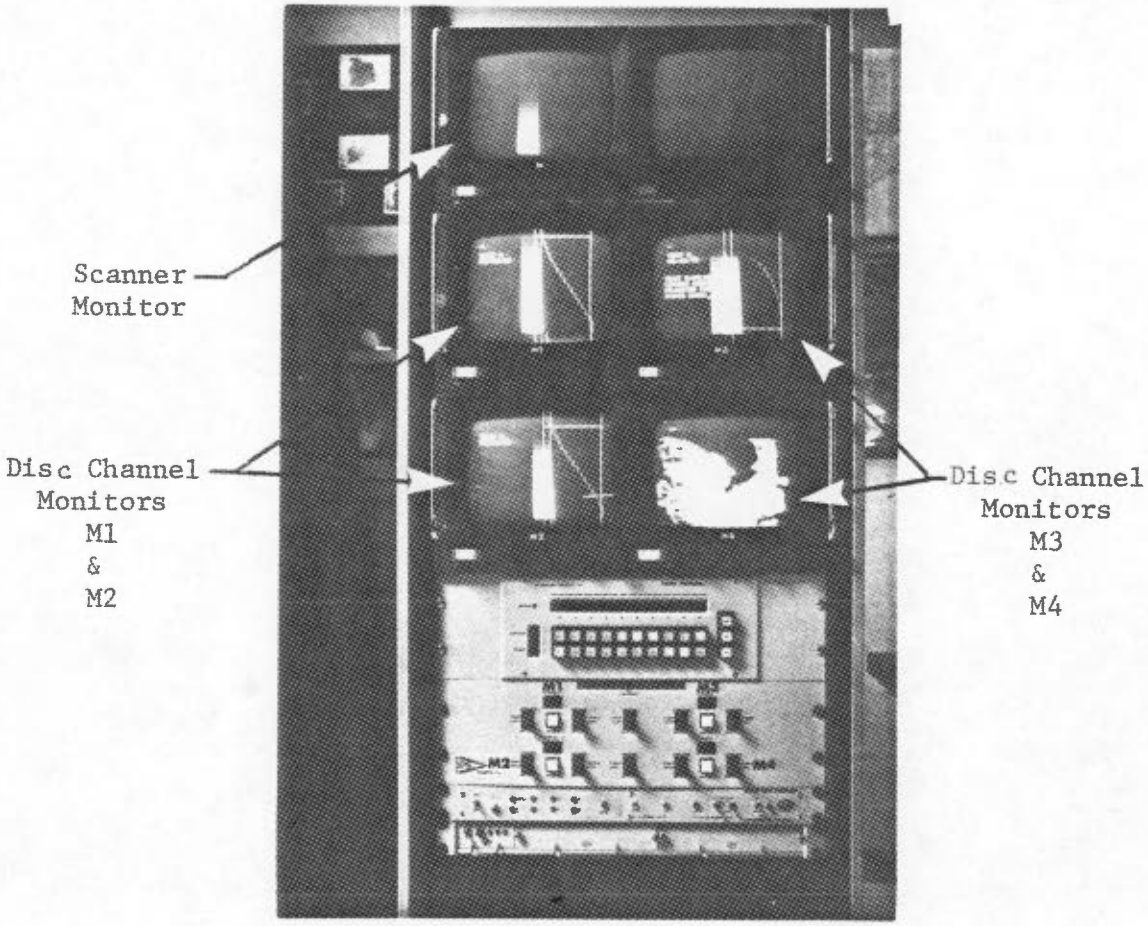

FIGURE 4.2. Channel Monitors For
The Video Disc

5. MULTISPECTRAL PROCESSOR

5.1 Introduction

The Multispectral Processor (MSP) permits the reconstitution of 3 spectral bands from the video disc into a colour composite on the colour monitor. Various positive or negative band ratios are possible through the MSP as are the alteration of the brightness and contrast of an image for enhancement purposes. The band ratios are obtained from images stored on disc while the brightness and contrast can be altered on an image from either disc or live from the scanner.

5.2 System Description

The signal flow through the system is shown schematically in Figure 5.1. The video from the EYECOM® Scanner and the video disc channels (SC, 1, 2, 3, 4) are switched to the Multispectral Procesor (MSP) circuits by the Input Switching Matrix (ISM). Delay circuits prior to the switcher adjust the horizontal registration of the four images.

Any three of the four inputs, i.e. Scanner, Disc 1, 2 and 3 may be selected as the **X, Y** and **Z** inputs to the MSP. The Main Processor Panel contains six banks of pushbuttons for selecting combinations of **X, Y** and **Z** either positive or negative, linear or log. The outputs of each pair of banks are added in proportional amounts in the **MIX** control. When an **OUT** pushbutton is depressed or the **BY-PASS** switch is turned to the left the **MIX** is

inoperative and only one signal is passed through. When the **MIX** dial is set to 5.00 (halfway) the two signals are added in equal amounts. At the two extremes one signal is passed and the other turned off. Turning the **MIX** fully clockwise results in 100% of the signal from right-hand column of a particular channel buttons that are pushed, i.e. **X, Y** or **Z**, being passed through the **LEVEL** and **GAIN** controls. If the **MIX** dial is turned fully counterclockwise then the signal from the left hand column of the same channel can be altered.

The mixed signal may be contrast enhanced by turning the **GAIN** control clockwise. The normal position for the **GAIN** control is counterclockwise. The **LEVEL** control adjusts the brightness level of the picture so that the contrast of different sections of the gray scale may be expanded.

The three mixed and contrast enhanced signals, **A, B** and **C** go to the Output pushbutton Switching Matrix (OSM). They can be switched to the red, green or blue channels of the colour monitor; to the DATACOLOR® input; or to the video disc for rerecording.

The DATACOLOR® receives **A, B** or **C** as selected and produces either an edge-enhanced picture or a colour analysis. The colour density analysis may be viewed on the colour monitor by depressing the top row of red, green and blue pushbuttons. The green output of the DATACOLOR® contains either the black and white density contour picure or the edge-enhanced

picture depending on the DATACOLOR® mode of operation. This B/W picture may be connected to the disc recorder using the appropriate pushbutton on the OSM. Figures 5.1, 5.2 and 5.3.

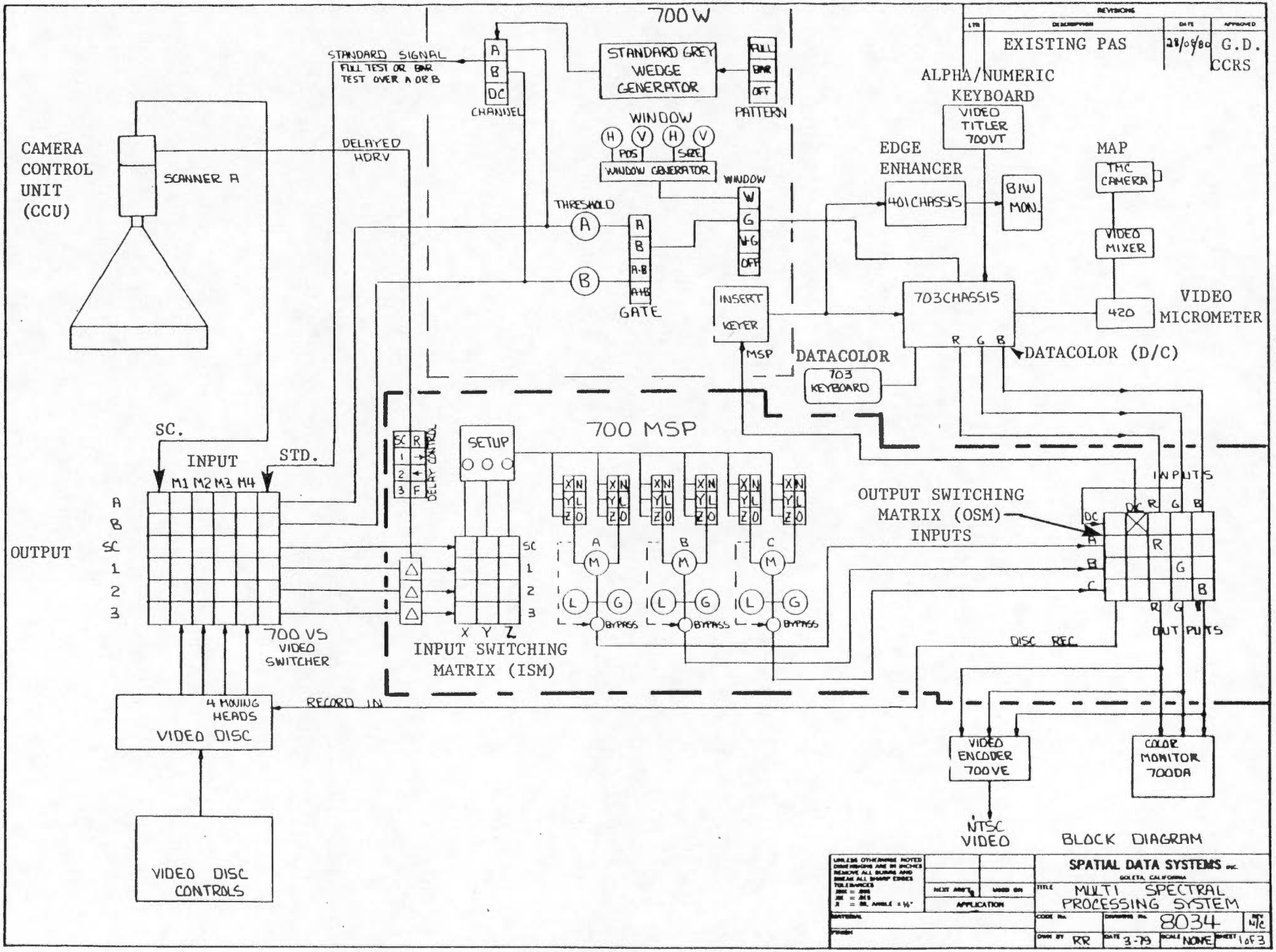

FIGURE 5.1 PAS SYSTEM OVERVIEW WITH MSP INDICATED.

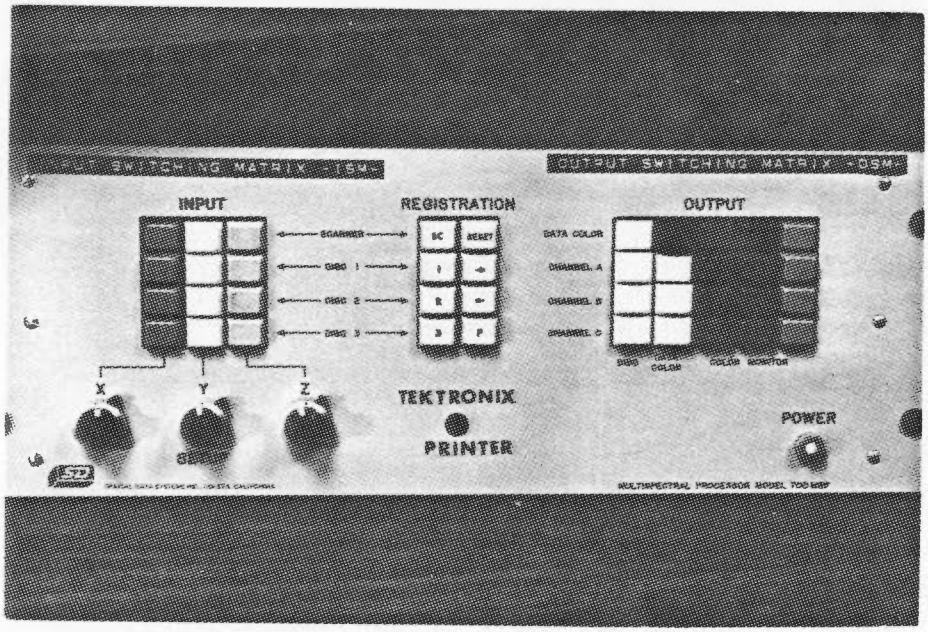

FIGURE 5.2. MSP - Left-Hand Chassis

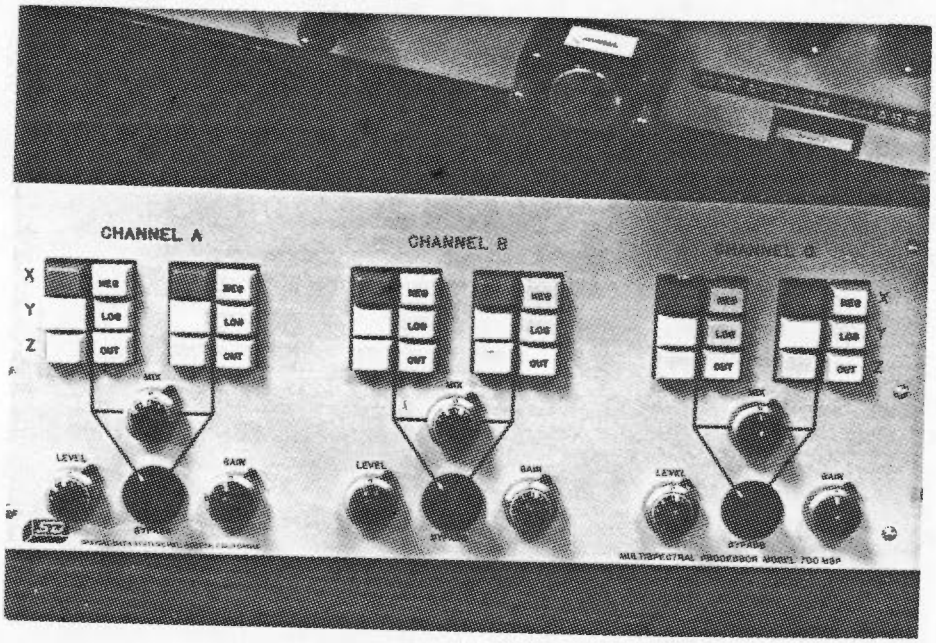

FIGURE 5.3. MSP - Right-Hand Chassis

6. INITIAL SET-UP PROCEDURES FOR THE PAS

In order to provide a standardized method of approach to the PAS, it is recommended that a user set up the various components of the PAS as described in the following sections.

