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MICROSCOPE VIDEO CAMERA
C2400
INSTRUCTION MANUAL

HAMAMATSU

VIDEO CAMERA FOR MICROSCOPY
C2400
INSTRUCTION MANUAL

-CONTENTS-

1. INTRODUCTION

The C2400 is a compact, 2-piece, high performance video camera system designed specifically for microscopy and quantitative electronic imaging. The system utilizes the very latest technology to achieve exceptionally high quality images ideally suited for both analog and digital processing. The system is composed of a lightweight camera head and separate camera control unit. All system functions are conveniently controlled from the front panel of the control unit.

Standard features include a contrast enhancement circuit allowing for the visualization of detail undetectable visually or photographically, Automatic Gain Control Circuit, SIT Protection Circuit, crystal oscillation timing control, input indicator LED's, multiple video outputs and protection circuitry.

Optional features include a shading corrector circuit, a variable gamma corrector, video polarity inverter, external synchronization, non-composite video output, and Automatic Sensitivity Control Circuit for SIT tube. All options are contained on single PC board modules allowing for upgradability and ease of installation. The camera head may be specified with any of 10 different imaging tubes to ideally match the system with the application at hand. Moreover, the camera control unit has been designed to support any of the camera heads, thereby allowing for various heads to be used with a single control unit.

2. FEATURES

2-1 CONTRAST ENHANCEMENT CIRCUIT

A contrast enhancement circuit, providing for the independent amplification of overall video gain and black level(offset), allows image contrast to be dramatically increased over a very wide range. This feature makes possible the visualization of structures undetectable visually or photographically.

2-2 AUTOMATIC GAIN CONTROL CIRCUIT

This circuit detects the intensity of the incident light, automatically adjusts the amp gain, and keeps a constant video signal level.
The correction range against the incident light is about 8:1.
(It corresponds to the iris at 3 levels.)

2-3 SIT PROTECTION CIRCUIT

When using a SIT tube as for a camera head, this circuit protects the SIT tube from the excessive incident light.
When the quantity of light, is 1.3 times as much as the normal that, is input, this circuit works.

2-4 TIMING CONTROL BY CRYSTAL OSCILLATION

All control signals, as well as deflection frequency, are controlled by crystal oscillation. This results in very high precision in the scanning and synchronization signals ensuring a consistently high quality image.

2-5 LEVEL INDICATOR

A video level indicator circuit accurately monitors input intensity to the imaging tube by way of two LED's. This feature allows for the rapid determination of the ideal illumination level required to produce the highest quality image.

2-6 TUBE PROTECTION CIRCUIT

A protection circuit has been provided to prevent burn-in of the imaging tube should the horizontal or vertical synchronization signals be lost.

2-7 WHITE CLIPPER

This circuit clops the video signal when it exceeds 1.2V thereby preventing the TV monitor from losing synchronization.

2-8 SELECTION OF CAMERA HEADS

10 tube types are available to ideally match camera characteristics to a wide variety of applications.

2-9 SHADING CORRECTOR (OPTION M2502)

The shading correction circuit can correct shading in the image due to uneven illumination in the optical path, as well as any shading introduced by the imaging tube.

2-10 VIDEO BOOSTER (OPTION M2503)

This feature enhances the contrast and, thereby, the detectability of detail within dark regions of the image by modifying the output characteristics of the camera.

2-11 VIDEO INVERTER (OPTION M2504)

The video inverter reverses the polarity of the video signal producing a negative image. This feature is valuable in enhancing detectability in low intensity portions of the image when used in conjunction with contrast enhancement, as well as facilitating the interpretation of high contrast images.

2-12 EXTERNAL SYNC (OPTION M2505)

The External SYNC enables the synchronization of C2400 scanning with other equipment by supplying HD and VD signals to the C2400.

2-13 OPERATIONAL VIDEO OUTPUT

For applications in which a non-composite video signal is required, the camera is easily configured to provide this. This operational video output signal does not include a synchronizing signal and is therefore DC in nature with the black level defined at 0V.

2-14 5M CAMERA CABLE (OPTION)

The standard camera cable is 3m in length. A 5m cable is availabe for applications in which the camera must be more remotely located from the CCU.

2-15 AUTOMATIC SENSITIVITY CONTROL FOR SIT (OPTION M3322)

When obtaining a constant video output signal against the incident light for SIT, and when extending the dynamic range against the incident light, this option is useful.

This detects the intensity of incident light and automatically adjusts the voltage of sensitivity control for tube.

The correction range is more than 64:1.(It corresponds to the iris at 6 levels.)

When the ASC function is used, it is impossible to use either M2503 or M2504, also the AGC function.

3. SYSTEM COMPONENTS

(1) Camera Head		1
(2) Camera Control Unit		1
(3) Camera Cable	3m	1
(4) TV MONITOR Cable	3m (BNC-M)	1
(5) GROUND Cable	3m	1
(6) Spare Fuse	(250V , 2.5A)	1
(7) Instruction Manual		1

4. SPECIFICATIONS

ELECTRICAL

Input Voltage	AC100/117/220/240 ± 10% (50/60Hz)
Power Consumption	80VA nominal
Vertical Sweep Rate	60Hz, EIA RS-170
	50Hz, CCIR System B
Horizontal Sweep Rate	15.750KHz, EIA RS-170
	15.625KHz, CCIR System B
Lines per Frame	525, EIA RS-170
	625, CCIR System B
Effective Lines per Frame	487, EIA RS-170
	575, CCIR System B
Interlace	2:1
Aspect Ratio	4:3 (H:V)
Synchronization Method	Internal via crystal oscillator (Optional external sync available)
Video Output Signal	Two composite 1.0Vp-p/75Ω (When equipped with Optional Ope. Video, VIDEO OUT 2 is utilized for non-composite video output)
Sync Signal Output (HD,VD)	Negative logic, 75Ω termination. Low less than 0.8V, high more than 2.5V. (When equipped with optional EXTERNAL SYNC, these terminals are utilized as input of external signal)

MECHANICAL

Camera Head, Dimensions	104(W)×98(H)×204(D)(255, -08) mm
Weight	Approx. 2 (Approx. 3 , -08) Kg
Camera Control Unit,	
Dimensions	232(W)×74(H)×308(D) mm
Weight	Approx. 5Kg
Lens Mount	1", C Mount

ENVIRONMENTAL

Operating Temperature	0~+40℃
Storage Temperature	-10~+50℃
Humidity	90% or less, non-condensing

5. PERFORMANCE

Geometric Stability	Less than 0.2% (10~40℃)
Geometric Distortion	Less than 1% (2% for -03, 3% for -08)
Signal to Noise	Greater than 50dB pp/RMS (Greater than 46dB for -03 and greater than 48dB for -08)
Video Bandwidth	0~10 MHz or greater
Contrast Gain	1~10 times
Sensitivity	1 Vp-p Composite video output at 300nA signal current
Vidicon Spurious Signal	Specification of tube used.

MODEL	TUBE	AVG.RESOLUTION, CENTER	LAG	GAMMA
-00	Visible Vidicon	800	20	0.65
-01	Chalnicon	700	20	0.95
-02	Silicon Vidicon	600	12	1.0
-03	IR Vidicon	600	60	0.6
-04	Plumbicon	750	4	0.95
-05	UV Chalnicon	700	20	0.95
-06	Saticon	750	3	0.95
-07	Newvicon	700	20	1.0
-07ER				
-08	SIT	500	7	1.0

typical

6. INSTALLATION

6-1 UNPACKING

Carefully unpack the equipment, and see that all system components described in Section 3 of this manual are secure and undamaged.