6.1 Video Switcher

- The O/L line display sould read as follows:
  - Scanner (SC) **0** to read 9 (**STD**)
  - **D1** to read **M1**
  - **D2** to read **M2**
  - **D3** to read **M3**
  - **A** to read **0** (**SC**)
  - **B** to read **0** (**SC**)

6.2 Multispectral Processor Chassis (MSP) Figures 6.1 and 6.2

1. All buttons to be activated are indicated with a star ★ on the figures. On the **X** column of the Input Switching Matrix (ISM) push the scanner button (blue colour) and adjust the **SET-UP** dials on the **X**, **Y**, and **Z** columns of the ISM to read 1.8 (Figures 6.2 and 6.1).
2. Reset the disc and scanner registrations by pushing the **SC**, **1**, **2**, and **3** buttons following each one by pushing the reset button.
3. On the Disc column of the Output Switching Matrix (OSM) push the **DATACOLOR** button (white colour) on the top

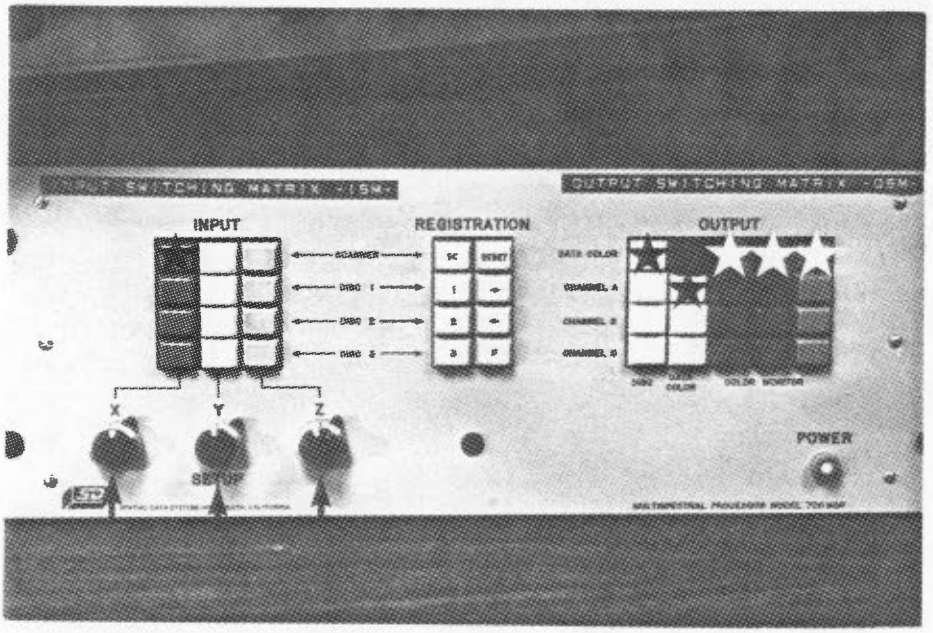

FIGURE 6.1. MSP - Left Chassis - Calibration Set-Up

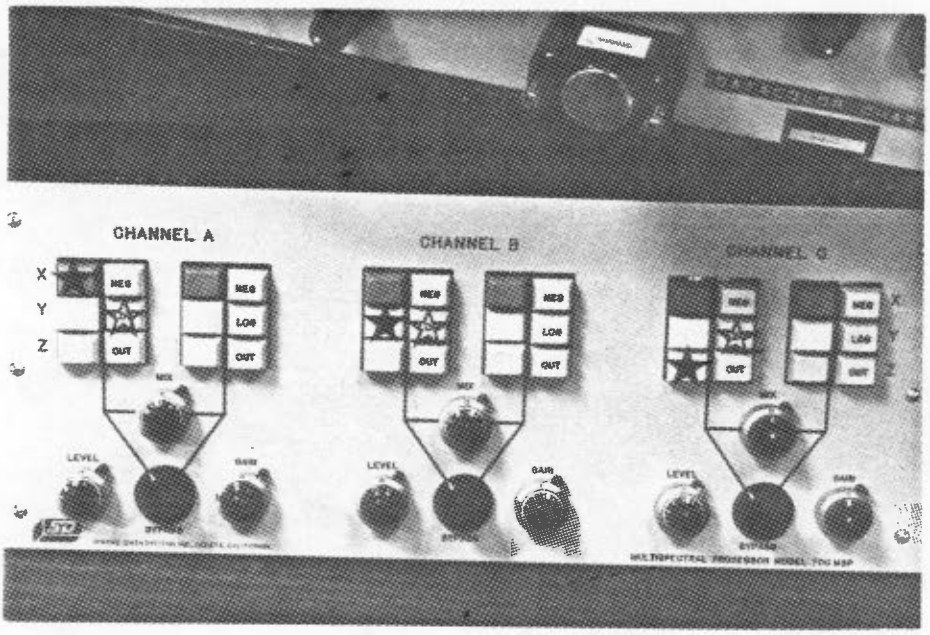

FIGURE 6.2. MSP - Right Chassis - Calibration Set-Up

row. Push down the red, green and blue buttons on the top row. Push also the **DATACOLOR** button (white) on the Channel A row, DATACOLOR® coloumn.

4. On the right MSP chassis, set channels A, B, and C to read **X, Y,** and **Z** respectively by pushing the appropriate buttons in the left columns of each channel. Push also the **LOG** buttons and turn the **BY-PASS** switch to the left.

6.3 Keyboard (Figure 6.3)

The keyboard consists of the 32 keys which allow a range of densities, say from 0 to 2.25 optical density units* to be divided into a maximum of 32 levels or slices or a minimum of 3 slices. There are 8 colours and 4 shades of each colour that colour code the 32 levels and each level is numbered. The yellow keys (#'s 1-4) are associated with low density values (clear) and the blue keys (#'s 29-32) are associated with higher densities (O.D. of approximately 2.25 black).

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* Optical Density (O.D.) = $\log \frac{1}{T} = \frac{Ii}{It}$

where T = transmission = $\frac{It}{Ii}$

Ii = light incident of a transparency
It = light transmitted through a transparency

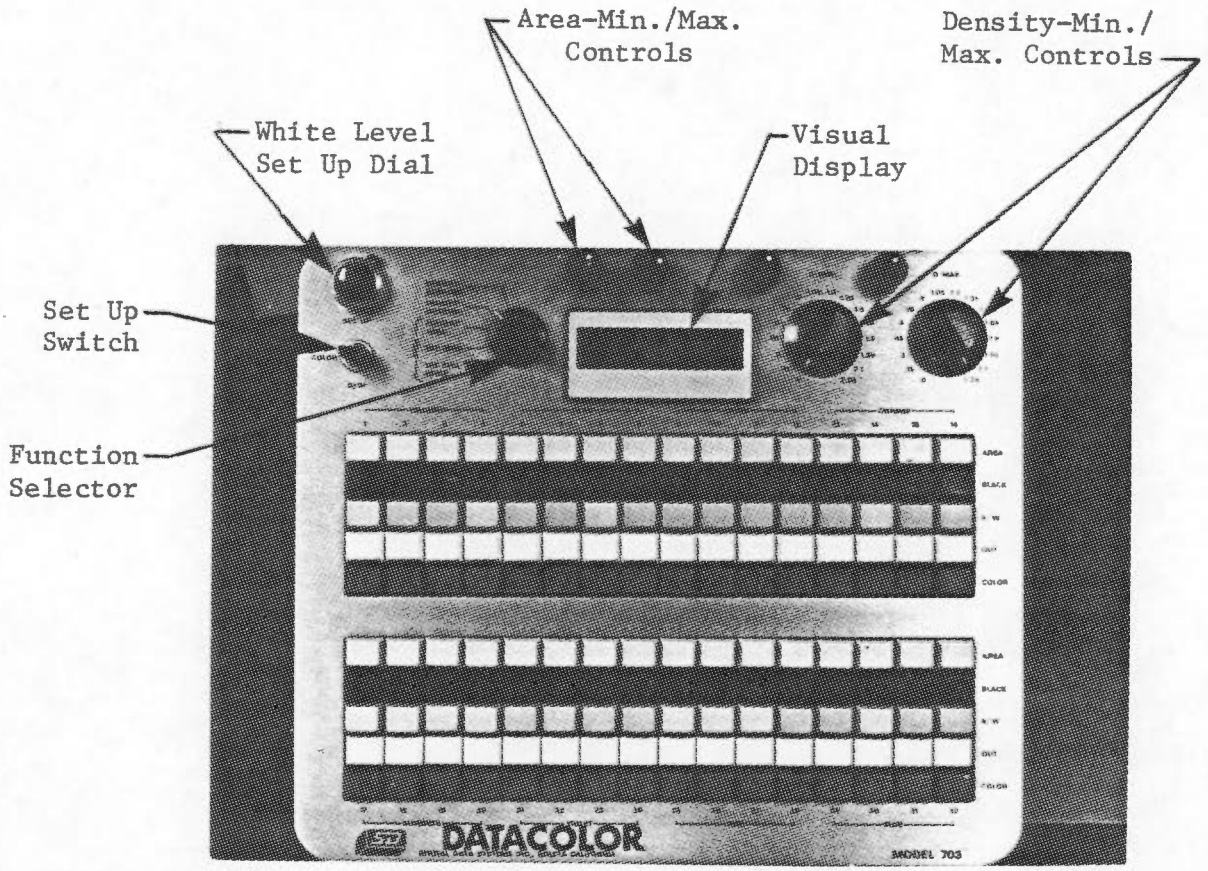

FIGURE 6.3. DATACOLOR® Keyboard

To activate a slice the blue **COLOR** key is pushed. This slice or level can also be encoded as black or gray by pushing a **BLACK** or **B/W** key. If the white **OUT** key is pushed the level is de-activated. If the area of a particular slice is required, push the brown **AREA** key after calibrating the area planimeter as outlined in Section 8.1. To stop measuring an area, push the brown key again.

Set the first 16 levels (#'s 1-16) on the keyboard by pushing down the blue keys. Check slices 17-32 to ensure that the white **OUT** keys are down and the slices are not active. Move the function selector to **Density Interval** and the **SET-UP** switch to **Color.** Place the D_{MIN} and D_{MAX} dials at 0 and 2.25 respectively and turn the fine adjustment dials for D_{MIN} and D_{MAX} fully clockwise.

The digital readout display shows what values are being read by the function selection. With the selector at **Density Interval** and the range of density values being analyzed going from 0 to 2.25 O.D. units, with 16 levels the reading on the display should be approximately .15 O.D. units. The values for the density interval should not be smaller than .03 - .04 or electronic noise from the system may affect the readings.

The **SET-UP** dial is used to bring in the first step (clear or low density) of a 16 step test wedge.

6.4 Camera and Light-Table (Figure 6.4)

1. Use the silver ring on the lens to adjust the aperture to f/2 to f/2.8.
2. Install a Kodak Number 2 Step Tablet in the centre of the light table under the top glass platen. Adjust the moveable masks to cut off extraneous light from around the step tablet.
3. Lower or raise the camera (with the large knob on the right of the stand) until the lowest part of the camera, the shutter, is approximately 24 cm (10") from the light table.
4. Open the shutter, centrally locate the step tablet by looking at the colour monitor and then use the adjustment knobs on the camera bellows unit to focus the image. The image should appear on three monitors - the small Scanner (SC) monitor in the vertical equipment rack, the edge enhancer monitor and the colour monitor.

   The light table can be moved in the X and Y directions by releasing screws "**X**" and "**Y**" and it can be rotated by releasing screw "**Z**". Fine adjustment is accomplished by locking screws "**X**" and "**Y**" and then adjusting screws "X^1" and "Y^1", noting any changes by means of the scales and pointers.
5. Leave the shutter open and proceed to the next section.

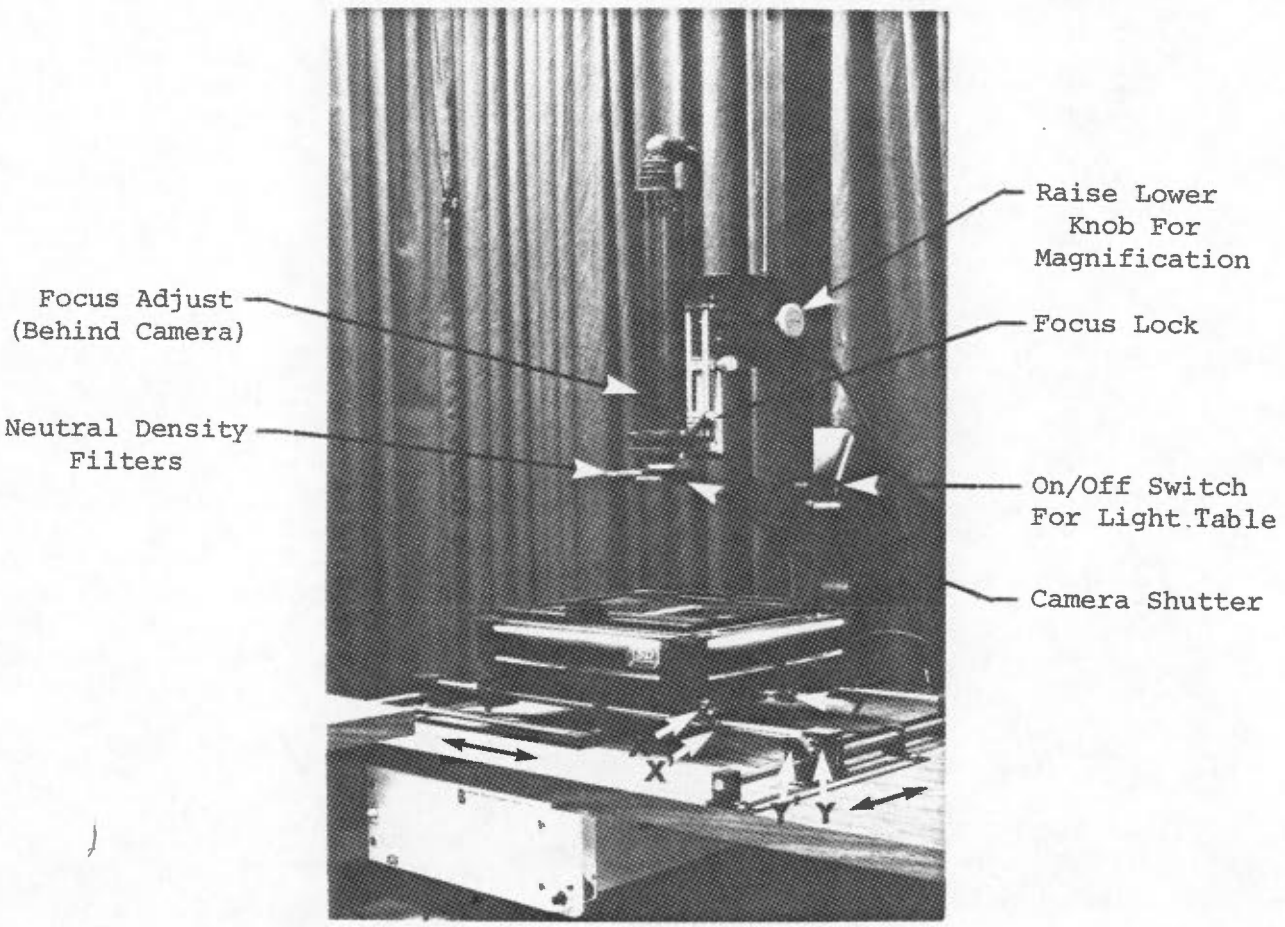

FIGURE 6.4. EYECOM® Camera and Light Table

X, Y & Z are locking screws to stop motion in the X, Y & Z (rotation) directions respectively.

X^1 & Y^1 are fine adjustment screws in the X & Y directions respectively.

6.5 DATACOLOR® Chassis (Figure 6.5)

1. All toggle switches on the front of the chassis, except the power switch, should be down.
2. Turn the profiler on by turning the inner dial of profiler clockwise until the profile appears on the colour monitor.
3. Move the extreme left line of the profiler over the stepwedge (tablet) image on the colour monitor. A stepped profile of the density on the step tablet is then shown to the right of the tablet. See Section 8.3 for more details about the profiler.
4. Close the shutter.

6.6 Calibration Procedure

After 1/2 hour from starting up the PAS

1. Open the shutter and adjust the **SET-UP** dial on the keyboard to bring step number 1 (white) onto the first clear step of the tablet (0 density) (the colour screen should not go orange). If step number 1 cannot be placed on the clear step of the tablet, then open the aperture of the lens to between 2.0 and 1.4.
2. Adjust the **SET-UP** dial on the camera control unit (CCU) (Figure 6.6) until step number 16 (dark orange) falls

FIGURE 6.5. DATACOLOR® Chassis

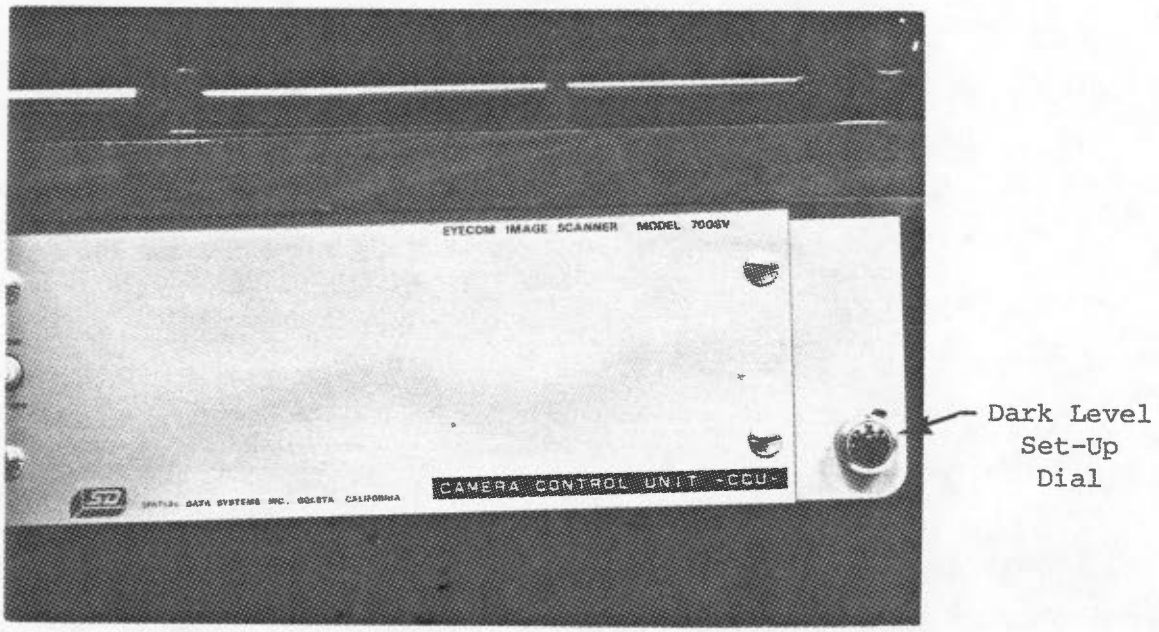

FIGURE 6.6. Camera Control Unit (CCU)

on the 16th step of the tablet.* Readjust the other **SET-UP** dial on the keyboard if the first white colour of the keyboard moves off the first step of the wedge. Iterate between both dials until there is 1 colour per slice.