6-2 INSTALLATION SITE

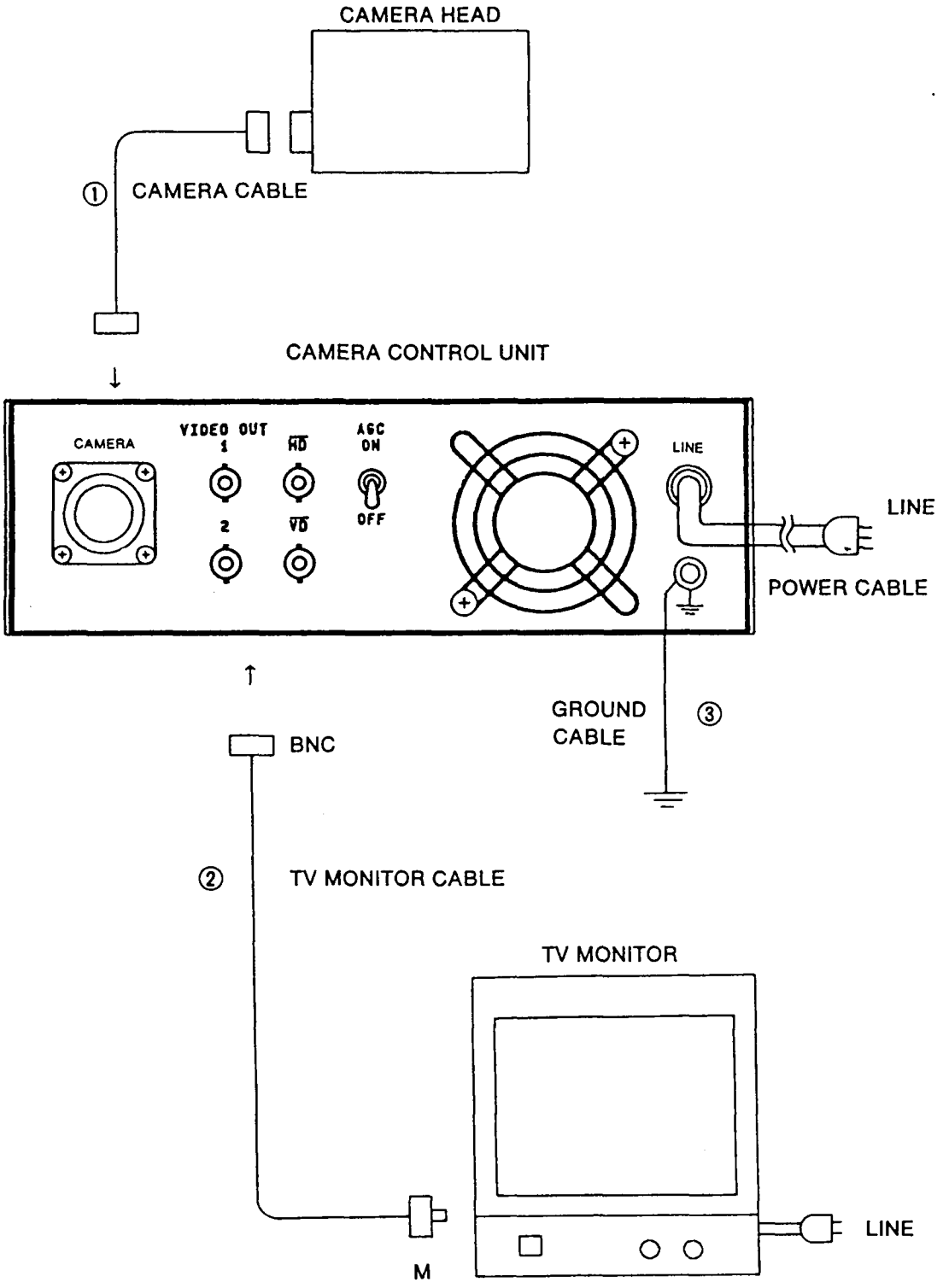
When installing the equipment, attention should be paid to the following points:

1. Do not use or locate the equipment near a strong electrostatic or magnetic field.
2. Situate where temperature is in the range of 0~40℃.
3. The site chosen should be relatively free of temperature fluctuations.
4. Humidity should be maintained at less than 90% (non-condensing).
5. Location site should be free of vibration.
6. The instrument should not be exposed to highly corrosive gas(es). (Chlorine, fluorine, etc.)
7. Keep location clean.
8. Avoid direct exposure to sunlight.
9. Allow adequate space around the CCU for efficient air exchange -exhaust fan at rear of CCU and side vents.

6-3 INSTALLATION OF CAMERA HEAD

Connection of the camera head to the optical imaging system is made via a standard, 1" C-mount adaptor.
Depending on the geometry of the camera head installation it may be necessary to stabilize the camera via a camera stand, base plate, etc.