3. Close the shutter.
4. Repeat steps 1 to 3 approximately 1 hour after starting up the PAS.
5. The PAS should remain stable for the duration of the working session with only minor adjustments of the **SET-UP** dial on the CCU required.
6. The PAS is now calibrated for use with the camera at the same height. For any change in camera height steps 1 and 2 should be repeated for more precise densitometric work. For qualitative analysis recalibration is not necessary.

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*NOTE: **There may be noise in the dark end of the step wedge making the allocation one of the 4 orange shades to steps 13, 14, 15 and 16 somewhat difficult. The noise is usually dark orange (step number 16) in colour and may also be located at the bottom and corners of the colour monitor.**

7. OPERATION OF THE PAS FOR RECORDING AND DENSITY SLICING

7.1 General

1. Both the Video Switcher and MSP chassis, should be set up as described in Section 6.1 and 6.2.
2. The keyboard should be set up as described in Section 6.3. For recording the **SET-UP** switch is moved to black and white (**B&W**) position and for slicing it is left on **Color.**
3. If the electronically generated gray level standard is required to be with the image to be analyzed or recorded, turn on the standard which is located in the Universal Window Chassis (UWC) Test Wedge section. To turn the standard on, push **BAR** and **A** or **B** to create a continuous tone test wedge on the top of the edge enhancer's (EH) monitor and the colour monitor. In the Window section of the UWC push the **OFF** button. In Figure 7.1 the stars ★ show buttons to be pushed.
4. Place an image on the light table and then mask the area of interest. Open the shutter, magnify the image as desired and then focus the image. With the **SET-UP** switch on the D/C keyboard on **Color** there should be no black areas showing in the image. If there is black in the high density areas and there are colour slice numbers 4 or 5 in the low density areas, consult Section 7.3.2 on Analyzing High Density Photographs.

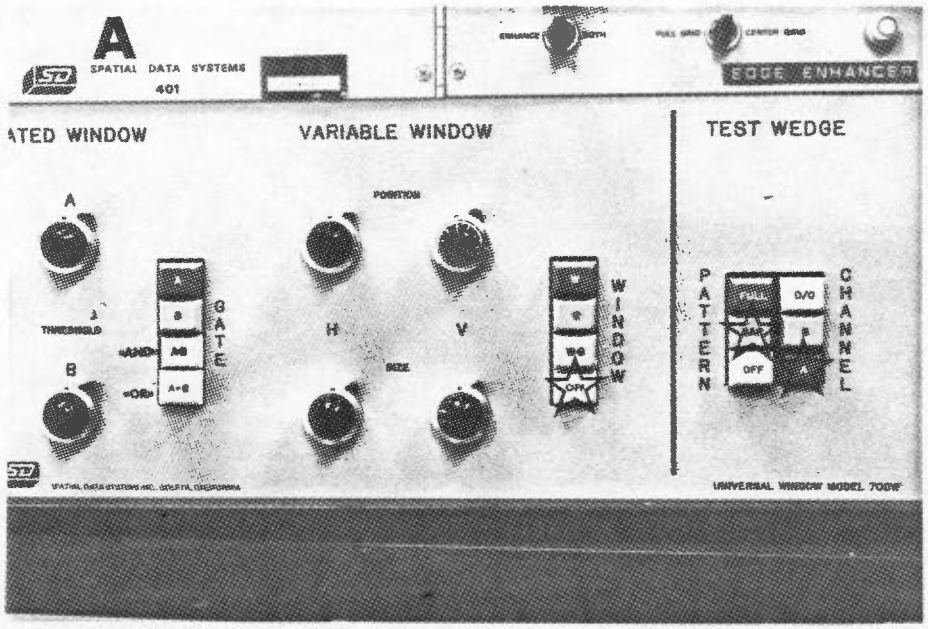


Figure 7.1. Universal Window Chassis

Close the shutter. Lock the light table in place by means of screws "**X**", "**Y**" and "**Z**".

7.2 To Record

1. On the Disc Controller, select a channel (M1 to M4) and a track (2 to 89), to store the image.
2. Use Channel A on the MSP to display the image on the colour monitor.

   NOTE: Always record each image (different bands or dates) to be stored on disc, through the same channel, i.e. if A is used for band 1, then A should be used for bands 2, 3, 4, etc.
3. Move the **SET-UP** switch on the D/C keyboard to **B/W.**
4. Open the camera shutter.
5. Annotate the image by means of the alpha/numeric keyboard, as desired (Section 12).
6. To store the image and annotation push the **RECORD** button (white) on the disc controller on for example, channel M1 track 10.
7. Close the shutter and remove the image from the light table.
8. To store images of different bands or dates, already preregistered on the punch registration light table, repeat steps 1 to 7. Store each image in a logical sequence, i.e. if band 1 is on channel M1 track 10 then

store the subsequent bands or dates use channels M2 track 10, M3 track 10, M4 track 10. If more bands or dates are to be stored then use track 11 on the four channels.

7.3 Normal Operation as a Density Slicer from the Scanner

On the DATACOLOR® keyboard turn the **SET-UP** switch to **Color** position and use the D_{MAX} and D_{MIN} dials to adjust the density range represented by the colour analysis (see below). The numbers of colours may be reduced by depressing the **OUT** keys for those colours that are not needed. The colours always represent equal density intervals no matter how many are used. Therefore, when an **OUT** key is depressed, the corresponding colour disappears, and all the other colours shift to fill the space. Any combination of from 3 to 32 levels may be used. If any black areas appear between slices push the keys down more firmly. Move function selector switch to Density Interval and the density step for each colour is indicated directly.

The **BLACK** keys, "black-out" colours so as to accentuate particular densities. These keys are useful to pick out a colour band not immediately obvious.

The **B/W** keys are used to insert the original black and white photograph in parts of the display. Thus, the original can be monitored while specific densities are displayed in colour.

7.3.1 Image Calibration for a Density Slicing

1. Install an image in the light table and mask area of interest.
2. Magnify and focus image until approximately 80% of the colour monitor screen is taken up by the image.
3. Move **SET-UP** switch to colour position and the first 16 slices are in use.
4. Turn D_{MAX} dial counter-clockwise until some black appears in an image area. Turn clockwise 1 position and use fine adjustment to just remove the black.
5. Turn D_{MIN} dial clockwise 1 position and use fine adjustment to just bring in the white slightly.
6. The total image is now calibrated. The D_{MIN} and D_{MAX} controls may be used, if desired to narrow the density interval to look at a particular range of densities of interest to the user.
7. The density interval should not be smaller than 0.04 D.

7.3.2 Analyzing High Density Photographs

When the minimum density in the photograph is greater than 0.6, then better results are obtained by removing one of the neutral density filters out of the camera lens light path. The filter assembly on the camera lens contains two 0.6 D filters mounted on slides. Pulling one slide out removes one filter, both slides out remove two filters for photographs with a

minimum density of greater than 1.2.

A density value of 0.6 for 1 filter out and 1.2 for two filters must be added to the **D_{MAX}** and **D_{MIN}** controls to obtain the correct density reading. Thus, the density range is expanded to 3.45 D.

In order to protect the camera tube from overexposure do not remove filters if any area of the photograph is less dense than the 0.6 D and 1.2 D limits.

7.4 Density Slicing Images Stored on Disc

1. Select disc location, i.e. channel and track, from the Disc controller, of the image to be analyzed.
2. On the MSP left hand chassis in the ISM, push the Disc 1 button on the X column (see figure 7.2). On the right MSP chassis push the **X** button on A and the image will appear on the EH monitor and the colour monitor (see Figure 7.3). On the right chassis of the MSP remove the log function by pushing the **LOG** button to allow it to come up. After setting the **SET-UP** switch on the D/C keyboard to **Color**, adjust the **X-SET-UP** dial on the ISM to bring the dark orange (level #16) to colour the maximum density of the image.

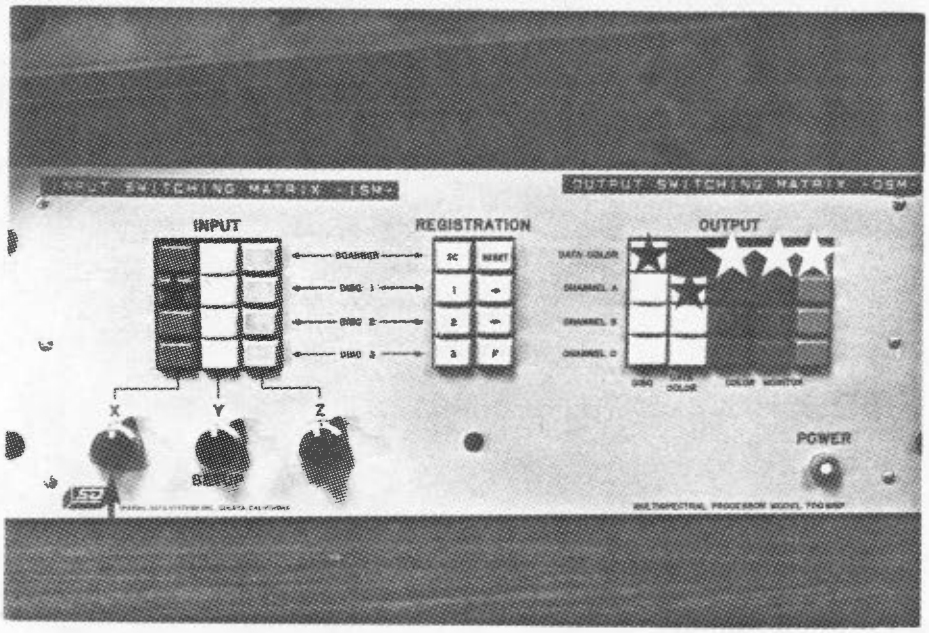


FIGURE 7.2. MSP-LEFT CHASSIS - Push Button set up to read & density slice an image from disc 1 (D1) through channel A.

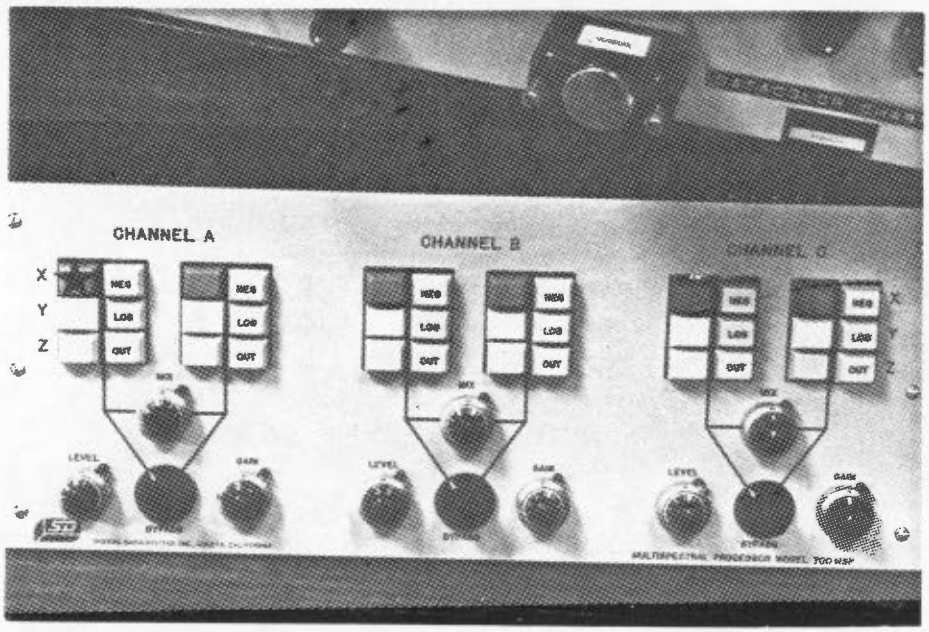


FIGURE 7.3. MSP-RIGHT CHASSIS - Push Button set up to read & density slice an image from disc 1 (D1) through channel A.

3. All other aspects and functions of the MSP's right and left chassis and the keyboard remain the same as described in Sections 6.2 and 6.3.
4. The PAS can now be used to density slice the image as described in Section 7.3 - Normal Operation.

8. OPTIONS

8.1 Area Planimeter (Figure 8.1)

When the function selector is switched to **AREA**, the digital readout operates with the DATACOLOR® Planimeter circuits and indicates the area represented by each of the colours relative to the total area of the masked picture. The **AREA** keys (brown) on the colour keyboard select the colour to be measured. When more than one **AREA** key is depressed, the Planimeter indicates the sum of the area of the colours. The Planimeter will continue to indicate the selected area even when the colour or colours are replaced by the **BLACK or B/W** keys.

To measure an area, the Planimeter must be adjusted for zero and full scale for the picture size being used (nominally a rectangle about 80% of the CRT screen area).

1. Adjust the DATACOLOR® **D_{MIN}** and **D_{MAX}** controls so that the entire frame contains colours.
2. Set selector switch to **Zero** and adjust **Zero** control for 000.0% reading.
3. Set selector switch to **Full Scale** and adjust the **Full Scale** CONTROL so that the Planimeter reads 100.0%. If 100.0% cannot be achieved, then adjust the camera magnification so the full scale reading is 100% or adjust the full scale reading to be a multiple of 100%, i.e. 25 or 50%.
4. Recheck the **Zero** and **Full Scale**, steps 2 and 3.

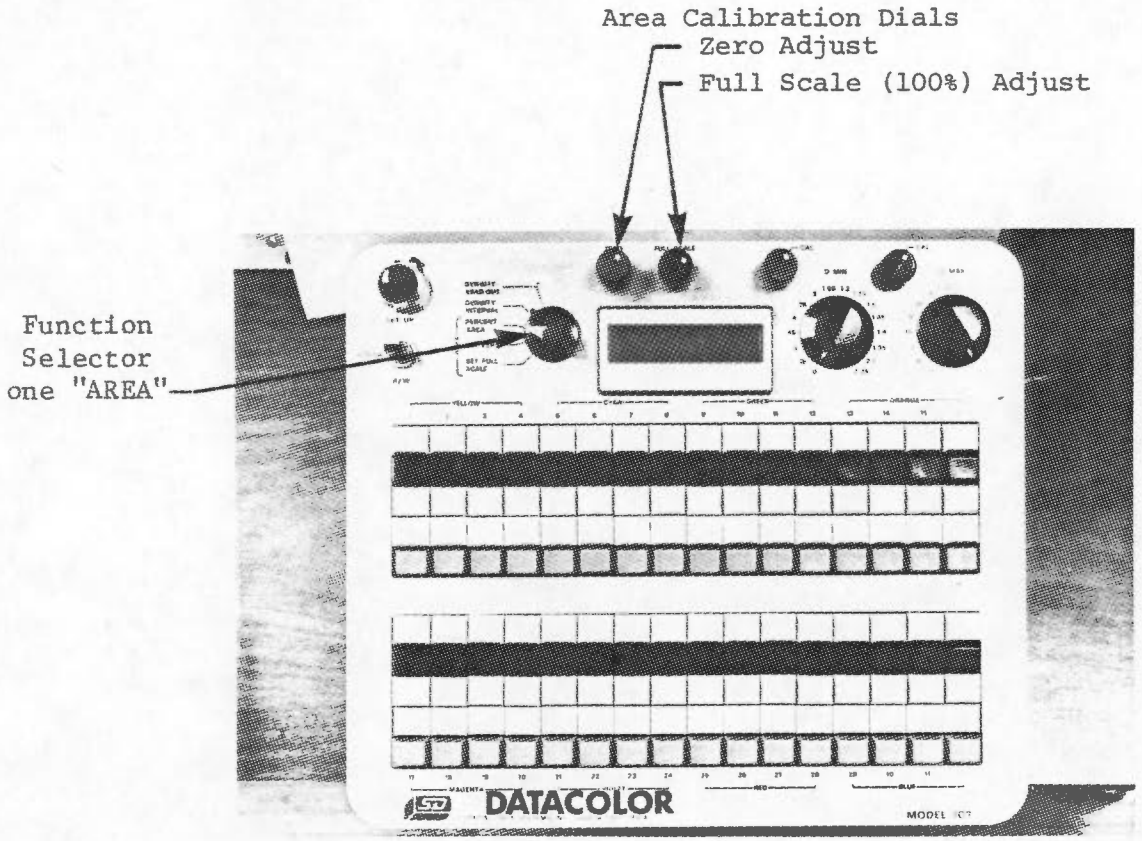


FIGURE 8.1. Area Planimeter on DATACOLOR® Keyboard

5. Set selector switch to **AREA.**

The Planimeter is now ready to measure the percent area of the colours. Depress **AREA** key(s) corresponding to the desired colour(s) and read the % area as indicated.

The Planimeter measurement is based on the accuracy of the camera scanning system and is independent of the monitor scanning adjustments (height, width, linearity, etc.). When the Window Option (Section 8.7) is in use, the Planimeter will only measure the areas of levels within the window. If a binary mask is used to mark out an irregular region of interest, the Planimeter will measure the areas of levels within the irregular region (e.g. a drainage basin).

8.2 Gamma Control (Model 703-2) (Figure 8.2)

The standard Model 703 has calibrated controls for the upper and lower limits of the density range shown in the colour analysis. Each colour band then represents, within the accuracy of the DATACOLOR®, equal intervals of density so that the curve of density versus colour is linear. The slope of the colour-density curve is analogous to the slope of the photographic density-log exposure curves. The slope of these curves are generally denoted by the Greek letter gamma. The gamma of the density-curve is set by the DATACOLOR® density controls and is constant over its range. The gamma of the photograph is not constant except in the center of its range. The optional

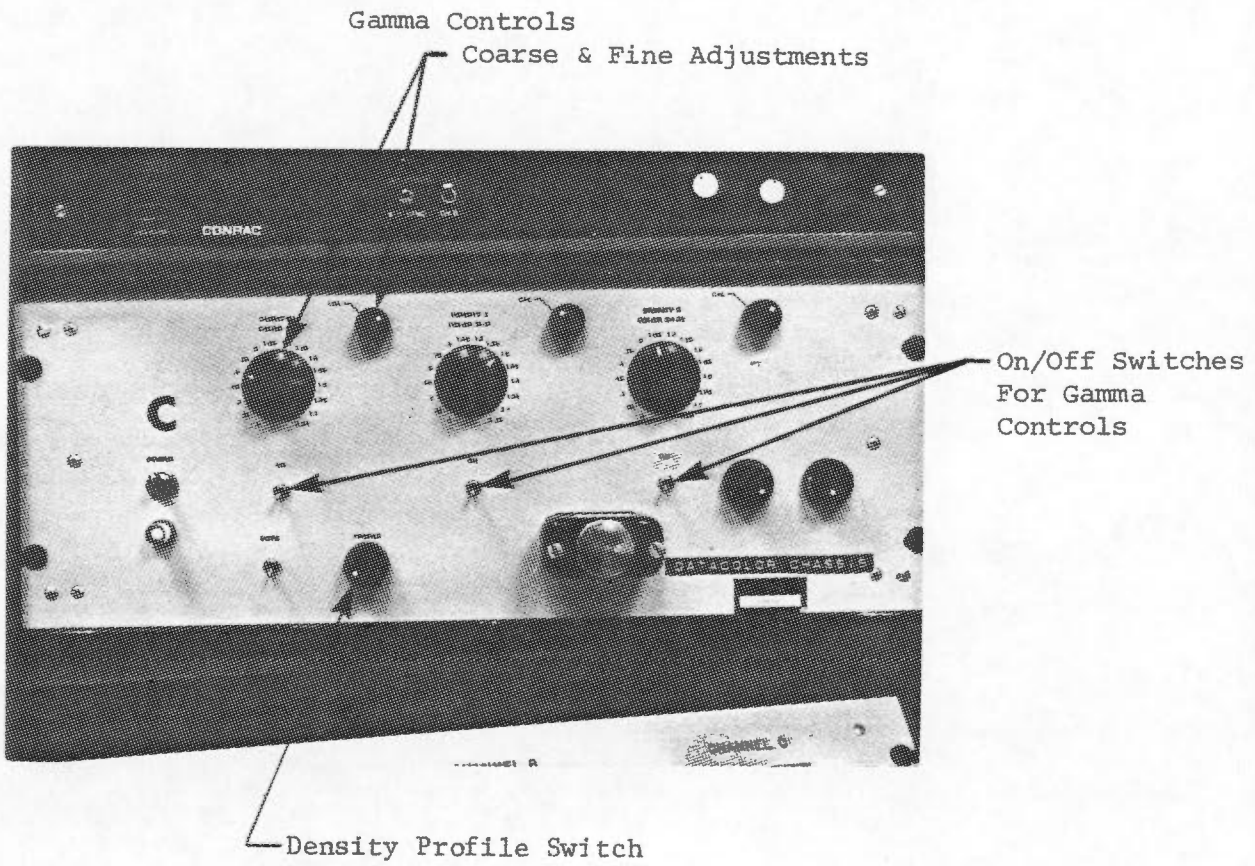


FIGURE 8.2. DATACOLOR® Chassis

DATACOLOR® Gamma Controls provide three extra density dials for changing the gamma of selections of the density colour curve to simulate or compensate for the photograph's non-linearity.

The Gamma Controls on the colour analyzer front panel are identical in operation to the Density Controls on the keyboard. The three Gamma Controls plus the two standard Density Controls divide the density range into four sections of eight colours each. The density corresponding to the five end-points of each colour section are set directly on the five controls and can result in many density-colour curves. Thus, for an image with a given density range, a particular group of densities of interest to the analyst within the total range, may be subdivided into finer increments than the densities outside this group.

Each of the three Gamma Controls has a switch which disables the control. With all three switches off, the colours represent equal density intervals. With one switch on, a three slope curve; and with three switches on a four slope curve.

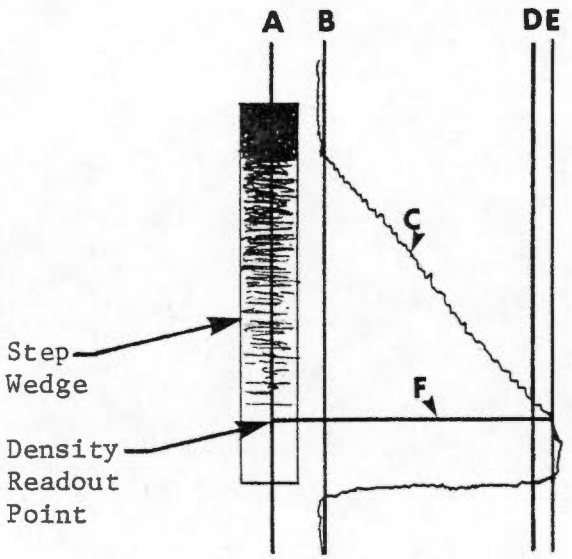
The density increment per colour may be further adjusted by using the **OUT** keys on the Colour Keyboard to vary the number of colours between the end-points of a colour section. Thus, halving the number of colours in one section from eight to four doubles the density interval for one slice.

8.3 Density Profile Display (Data Color Chassis) (Figures 8.2 and 8.3)

The Density Profile Display allows the presentation, under control of a front panel dial, of a graphic display of density along a vertical line in the picture. The display is turned on by turning the inner dial of the profile dial clockwise. The inner dial controls the location of the horizontal line F and the outer dial moves the profile across the screen of the colour monitor. A vertical white line (**A**) on the extreme left serves to indicate the cross-section across the picture along which the displayed densities are taken. The next line (**B**) serves as the base line of the graph and corresponds to a density of approximately 2D. The actual density values are shown plotted to the right of the reference line, maximum amplitude to the right corresponds to ZERO density, line **D** for image calibration density and line **E** for unit calibration.

Density variations across any line in the photograph on the light box may be displayed simply by translating and rotating the light box until the desired picture area lies along the reference vertical line.

The density profile (**C**) may be calibrated by analyzing a calibrated step wedge.



A - Reference Line for Measurements

B - D_{MAX}

C - Profile

D - D_{MIN} - Image Calibration

E - D_{MIN} - Machine Calibration

F - For Spot Density Readout

FIGURE 8.3 - Colour Monitor Profiler

8.4 Density Readout (Figures 8.3 and 8.4)

Associated with the above density profile display is a spot density readout. The spot reader is located by the extreme left profile line and an adjustable horizontal line (F).

To obtain a density value, turn the function selector on the D/C keyboard to **Density Readout** and move the vertical and horizontal intersection point to the spot where a density value is desired. The entire profile display must be visible on the screen in order to make proper density measurements.

8.5 Video Micrometer (Figure 8.5)

The Model 420 Video Micrometer operates in conjunction with the Model 703 DATACOLOR® to provide fast, semi-automatic measurement of objects viewed on the display. The unit is self-contained in a single keyboard unit that is operated remotely from the DATACOLOR®.

The principle of the Video Micrometer, is that any object displayed on the DATACOLOR® at any power of magnification can be measured by two calibrated reference marks adjustable in spacing. The spacing is read from a digital display that, when calibrated, reads directly in the proper units: millimeters, meters and kilometers. The marks may be oriented vertically or horizontally by means of a front panel switch so that dimensions in either axis may be measured. The subject may be oriented in line with the dots by rotating the light table. Vertical

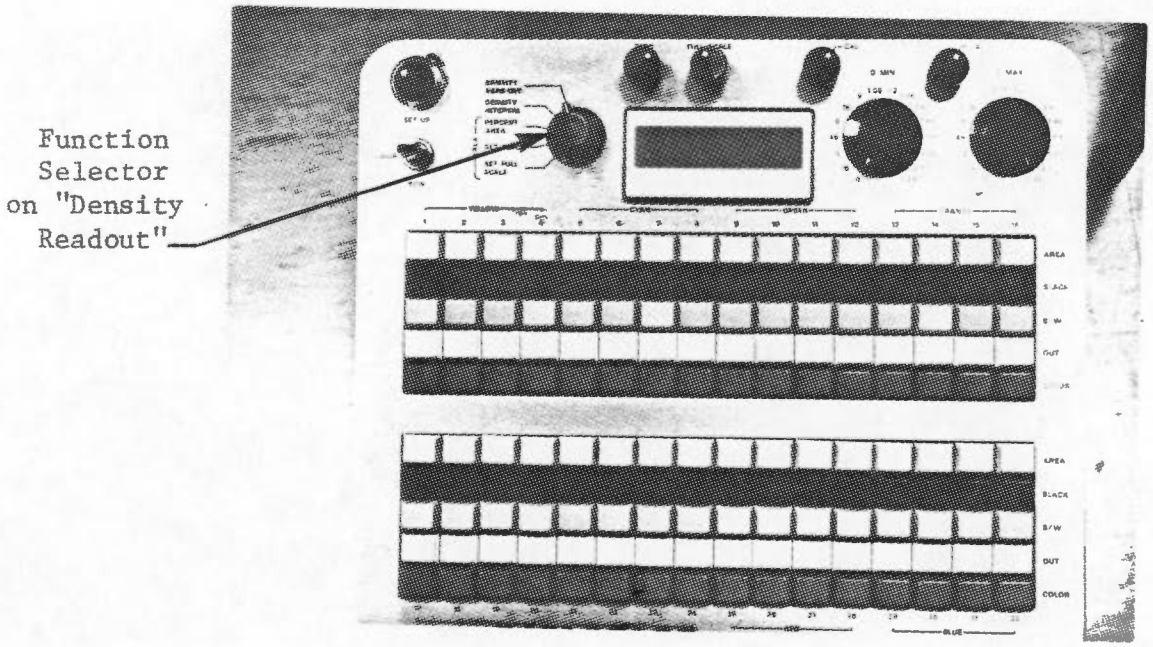


FIGURE 8.4. Spot Density Measurement on DATACOLOR® Keyboard

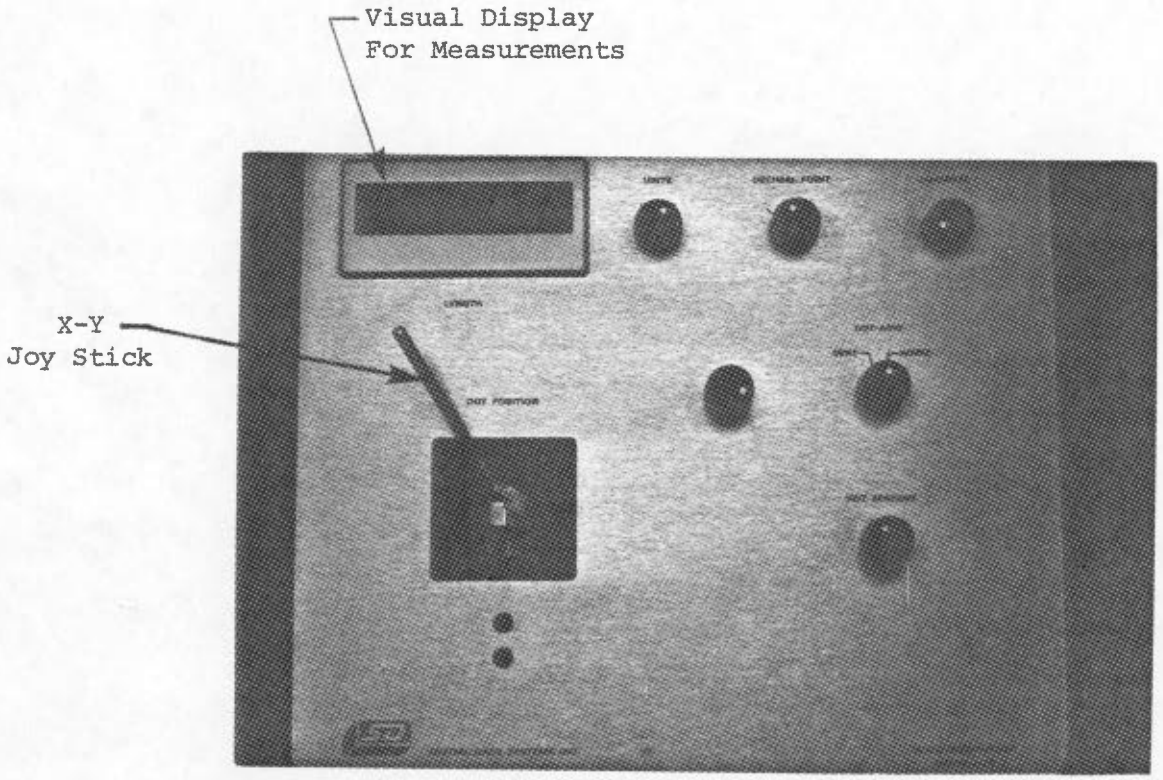


FIGURE 8.5. Video Micrometer

dimensions are measured between the end points of a horizontal line. Calibration is quickly performed in three easy steps:

1. Select the proper magnification and focus for the size of the object to be viewed and place a calibrated scale in the field of view.
2. Use the **X-Y JOYSTICK** to position the reference marks on the scale and adjust the **DOT SPACING** control to match a convenient length (e.g. 1.80 Kilometers).
3. Adjust the **DECIMAL POINT** and the **CALIBRATE** dial so that the digital readout indicates 1.80. Set the **UNITS** control to display km.