6-4 CABLE CONNECTION



(1) Camera Cable

Insert the male connector of the camera cable into the female receptacle at the rear of the CCU and the female connector of the cable to the camera head. Tighten the threaded rings around the connector.

(2) Monitor Cable

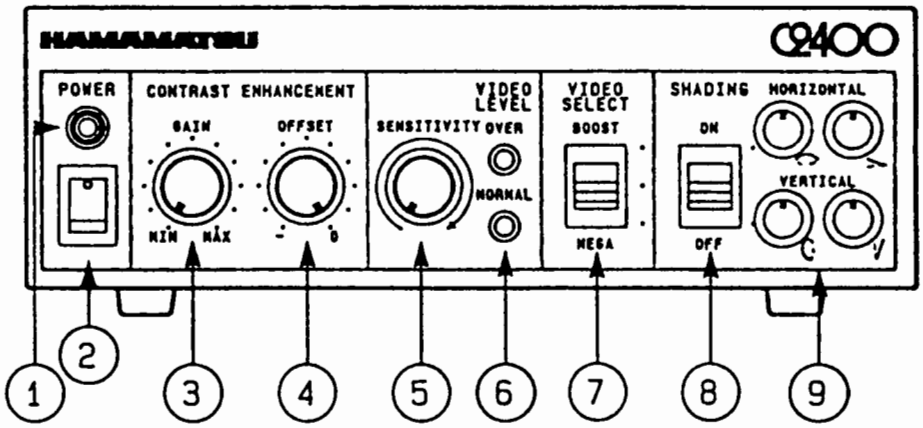
Connect the BNC(small) end of the monitor cable to the VIDEO OUT connector(1 or 2) at the rear of the CCU. Rotate the connector a quarter-turn clockwise to ensure proper connection. Insert the M connector end (large) of the monitor cable into the socket located at the rear of the monitor and turn clockwise until secure. Be sure to confirm that the 75Ω switch on the monitor is turned ON.

(3) Power Cable

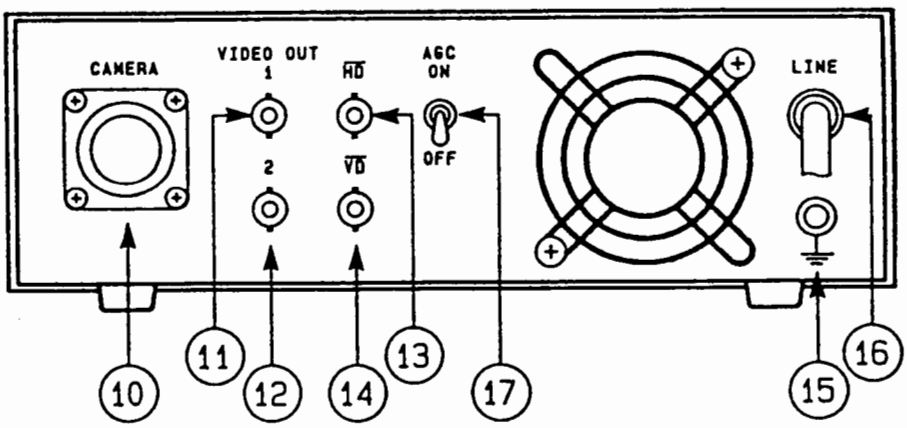
Confirm that the POWER switch at the front panel of the CCU is turned OFF, then connect an AC power source that will have a capacity of more than 100VA. An AC power source that has a third grounding terminal is recommended. If unavailable, (i.e. utilizing an AC power source with only two terminals) connect the ground terminal of the CCU to the ground terminal(s) of other equipment being used.

7. LOCATION AND FUNCTION OF CONTROLS

FRONT PANEL



REAR PANEL



① Power Pilot LED

When lit, the LED indicates that power is supplied to the CCU.

② POWER ON-OFF Switch

This is the main power switch of the CCU.

③ GAIN (Contrast Enhancement)

This is the pot. to adjust the gain of the video signal within a range of one to ten times.

④ OFFSET (Contrast Enhancement)

This is the pot. to adjust the offset level. Turn the OFFSET CCW and the black level will be redefined to a higher value.

⑤ SENSITIVITY

* Effective only with the C2400-00,-03 and -08 camera heads. This control adjusts the sensitivity of the tube.
Turn this control CW and the sensitivity of the tube will be increased.