   The Micrometer is now ready for use. Any object may be measured by positioning the reference marks with the joystick and adjusting the spacing to match. The correct length is read immediately on the digital readout.

8.6 Edge Enhancer

8.6.1 Introduction and Overview (Figure 8.6)

The Model 401 Edge Enhancer uses a combination of analogue computer and closed-circuit television systems to produce an enhancement of edges and lines in photographic transparencies. A high-intensity light table illuminates the transparency. A precision closed-circuit television camera (EYECOM® Scanner) on an adjustable mount converts the illuminated image to an

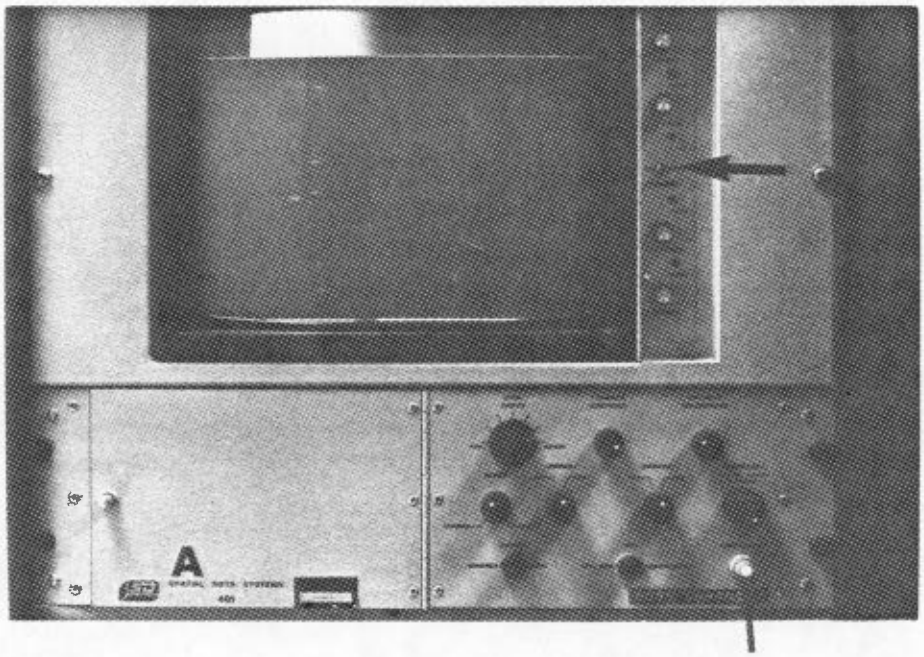


FIGURE 8.6. Edge Enhancer Monitor and Controls

electrical video signal. This signal is processed by high speed analogue computer circuits in the Enhancement chassis. These circuits produce an enhanced television picture which is reproduced on the Enhancement or DATACOLOR® monitors. Front panel controls adjust the amount of enhancement and also allow the normal reproduction of the photograph on the monitor.

This enhancement technique is extremely useful for detection of linear or circular features such as geological lineaments, faults, etc. on photographic transparencies.

The Enhancement Process

The television signal from the camera can follow one of two paths through the enhancement circuits. The first path provides normal or inverted amplification of the signal so that the image may be viewed on the monitor as a positive or negative reproduction.

The second path also provides for positive or negative amplification but processes the signal for edge enhancement.

An analogue computer circuit performs two operations:

a. Calculate the relative photographic density of the transparency.

b. Calculate the rate of change of the relative density across the picture from left to right.

The result of these operations, calculated at television speeds, is displayed on the monitor. Gray areas on the enhanced

picture represent zero density change, white represents positive change, black represents negative change. Sharp edges show as black or white shadows. The width of the lines and shadows are adjustable by a front panel control. Contrast and brightness are also adjustable by front panel controls.

Notice that only density changes in the horizontal direction are calculated and displayed. This means that edges and lines running horizontally across the monitor screen are made invisible. This feature allows undesirable features to be eliminated by rotating the transparency so as to align these features horizontally across the monitor screen. The light-table has been designed for easy rotation so that the operator can take full advantage of this feature.

Reference Grid

An electircally generated reference grid is provided. The grid may be superimposed on the entire picture or only in the center. The accuracy of the grid spacing in reference to the photographic transparency is dependent only on the geometric accuracy of the camera. Geometric distortions in the monitor do not introduce error when using the grid for measurements.

Simultaneous Normal and Enhanced Display

The enhancer may be operated so that both the normal and enhanced displays are visible simultaneously. The center of the

picture is enhanced and the rest of the picture is shown normally.

8.6.2 Operating Procedures

Monitor Controls

1. **BRIGHTNESS** - adjusts brightness of normal picture.
2. **CONTRAST** - adjusts contrast of normal picture.

Enhancement Controls

1. **ENHANCE - NORMAL - BOTH** - selects the display of enhanced, normal, or both enhanced and normal picures.
2. **FULL GRID-OFF-CENTER GRID** - displays, either a full grid over entire screen or a central grid.
3. **NORMAL ±** - reverses a gray scale in normal picture to produce a negative or positive display.
4. **ENHANCE ±** - reverses a gray scale in the enhanced picture.
5. **EDGE WIDTH** - varies the width of the edges in the enhanced picture in seven steps from fine to coarse.
6. **ENHANCE CONTRAST** - adjusts the contrast of the enhanced picture.
7. **ENHANCE BRIGHTNESS** - adjusts the brightness of the enhanced picture.
8. **ON** - push-button power switch turns on power to light table, camera, monitor, and enhancement chassis.

Adjust for Normal Picture

1. Lift the top glass frame on the light table and place transparency under glass. Close top glass to hold transparency in place.
2. Mask the transparency so that clear areas are covered. Excessive light surrounding the film will cause reflections in the camera lens which will interfere with the enhancement.
3. If a dark area of the photograph is to be enhanced it is best to mask off any nearby light areas, such as identifying numbers, to prevent overexposure of the camera.
4. Remove camera lens.
5. Set **ENHANCE-NORMAL-BOTH** switch to **NORMAL** and **NORMAL ± to +**.
6. Adjust monitor **CONTRAST** and **BRIGHTNESS** to obtain a visible, but not necessarily focussed, image.
7. Adjust light table position, camera **HEIGHT** and **FOCUS** for desired area of view and proper focus.
8. If picture is washed out or dim, open camera lens (Decrease f stop number) or remove one or two neutral density filters (Section 7.3.2) to obtain a good picture. Do not open lens more than is necessary to obtain a good picture so as to prevent overexposure. As a rough guide, normal photographs require about f2

to f4, very light photos about f8 to f16, and very dark film about f2 to f1.4.

9. Readjust monitor **CONTRAST** and **BRIGHTNESS** for the best picture.
10. The picture gray scale may be reversed with the **NORMAL ±** switch if desired.
11. The enhance image may also be displayed on the DATA-COLOR® monitor by moving the toggle switch on the front of the monitor from channel A to B (Figure 6.5).

Enhancing the Picture

1. Having adjusted for normal operation (above), place the **NORMAL-ENHANCE-BOTH** switch in the **ENHANCE** position.
2. Set the **EDGE WIDTH** to an intermediate position and adjust **ENHANCE CONTRAST** and **ENHANCE BRIGHTNESS** for optimum results.
3. **EDGE WIDTH** may be adjusted for best rendition of the enhanced picture. The **ENHANCE ±** switch provides reversal of the image.

Eliminating Horizontal Lines

The light table is designed so that the area of interest on the photograph may be translated and rotated. Rotation of the image is an important part of the enhancement process as any

lines or edges lying horizontally across the monitor screen are elminated.

Rotate the photograph so that lines of interest are vertical or at least a 30° angle from the horizontal. Interfering lines or scratches will disappear if they are made to lie exactly horizontally. Since the vertical structure in the interfering lines is enhanced, the effect is like "seeing through" the interfering lines.

Observing Both Normal and Enhanced Picture

Place the **NORMAL-ENHANCE-BOTH** switch in the **BOTH** position. The normal picture will now surround the central enhanced square. Control of the two images is exactly the same as for each alone.

8.7 Universal Window Chassis

8.7.1 Introduction

The Universal Window is designed for use with the Multispectral Processor, MSP, to provide the following functions:

1. A variable size and position rectangular reference window to define the area of colour analysis.
2. A window whose boundaries are gated or keyed by an external video signal or combination of two video signals.

3. A window which is the logical OR of the rectangular and video gate.
4. A standard logarithmic video signal that produces a reference test wedge. This wedge may be combined with a video signal to display the wedge across the top of the picture or across the entire picture.

8.7.2 Operating Procedure

8.7.2.1 Controls (Figure 8.7)

1. **Gated Window THRESHOLD A&B:** Adjusts threshold or keying levels applied to video A and video B

   GATE: Selects gated window signals as either:

   A - video A threshold

   B - video B threshold.

   A.B - logical AND of A and B

   A+B - logical OR of A and B.

2. **Variable Window**

   POSITION H&V: Adjusts horizontal and vertical position of variable window rectangle.

   SIZE H&V: Adjusts horizontal and vertical size of variable window rectangle.

   WINDOW: Selects output window as either:

   A - variable window.

   B - gated window.

   W.G - logical AND of variable and gated windows.

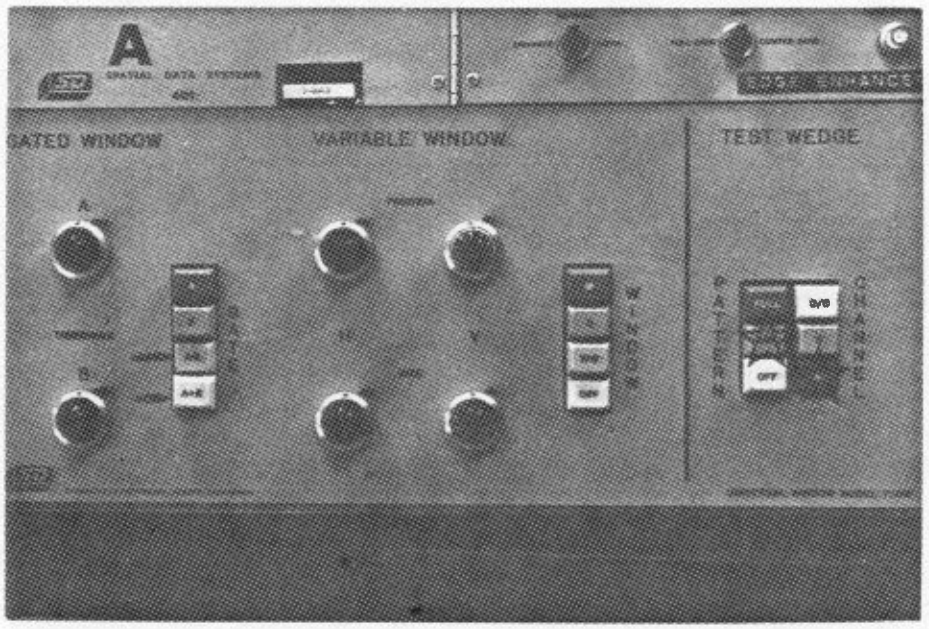


FIGURE 8.7. Universal Window Chassis

OFF - no window (full screen).

3. **Test Wedge**

PATTERN: Selects test wedge pattern as either:

FULL: test wedge is displayed the full picture height on STD video;

BAR: test wedge is displayed at top of STD video; or

OFF: no test wedge.

CHANNEL: Selects video channel for test wedge output as either:

D/C: inserts test wedge at input of the DATACOLOR (output of MSP, Channel A, B, or C); generally not used.

B: inserts test wedge into video B and outputs on STD; or

A: same as B except video A.

8.7.2.2 Principles of Operation

The Universal Window operation is shown functionally in the block diagram of the PAS, Figure 1.1. This drawing also shows the connections to the MSP.

Test Wedge

The test wedge is generated by the Standard Gray Wedge Generator either as a bar reference, or full screen as selected by the pattern pushbuttons. The test wedge appears on the STD

output, and can be inserted into the video on video A or video B channels as selected by the channel pushbuttons. The arrangement of the Video Switcher (Section 3) under "**Normal Operation**" allows this wedge to accompany the image being analyzed or recorded.

The channel selector **D/C** pushbutton connects the gray wedge to the insert keyer on the output of the MSP. The keyer inserts the step wedge into the MSP output prior to display on the 703 DATACOLOR®. This function is not generally used. Use channel A or B.

The test wedge is adjusted to correspond to the video voltage range obtained from the Scanner when observing a photographic density range of 0 to 2.2D. Internal adjustments on the generator board are provided to match this range to the particular camera tube supplied with the system.

Gated and Variable Windows

General Description

The video inputs A and B are thresholded by two adjustable threshold circuits to provide two binary video signals for the gated window. Either of these binary signals, or the logical AND and OR of the two, are selected by the gate pushbuttons.

The resultant gate signal is sent to the window output or "AND"ed with the variable window gate as selected by the window pushbuttons.

The window generator generates a rectangular-window gate signal with adjustable size and position. This signal is sent to the window output and may be "AND"ed with the gated window.

Operation of the Variable Window Option

If an individual wants to analyze, by density slicing alone, a square or rectangular portion of an image then he can push the window (**W**) button (blue) on the window chassis. The location and size of the window is controlled by the 4 dials on the front of the window chassis (Figure 8.7).

Operation of the Gated Window Chassis

This function can be carried out over the entire displayed image or "AND"ed with the variable window to threshold only a specific portion of the image.

1. Set the Video Switcher (Section 3.3) to allow thresholds A&B to read the desired channels and tracks on the disc, i.e. M1, M2, M3 or M4 and tracks 2-89.
2. Place image one on the light table and then level slice the image.
3. Select the number of levels that best identify the known ground class of interest and then push the **B/W** keys on the D/C keyboard for those slices.
4. Push the **BLACK** keys for all other slices.

5. Store the image on disc by pushing the **RECORD** button on the Disc Controller.
6. Repeat steps 3-5 for each slice as required, except change the disc channel for each level being stored (e.g. store image 1 on M1 track 11, image 2 on M2 track 11, image 3 on M1 track 12, etc.
7. Place the second previously pin registered image on the light table and repeat steps 1-6.
8. Push the **black** button on the OSM of MSP left chassis to cut out the DATACOLOR chassis.
9. On the Universal Window Chassis push the **G** (gated) button and then push the **A** button (blue) in the Gated Window section.
10. A binary image should appear on the colour monitor.
11. Adjust the **A** Threshold dial to bring in the themes (levels or slices) as black.
12. In the Gated Window section push the **B** button (gray) and repeat step 11.

Now the logical AND/OR functions of these slices on Thresholds A&B can be found (Rectangular Parallelepiped Classification). When the logical AND/OR functions are selected, the results are displayed on the colour monitor. These results can be stored on a disc channel that is not being read from (i.e. if M1 and M2 are providing two images being thresholded through A&B then, you must store on M3 or M4).

NOTE: The logical OR function is inclusive.

8.8 Map Overlay

8.8.1 Introduction

This unit allows a map to be overlayed on an image being analyzed on the colour CRT. Registration is accomplished by adjusting the map camera's height to fit the scale of the image being studied.

8.8.2 Mixer Controls (Figure 8.8)

1. **MIX** - blends the two signals from the map and image cameras. It is adjusted until the desired mix is achieved.
2. **MULTIPLY** - increases the input level of the map camera so that the map is still visible when the **MIX** control is reading 100% of the image being studied.
3. **POS/NEG** - switches the map into positive or negative image.

8.8.3 Map Camera (Figures 8.9, 8.10A and B)

Operation and Controls

1. The map camera is powered on by connecting the power cable (**P**) to the top of the camera and then connecting the other end of the cable to the Video Micrometer after removing the Terminator plug on the Video Micrometer.
2. The video cable (**V**) should also be connected to the

FIGURE 8.8. Video Mixer

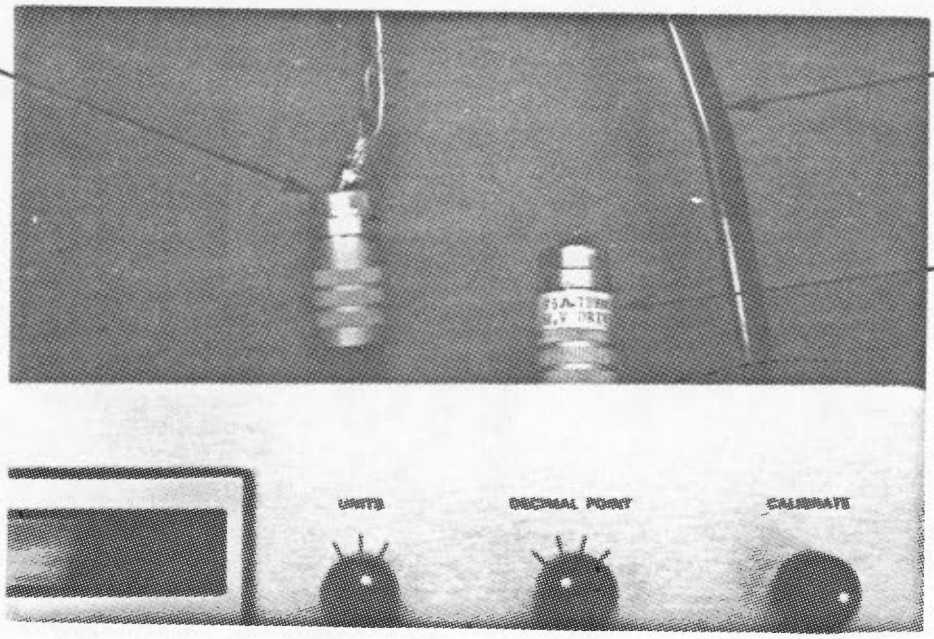


FIGURE 8.9. Map Camera Cable Connections to Video Micrometer

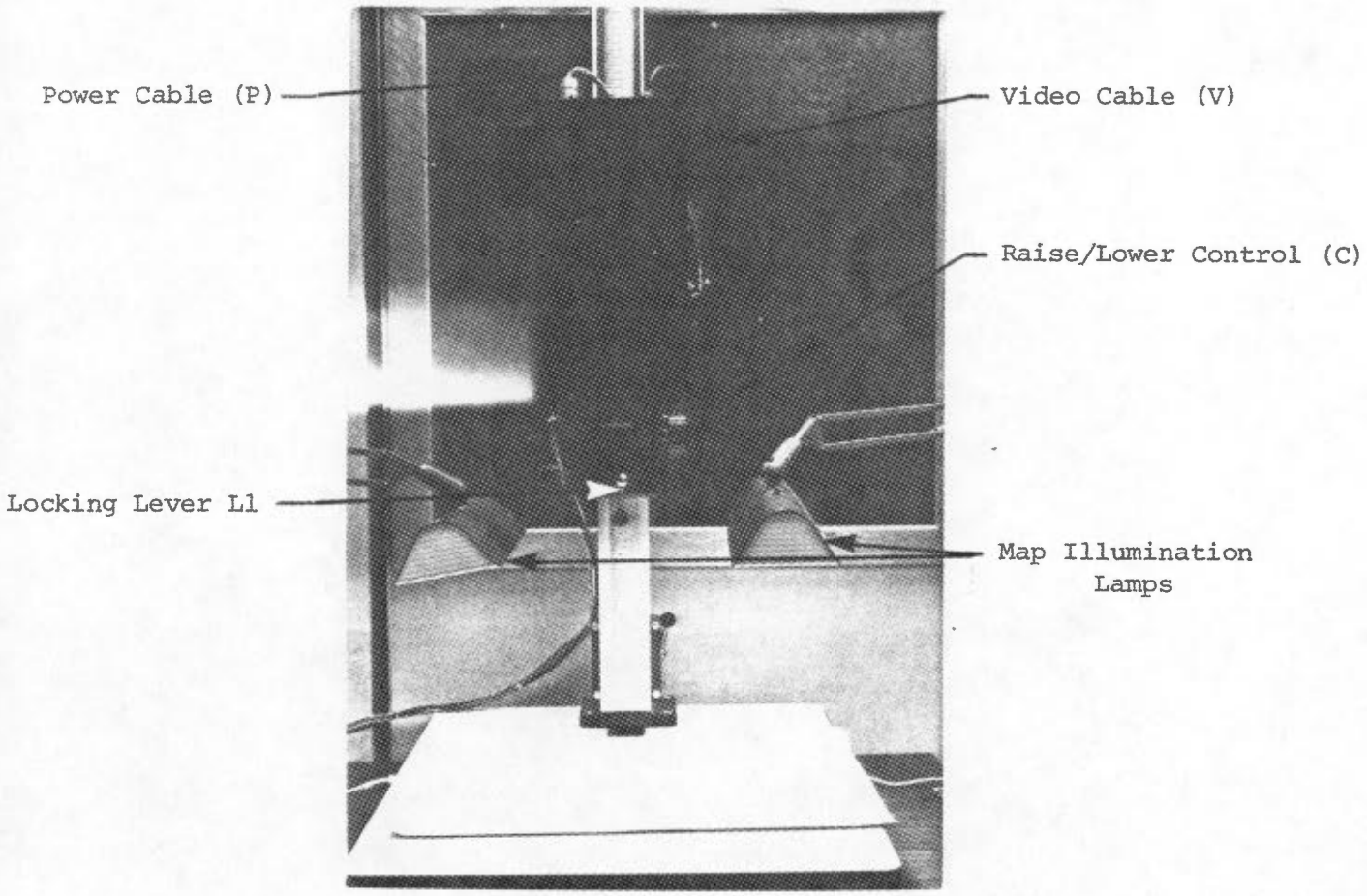


FIGURE 8.10A. Map Camera and Stand (front view)

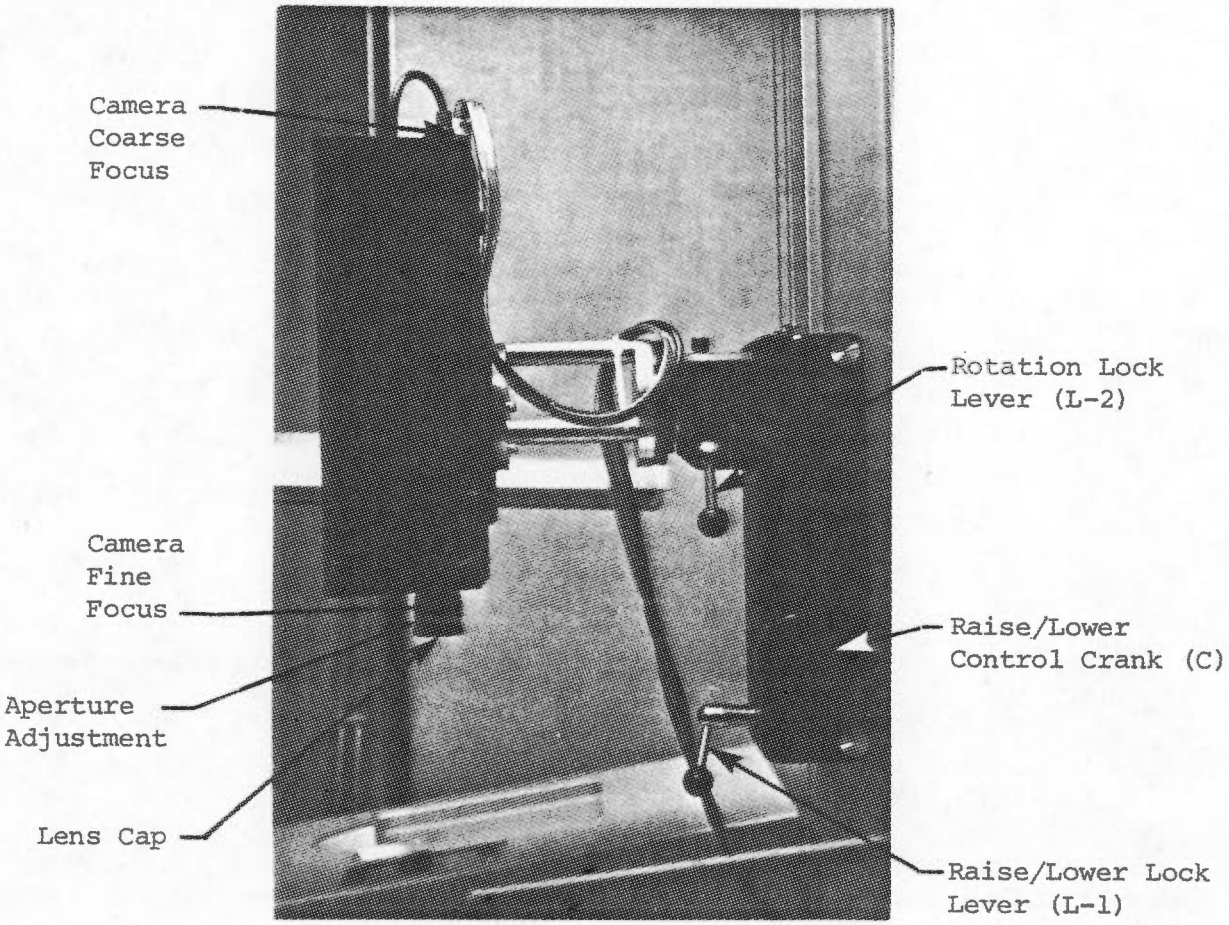


FIGURE 8.10B. Map Camera and Stand
(side view)

camera and then proceed to the Video Mixer.

3. The lens of the camera should be capped and the lens aperture set at f/22 (adjusted by the silver ring on lens barrel) when the camera is not being utilized.
4. The scale of the map being overlaid on the level sliced image is adjusted by releasing locking lever **L-1** and turning crank **C** clockwise or counterclockwise.

NOTE: At <u>all</u> times when adjusting the camera height keep one hand supporting the camera.

5. The camera can be rotated by releasing locking lever **L-2** and manually rotating the camera. This will produce a form of "skew" distortion in the map which may allow a better fit to the image being analyzed.
6. The map to be used for the overlay should have black lines and white background.
7. Illumination of the map is provided by two adjustable fluorescent lamps. These lamps are turned on by pushing and holding down the red button on the lamp housing for a few seconds until both fluorescent tubes are illuminated. Push the black button to turn the lamps off.
8. Remove the lens cap, adjust the Video Mixer until the signal on the colour monitor is entirely from Map Camera and then open the aperture from f/22 to f/11 or f/8 until the map is clearly visible on the colour monitor.

9. Reset the Video Mixer with the **MIX** control until it is receiving 50% of the signal from the Map Camera and 50% from the image being analyzed. Some adjustments to the colour monitor's brightness and contrast controls may be required.
10. Adjust the scale of the map to fit the image being analyzed and then refocus the map by means of the focus adjustment knob on the top of the camera. If the map scale cannot be made to match the image scale then the image's scale may have to be changed.
11. Reset the **MIX** control to read 100% of the image being analyzed and turn the **MULTIPLY** dial to bring in the map overlay. Adjust the colour monitor's brightness and contrast controls as necessary.
12. Once the map and image are registered, stop extraneous light from the Map Camera from reaching the EYECOM® Image Scanner by pulling the black-out drapes between the two units.
13. If the map overlay is no longer required, then recap the lens, set the aperture to f/22, disconnect cable P from the Video Micrometer and install the terminator in place of cable P.

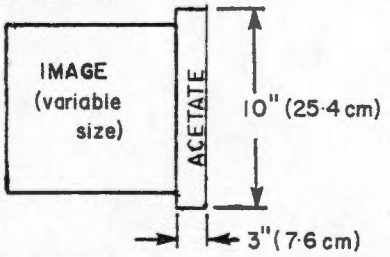
9. IMAGE REGISTRATION

9.1 Introduction

In order to overlay images of different dates or spectral bands from the video disc, onto the colour monitor, these images must be pre-registered. To accomplish the pre-registration, the images are aligned, by eye, on a light table equipped with a registration punch. The punch positions holes on the edges of images that are the same distance apart as a set of pins on the light table under the EYECOM® scanner.

9.2. Operating Procedures

1. Attach a piece of acetate or mylar to the side of all images to be registered.



2. Place image on the punch registration light table (Figure 9.1) with the acetate strip under the punches so that the strip is evenly positioned on either end of the punches. Tape image to light table.
3. Place the next image (i.e. different band or date) over top of the taped-down image and register by hand.
4. Pull punch arm forward and punch both images.
5. Remove second image and leave the taped-down image.

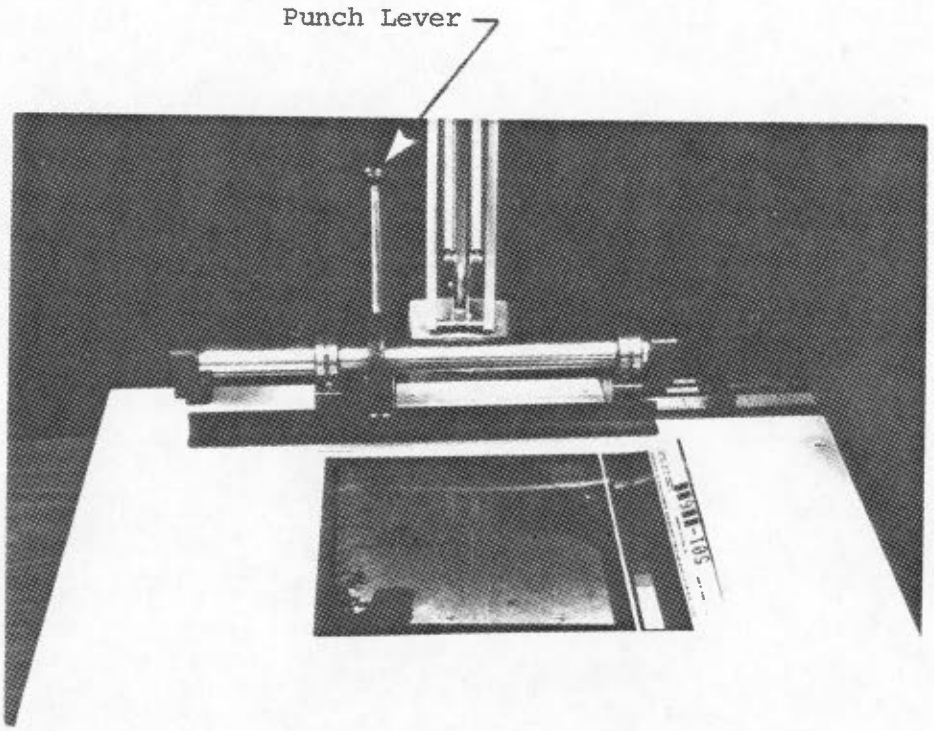


FIGURE 9.1. Punch Registration Light Table

6. Overlay third image and repeat steps 3-5.
7. Repeat steps 3-6 as necessary.
8. To prepare an image to be recorded on the PAS, place the image on the light table under the scanner - fitting the punched holes over the registration pins on the right side of the light table. Record as in Section 7.2.

10. PRODUCING A COLOUR COMPOSITE

10.1 Introduction

After installation of up to four spectral bands on disc channels M1, 2, 3, and 4, as indicated in Section 7.2, a colour composite of up to three spectral bands can be created on the colour monitor.