CAUTION : Excessive sensitivity values may cause permanent damage to the imaging tube.

⑥ VIDEO LEVEL

These LED indicators monitor light intensity to the camera. The green lamp indicates an appropriate level of illumination while the red lamp indicates excessive light intensity. In the case of the C2400-00,-03, and -08, the SENSITIVITY pot. can be used to adjust the light intensity.

⑦ VIDEO SELECT

This switch selects the video signal which is displayed on the TV monitor. The neutral(middle) position selects the normal image. The upper and lower positions select the boosted and inverted image outputs respectively when these options are installed.

⑧ SHADING ON-OFF Switch

This switch enables or disables the shading correction. When the M2502 SHADING CORRECTOR is installed, the ON position of the switch implements the shading circuitry.

⑨ SHADNG Correction Potentiometers

These pots. are utilized to adjust the shading correction values.

⑩ CAMERA

This terminal connects the CCU to the camera head.

⑪ VIDEO OUT 1

This terminal outputs a composite video signal.

⑫ VIDEO OUT 2

This terminal outputs a composite video signal identical to VIDEO OUT 1 unless the CCU is configured for Operational Video Output, in which case, this terminal outputs operational video signals instead of composite signals.

⑬ $\overline{HD}$

This terminal normally outputs HD(Horizontal Drive) signal. When the M2505 EXTERNAL SYNC option is installed this terminal becomes an HD signal input.

⑭ $\overline{VD}$

This terminal normally outputs VD(Vertical Drive) signal. When the M2505 EXTERNAL SYNC option is installed this terminal becomes a VD signal input.

⑮ GND

This is the frame ground of the CCU. Utilize this terminal to provide a "common" ground to other equipment being used.

⑯ LINE

This cable supplies power to the CCU.

⑰ AGC ON-OFF Switch

This switch enables or disables the Automatic Gain Control. The ON position of the switch implements the AGC circuitry.

8. OPERATION

8-1 PRELIMINARY ADJUSTMENTS

(1) Confirm that all cables are properly connected. (Refer to Section 6 for cable connection.)

(2) Preset each control on the front panel as specified below:
   a. Turn the GAIN control knob fully CCW.
   b. Turn the OFFSET control knob fully CW.
   c. Turn the SENSITIVITY control knob fully CCW.
   d. Set the VIDEO SELECT switch to the neutral(middle) position.
   e. Set the SHADING switch to the OFF position.

(3) Turn on the TV monitor and confirm that the POWER pilot lamp is lit. Adjust tha CONTRAST control and BRIGHTNESS control to a position in which the raster lines can be clearly observed. It will take approximately 20 to 30 seconds for raster to appear on the screen after power is turned on.

(4) Ensure that the light path to the camera head is blocked.

(5) Turn on the CCU power switch and confirm that the green POWER LED is lit on the front panel. If the display picture rolls, adjust the H.HOLD control and/or the V.HOLD control of the TV monitor.

(6) As for C2400-08, after powering on, for over ten seconds, high voltage is not provided to SIT. Therefore, the picture does not show up on the monitor screen. After waiting for about 20 seconds, input light.

8-2 ADJUSTMENT OF VIDEO LEVEL

The light intensity directed to the camera faceplate is critical. Too little light will result in a poor quality image. Excessive light intensity will likewise degrade image quality and if too high, can result in permanent damage to the image tube.

NOTE : The -00,-03, and -08 camera heads are particularly susceptible to damage from excessive light intensity *, **.

(1) Minimize image intensity
(2) Direct light to the camera head
(3) Slowly increase the image intensity until the green video level indicator comes on. This point represents the minimum intensity needed to produce a high quality image.
(4) Continue to carefully increase image intensity until the red LED just begins to come on. This condition represents the optimal image intensity.

* For -00,-03 Camera Heads

These imaging tubes employ a target with adjustable voltage. Increasing the voltage to the target(SENSITIVITY) results in increased tube sensitivity.

The highest quality image is obtained when the SENSITIVITY control is turned to its minimum position (fully CCW). Increased target voltage results in a poorer S/N, reduced dynamic range and increased lag; therefore, the SENSITIVITY control should be increased only when the imaging system can not supply enough illumination or it is intentionally desired to reduce object illumination. In this case, increase the sensitivity until the upper range of the green LED is reached.