10.2 Operating Procedures

1. Set the Disc controller so that the bands to be analyzed are on disc channels M1, M2, M3, and M4 and the appropriate tracks (Section 4.2).
2. To produce a colour infrared (CIR)* image, set the Video Switcher to read M1 on D1, M2 on D2, and M4 on D3 (Sections 3.2 and 3.3). This is required when bands 4, 5, 6, and 7 are stored on disc channels M1, M2, M3, and M4 respectively. The controls on the Multispectral Processor chassis should be arranged as follows. All buttons to be pushed are indicated by a star ★ in Figures 10.1 and 10.2.
3. On the left-hand chassis set the ISM to allow:
   - D1 to be on X (blue button down) reading disc channel M1

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* CCRS Colour Composite No. 1

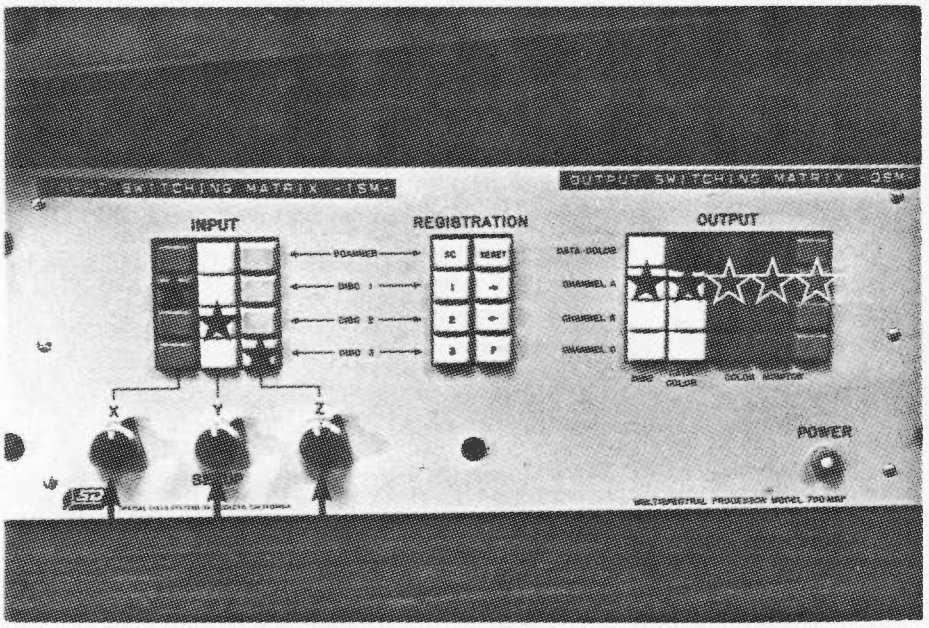

FIGURE 10.1. MSP - Left Chassis - Colour Composite Set-Up

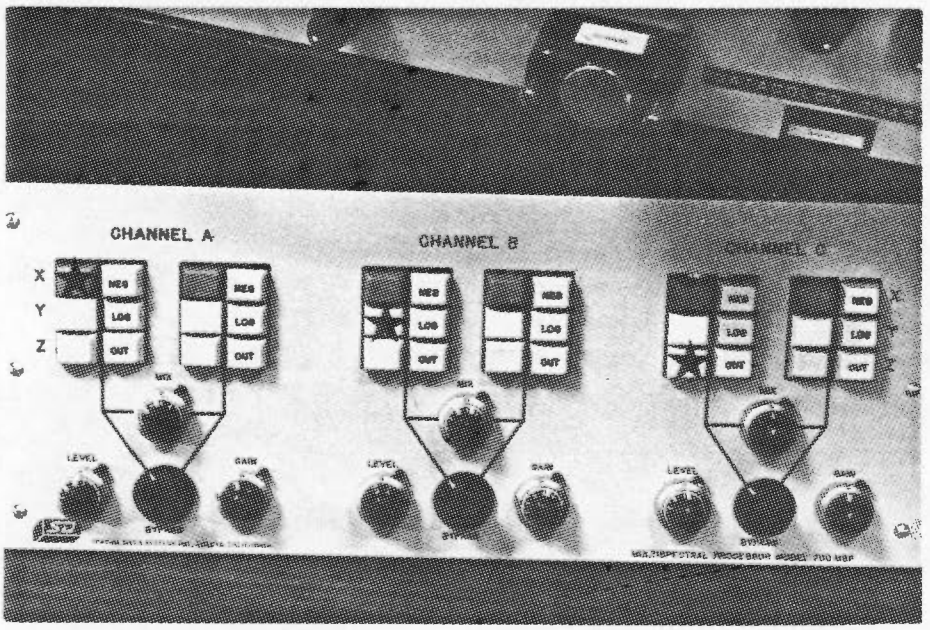

FIGURE 10.2. MSP - Right Chassis - Colour Composite Set-Up

- D2 to be on Y (white button down) reading disc channel M2
- D3 to be on Z (gray button down) reading disc channel M4

4. On the right chassis on CHANNEL A push the **X** button on both columns and remove the LOG function if the button is down by pushing it again. Leave the **BY-PASS** switch to the left.
5. On the OSM (left chassis) push the **DATACOLOR** button on the top row of the DISC column. Then push the **DATA-COLOR, RED, GREEN** and **BLUE** buttons on the CHANNEL A row. A black and white picture of the image recorded on disc channel M1 should appear on both the colour and Edge Enhancer monitors. If the image is extremely dark, adjust the **X-SET-UP** dial on the ISM to lighten the image.
6. Repeat steps 2 and 3 for CHANNELS B and C.
7. To produce a colour composite similar to a colour infrared (CIR) image, push the **RED** button on the CHANNEL C row, **GREEN** on CHANNEL B row and **BLUE** on CHANNEL A on the OSM (Figure 10.3). The CIR image will occur if band 4 is on M1 and band 5 is on M2 and band 7 is on M4.
8. If the colour composite lacks brightness and contrast (Section 5.2), turn the **BY-PASS** switch to the right on

CHANNEL A and set the **Mix** dial to read entirely from the right column of CHANNEL A. On the OSM (left chassis) push down the **RED, GREEN, BLUE** and **DATACOLOR** buttons on the CHANNEL A row thus creating a black and white image on the colour monitor (see Figure 10.1). Returning to the right-hand chassis, adjust the **LEVEL** and **GAIN** controls on CHANNEL A to bring the brightness and contrast of the image to what is required (Figure 10.4).

9. Repeat step 8 for CHANNELS B and C if so required.
10. To produce the colour composite, repeat step 7.
11. If another combination of bands is required for a different colour composite (e.g. CCRS colour composite No. 2), then the Video Switcher must be changed to read the appropriate disc channels into the ISM. For the above colour composite bands 5, 6, and 7 should be read into the ISM and thus to the MSP as A, B, and C respectively. Steps 3-8 may be followed again but when encoding the colour to the image, use BLUE on CHANNEL C, GREEN on CHANNEL B, and RED on CHANNEL A on the OSM.

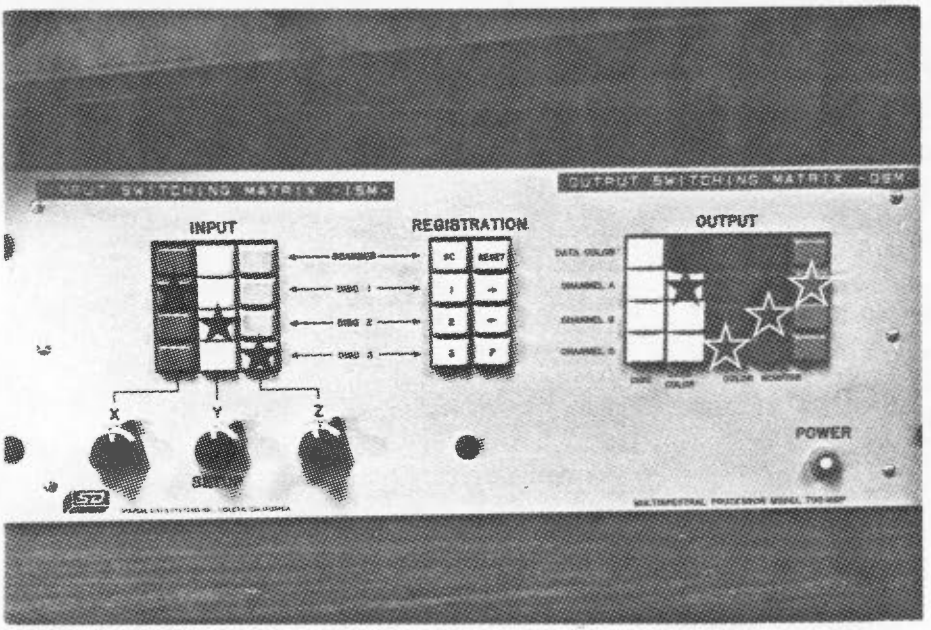

FIGURE 10.3. MSP-Left Chassis-Final Button Configuration for a colour composite.

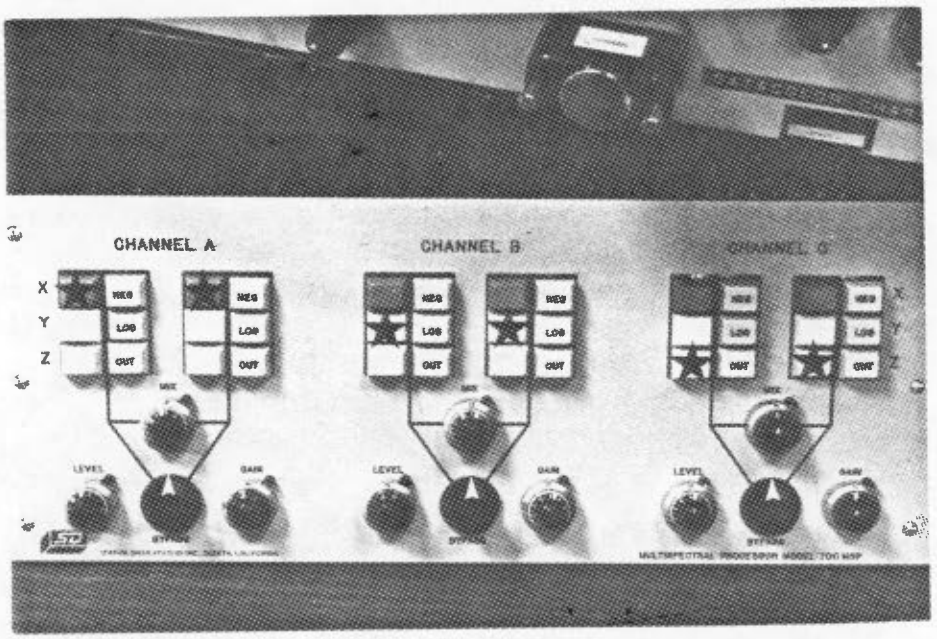

FIGURE 10.4. MSP-RightChassis-Button Configuration to adjust brightness (level) and Contrast (Gain) of images from X, y and Z.

11. IMAGE RATIONING FROM DISC (Figures 11.1 and 11.2)

11.1 Introduction

One enhancement technique for the analysis of water sediment, geological features and vegetation cover involves the ratioing of different spectral bands. For example, combining a positive band 5 with a negative band 7 results in an image that is very useful in delineating sediment concentrations in water bodies.

11.2 Operating Procedures

1. Record the images to be ratioed (different bands or dates) on the video disc (Section 7.2).
2. Locate the images to be ratioed on the appropriate disc channels (Section 4) and set the Video Switcher to read them (Section 3). On the D/C keyboard move the **SET-UP** switch to **B/W.**
3. On the left-hand MSP chassis, recall the first image to be ratioed through **X** and second image through **Y** on ISM. These images may come from any 2 of the three disc channels D1, D2 or D3 being read by the Video Switcher. Set the **DATACOLOR**, the **RED**, the **GREEN** and the **BLUE** push buttons on the top row of the OSM. Push the **CHANNEL A** button on the DATACOLOR column.
4. On the right-hand MSP chassis, remove the **LOG** function

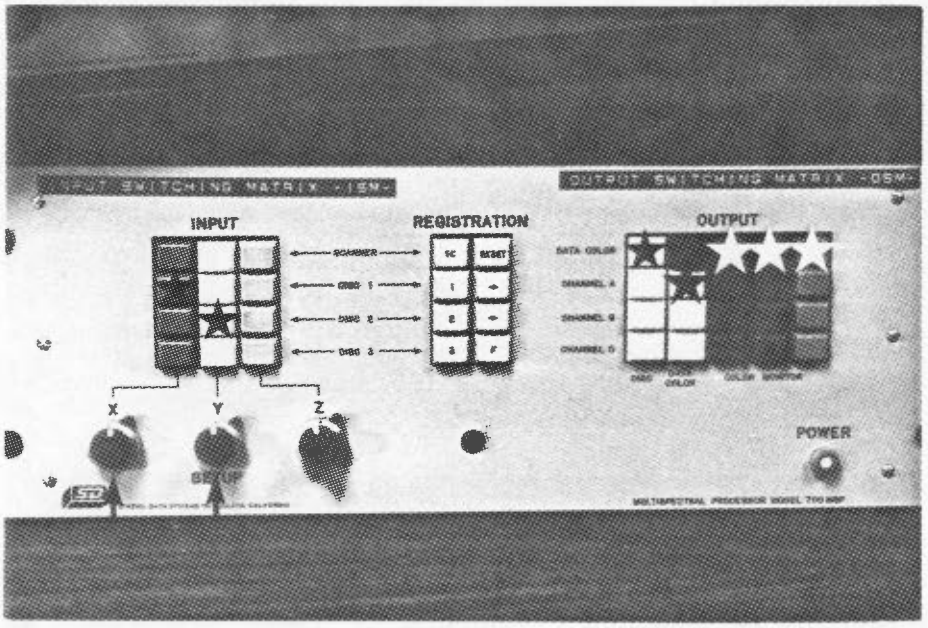

FIGURE 11.1. MSP - Left Chassis - Ratioing Set-Up

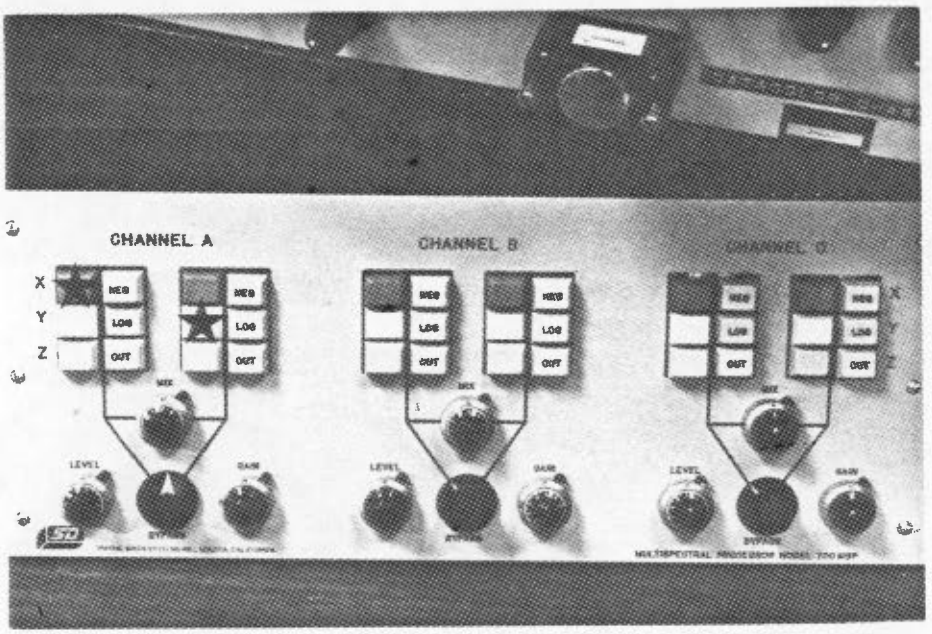

FIGURE 11.2. MSP - Right Chassis - Ratioing Set-Up

on both columns of CHANNEL A. Push the **X** and then the **Y** button on the left and right columns respectively of CHANNEL A.

5. On CHANNEL A move the **BY-PASS** switch to the right and set the **MIX** dial fully counterclockwise to read 100% of the signal on the left column from X. Set the **LEVEL** and **GAIN** controls to produce normal brightness and contrast, i.e. both set fully counterclockwise. Adjust the **X-SET-UP** dial on the ISM to bring up the dark levels of the image.
6. Now, set the **MIX** dial fully clockwise to read 100% of the signal from the Y signal on the right column of CHANNEL A. The **LEVEL** and **GAIN** controls should be left as previously set. Adjust the **Y-SET-UP** dial on the ISM to bring up the dark levels of the second image.
7. Set the **MIX** control to halfway (5.00 on dial). This will now give a 50/50 ratio of the two images that are being analyzed. If the **LEVEL** or **GAIN** controls are altered, both images will have their brightness and contrast changed by equal amounts.
8. If a ratio of a positive to a negative image is required, then push the **NEG** button to negate the proper image. To remove the negation, push the **NEG** button again.