** For -08 Camera Head

This imaging tube employs a intensifier with adjustable voltage. Increasing this voltage increases the sensitivity accordingly. The best quality image is obtained when the SENSITIVITY control is turned to its minimum position. Increased voltage results in a poorer S/N, therefore, the SENSITIVITY control should be increased only when the imaging system cannot supply enough illumination or it is intentionally desired to reduce object illumination. In this case, increase the sensitivity until the upper range of the green LED is reached.

8-3 ADJSUTMENT OF CONTRAST ENHANCEMENT

When observing a specimen with low contrast, image contrast can be increased through the proper use of the GAIN and OFFSET controls.

(1) While watching the monitor screen, turn the GAIN control knob CW until the intensity appears slightly more than suitable.

(2) Slowly turn the OFFSET control knob CCW until the image is displayed as desired.

(3) Repeat adjustments of both (1) and (2) until the desired part of the image is displayed most clearly.

Before enhancement　　After enhancement

8-4 ADJUSTMENT OF SHADING CORRECTOR (OPTION)

When the M2502 SHADING CORRECTOR is installed in the CCU, shading introduced by the camera and the optical system can be corrected. This feature allows for the most effective utilization of the contrast enhancement function.

Adjustment is as follows :

(1) Adjust CONTRAST ENHANCEMENT to achieve maximum image detail.

(2) Set the SHADING switch to the ON position.

(3) Correct the shading by adjusting the 4 pots. on the front panel of the CCU .

The functions of the pots. are as follows :

(1) Horizontal Parabola 
Adjusting horizontal parabola decreases the difference in the intensity between the center and the corners in the horizontal direction. Turning the adjusting screw CW results in the horizontal center becoming brighter. Turning the adjusting screw CCW results in the corners becoming brighter.

(2) Horizontal Sawtooth 
Adjusting horizontal sawtooth decreases the difference in the intensity between the right and left sides of the image. Turning the adjusting screw CW results in the left side of the image becoming brighter. Turning the adjusting screw CCW results in the right side of the image becoming brighter.

(3) Vertical Parabola 
Adjusting vertical parabola decreases the difference in intensity between the center and the corners in the vertical direction. Turning the adjusting screw CW results in the vertical center becoming brighter. Turning the adjusting screw CCW results in the corners becoming brighter.

(4) Vertical Sawtooth

Adjusting vertical sawtooth decreases the defference in intensity between the top and bottom of the image. Turning the adjusting screw CW results in the top of the image becoming brighter. Turning the adjusting screw CCW results in the bottom of the image becoming brighter.

8-5 VIDEO SELECT

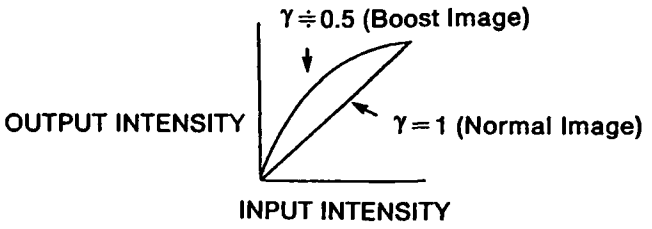
When the M2503 VIDEO BOOSTER or the M2504 VIDEO INVERTER is installed, this switch allows for the selection of the desired video display mode.
The three positions of the VIDEO SELECT switch are NEUTRAL, BOOST, and NEGA.

(1) Neutral

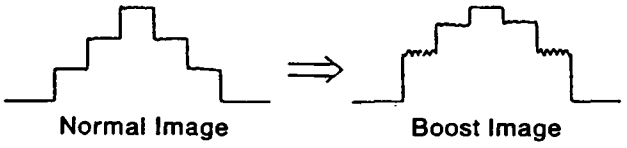
In this position(middle), a normal, positive video signal is output/ displayed.

(2) BOOST

In this position(upper), the output characteristics of the camera are modified to enhance the visualization of detail in dark portions of the image. The conversion characteristic(γ) is preset to 0.5 although this value is continuously adjustable from 0.3 to 1.0(See Section 10-2 for γ characteristic adjustment).
The basic principle of the conversion is as follows.