9. When the proper ratio is achieved, the image can be re-recorded onto a disc channel not already being utilized to produce the ratio* or the ratio can be density sliced by moving the SET-UP switch to **Color** on the D/C keyboard (Section 6.3).

---

* **NOTE: if for example the ratioed image is being created from images stored on disc channels M2 and M4, then the ratioed image can only be stored on M1 or M3 - NEVER TRY TO STORE AN IMAGE ON A VIDEO DISC CHANNEL THAT IS BEING READ OR ANALYZED ON THE PAS.**

12. ALPHA/NUMERIC KEYBOARD (Figure 12.1).

12.1 Introduction

This alpha/numeric keyboard has been added to the PAS to permit annotation of the imagery being analyzed on the colour monitor. When an image is being stored onto disc from this monitor, any annotation will also be stored. Subsequent density slicing or band ratioing of the imagery from disc will result in the annotation being sliced or ratioed as well as the image. It is therefore best not to store annotation on disc if you intend to use density slicing for area measurement because the area measurement will include the annotation.

12.2 Operating Procedures

1. Switch on the keyboard by means of a toggle switch on the back right of the unit.
2. A full screen display of all the alpha/numeric characters available on the keyboard will appear on colour monitor.
3. Push the **ERASE** button (red) and space bar simultaneously to remove characters.
4. A small rectangle (Cursor) appears at the top left hand corner of screen.
5. The **PAGE/TITLE/CRAWL** switch should be on "**PAGE**".
6. The **PROGRAM** switch is at "**ON**".
7. The **PROG/PREV** switch is in neutral (middle) position.

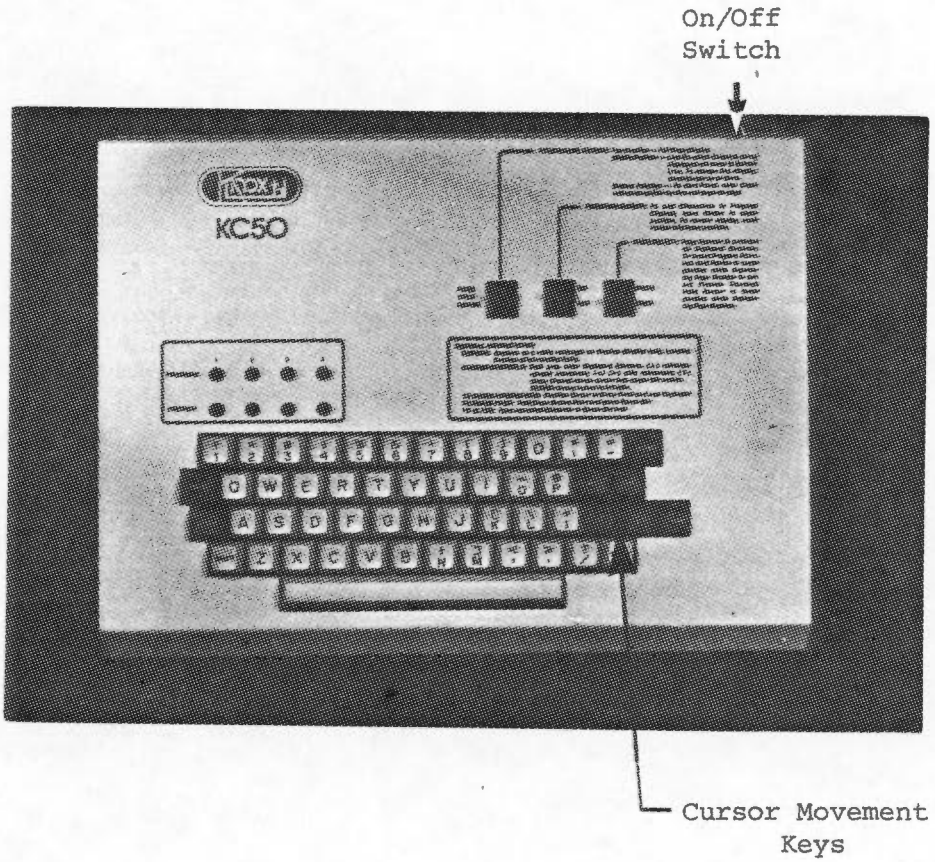

FIGURE 12.1. Alpha/Numeric Keyboard

8. To move the cursor to a desired location to annotate the imagery - use the 4 direction keys, indicated by arrows.
9. Pushing the space bar erases any character above the cursor.
10. The upper and lower case letters are accessed through the shift key, i.e. hold shift key down and push appropriate key. There are no lower case alpabetical letters.
11. At the end of each line, the cursor will return left side of the screen 1 line lower.
12. Ignore the flash button.
13. The **HOME** button returns the cursor to the top left of screen.

13. OUTPUT EQUIPMENT AND PRODUCTS

13.1 Tektronix Printer (Figures 13.1 and 13.2)

13.1.1 Introduction

This printer produces a gray level image of the scene displayed on the colour monitor. If only 1 or 2 density levels are required then a print analagous to a binary theme print from a Gould or Versatec device, can be produced.

13.1.2 Operating Procedure

1. Install paper as per instructions on inside cover of unit. (Lift front to raise cover). The paper is stored in the refrigerator in room 226.
2. Turn printer on (Green light).
3. Allow 20 minutes to warm up.
4. Bring image to be analyzed onto colour monitor.
5. Select desired number of slices.
6. Push print button on printer* - a gray level representation in discrete gray tones of the colour density sliced image will be produced. This print can be darkened or lightened by the control marked thusly on the top of the machine.

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* There is also a print button located in the centre of the left MSP chassis. See Figure 5.2.

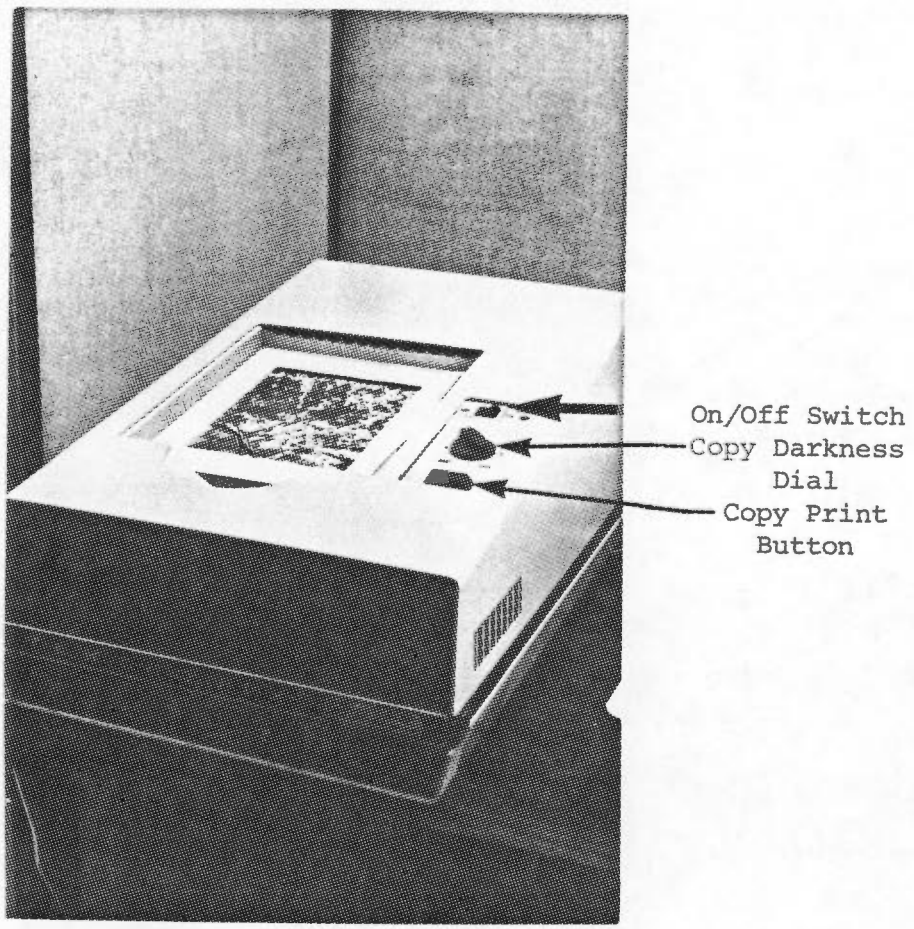


FIGURE 13.1. Tektronix Printer

NOTE: different colours (say a dark green and a dark orange) will appear as the same gray level. This is an inherent limitation in the printer when printing colour maps. To remedy this problem, please follow the subsequent steps.

7. On the D/C keyboard, push all the **B/W** keys that pertain to the coloured slices previously selected. This action will result in a B/W image appearing on the colour monitor.
8. Next select 1 or 2 slices at a time and push the black key for those slices.
9. Then push copy button on printer to get a print in which the background is a continuous tone gray level image and the selected slice(s) are black. This print is analogous to a binary theme print from a digital system.
10. Repeat the previous step for all the slices.
11. The alpha/numeric keyboard can be used to annotate the image and slices being printed.
12. When finished, shut off the machine, remove the paper and store it in the refrigerator.

    NOTE: If any problems occur, contact the technical supervisor.
13. The range of gray level sensitivity can be lowered or raised by adjusting the dial on the back of the printer (Figure 13.2).

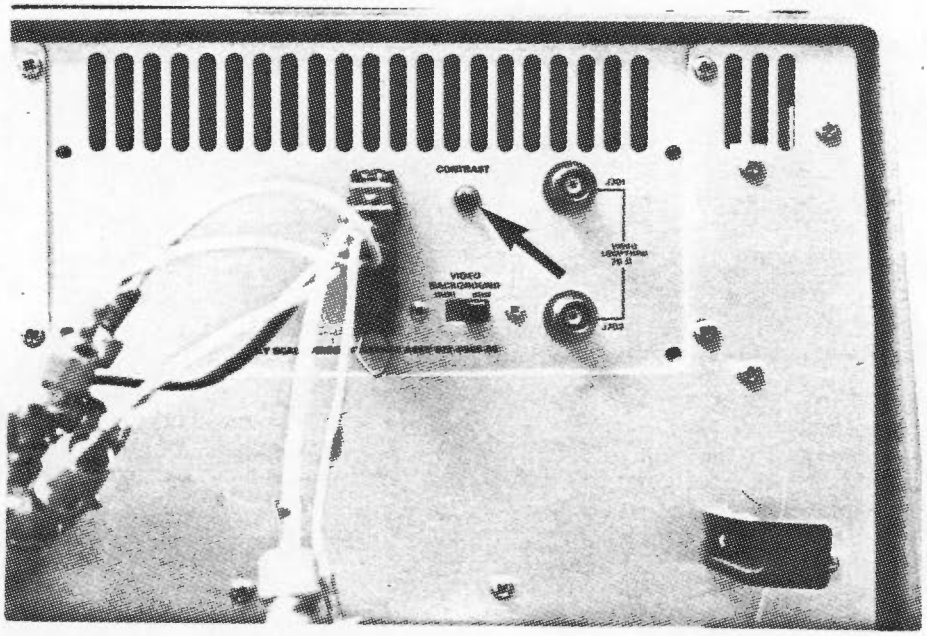


FIGURE 13.2. TEKTRONIX Printer - Contrast Adjustment Control

13.2 Output to Video Tape Recorder (Cassette or Reel-to-Reel)

13.2.1 Introduction

If a user wishes to have a video recording of the work they are doing, then the analysis can be stored onto a video cassette or reel-to-reel tape recorder. There is image degradation and this problem is presently being studied.

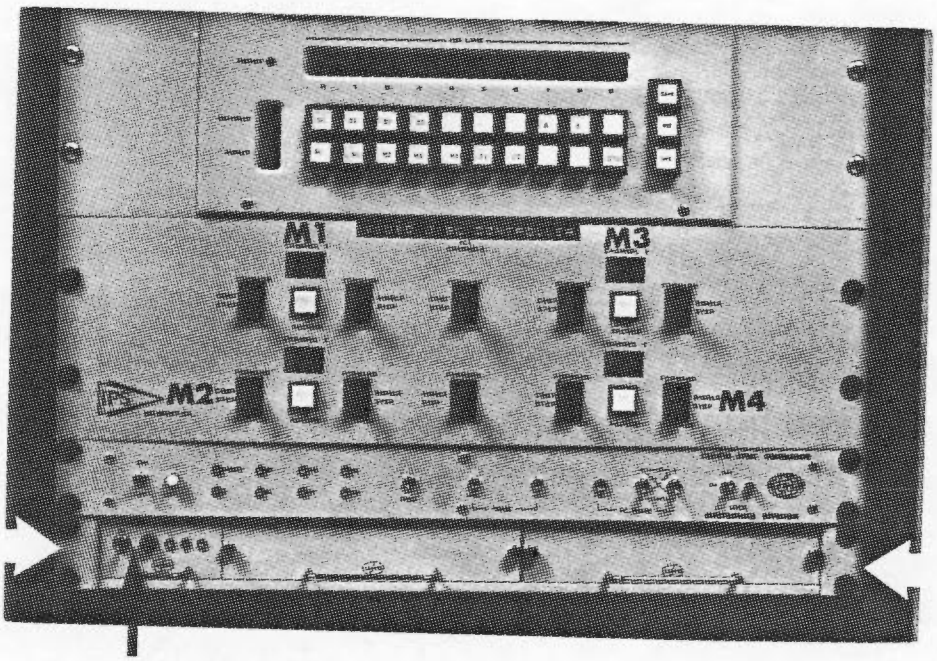
13.2.2 Operating Procedure

1. Switch on Lenco NTSC Video Encoder located directly above main video disc (red light appears) (Figure 13.3).
2. Take cable from back of equipment rack which houses the encoder and connect to any standard video recorder.
3. Record as indicated in the instruction manual for that recorder.
4. When finished, disconnect cable and shut off encoder.

13.3 Photography of the Television Monitors

13.3.1 Introduction

Hard copy of the images being analyzed, can also be achieved by photgraphing the colour or black and white monitors (CRT's). The photography can either be in 35 or 70mm format, however, 35mm is generally more convenient.



On/Off Switch
and Lamp

FIGURE 13.3. Location of the LENCO NTSC Video Encoder

13.3.2 Operating Procedures

1. Use daylight colour print or slide film with a film speed of 100 or 200 ASA.
2. Keep shutter speeds longer then 1/15 of a second, (i.e. 1/8, 1/4, 1/2, etc.).
3. Mount camera on bellows attached to the colour CRT (35mm format only) (Figure 1.2B) or on a tripod (70 or 35mm format).
4. If the screen is evenly illuminated, then the meter in the camera should indicate the proper exposure. If any doubt exists about the proper exposure, bracket the exposure (i.e. take exposures +1 stop, normal, -1 stop).
5. Normal exposure ranges for a 200 ASA film are 1/8-1/4 second at an aperture of f/5.6-8.

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Portions of the following documents, indicated by *, have been included verbatim in the text of this manual.

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Spatial Data Systems. No dates available:

* Model 703, Datacolor® Instruction Manual. 31pp. and drawings;

* Model 401, Edge Enhancer Instruction Manual. 22pp. and drawings;

* Model 700SV, EyeCom® Image Scanner Instruction Manual. 25pp. and drawings;

* Model 700MSP, Multispectral Processor Instruction Manual. 15pp. and drawings;

* Model 410, Video Micrometer Instruction Manual. 9pp. and drawings;

* Model 700W, Universal Window Instruction Manual. 6pp. and drawings.

Spatial Data Systems Incorporated, Goleta.

Tektronix. 1975. 4632 Video Hard Copy Unit, Instruction Manual. Tektronix Incorporated, Beaverton. 92 pp. and drawings.

Tektronix. 1975. Option 6, Enhanced Gray Scale for 4632 Video Hard Copy Unit, Instruction Manual. Tektronix Incorporated, Beaverton. 18 pp.

Tektronix. 1975. 4632 Video Hard Copy Unit, Users Manual. Tektronix Incorporated, Beaverton. 37 pp.

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