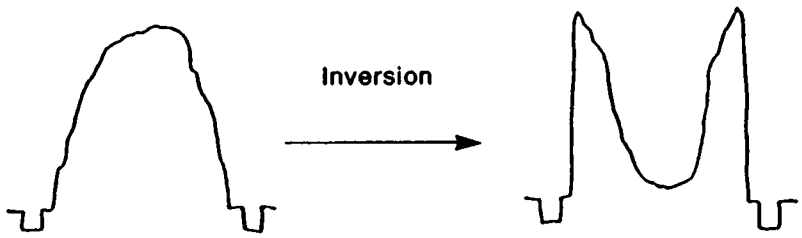


Example



(3) INVERTER

In this position(lower), the output video signal is inverted with regard to input intensity as indicated below.



8-6 AUTOMATIC GAIN CONTROL

AGC is a function to keep a constant output video signal against to the varior of the input intensity.

(1) In the condition of turning the AGC switch to OFF side, adjust the intensity of light until the green LED lights.

(2) Turn the AGC switch to ON side. Automatically adjusts AMP GAIN, and outputs a constant video signal.
The correction range against the incident light is about 8:1.
(It corresponds to the iris at 3 levels.)

CAUTION)

- When there is no or little incident light, AMP GAIN becomes maximum. Therefore, S/N becomes smaller.
- When the red LED on the front panel of CCU lights by the excessive incoming light, stop down the iris.

8-7 SIT PROTECTION (-08)

SIT PROTECTION is a function to protect SIT tube from the excessive incident light.

When the excessive incident light beyond 1.3 times as much as normal amount of light (VIDEO OUT 1Vp-p) is in, the high voltage supplied to SIT is shut down and protect SIT tube.

This time, red LED lights on. And, it indicates that protection circuit is working.

In case of cancelling the protection circuit, re-power the power switch on.

CAUTION)

- After powering on, for over ten seconds, the high voltage is not supplied to SIT and the picture does not show up on the monitor screen.
- When AGC is used, the function of SIT PROTECTION does not work.
- When ASC (option) is used, the function of SIT PROTECTION does not work.

9. MAINTENANCE AND TROUBLESHOOTING

9-1 CCU CLEANING

Cleaning the inside of the CCU is not normally required. However, should the CCU be exposed to abnormally dusty conditions, clean the inside of the CCU periodically, as follows.

(1) Unplug the power supply cable of the CCU.

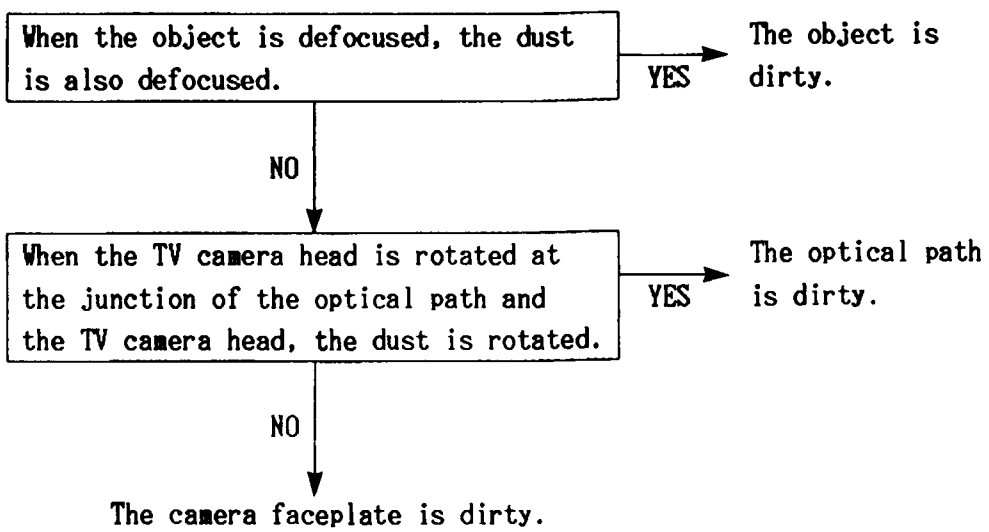
(2) Loosen the 4 screws on the sides of the CCU and take off the CCU cover.

(3) Blow away the dust using an air gun or gently brush with a soft cleaning brush. Take care not to damage electrical parts.

(4) Install the cover ensuring that the air vents are located on the left.

9-2 CAMERA FACEPLATE CLEANING

The camera faceplate is carefully cleaned at the time of shipment. However, dust may be diposited on the faceplate during installation of the camera to the imaging system. To ensure the highest quality image, eveluate the entire imaging system for the presence of dust or dirt. Identify the location of any contaminate using the following scheme and remove, if possible.



Procedure :

1. Attempt to remove the dust or dirt with an air gun or optical cleaning brush.
2. If dirt or dust is still present, gently clean the faceplate with a cotton stick or lens paper dipped in ethyl alcohol working from the center to the periphery in a circular fashion.
3. Wipe the faceplate more time carefully with lens paper lightly moistened with ethyl alcohol. Check for dust or dirt. If the surface is not absolutely clean repeat the procedure.
4. Confirm that faceplate is clean by attaching the camera to the optical system and check utilizing a uniform image.

9-3 C2400 TROUBLESHOOTING CHART

No image on the TV monitor	Are the pilot lamps of the CCU and TV monitor on? Are the video out of the CCU and the video in of the TV monitor properly connected? Are the CCU and the TV camera head properly connected? Is the OFFSET pot. on the front panel turned fully CW? Is the GAIN pot. on the front panel turned fully CCW? Is there an optical path between the object and the TV camera head? Is the green LED on the front panel of the CCU on? SIT protection circuit is working, isn't it?
Image on the TV monitor is not clear.	Is the green LED on the front panel of the CCU on? Are the CONTRAST and BRIGHTNESS on the TV monitor adjusted correctly? Is the object in focus? Is the resolution of the optical path(microscopy) satisfactory? Is the optical aberration satisfactory? Is the camera faceplate surface clean?
Noisy image	Is the green LED on the front panel of the CCU on? Is the 75Ω termination of the TV monitor on? Is the system properly grounded? Are the optical path and the TV camera head connected correctly? (Electrical connection is required.) Are there sources of electrical noise in the vicinity of the system?
Distorted image	Are there any sources of magnetic field around the TV camera head and the TV monitor? Is the optical imaging system properly aligned? Are the H.HOLD and V.HOLD of the TV monitor adjusted correctly?
Shaded image	Are the pots. of the shading corrector adjusted correctly? Is the shading of the optical path satisfactory?

10. OPTION INSTALLATION INSTRUCTIONS

10-1 M2502 SHADING CORRECTOR

The SHADING CORRECTOR option comes completely adjusted and ready for use.

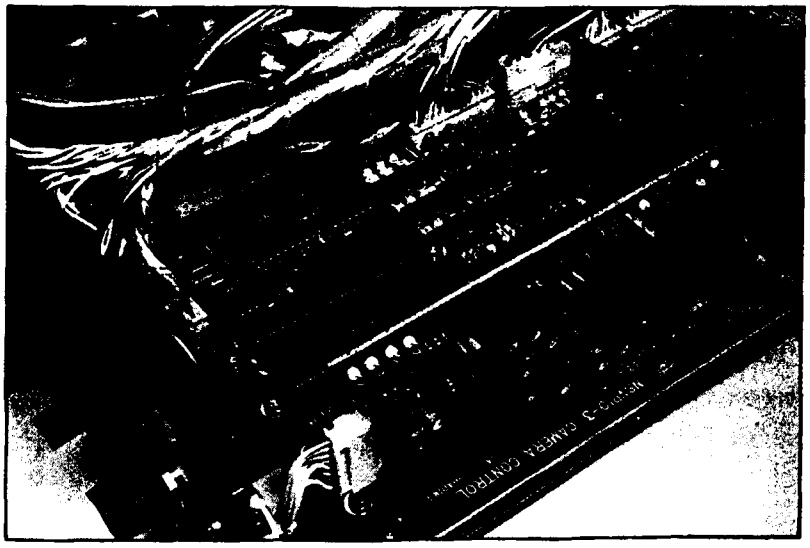
Installation :

(1) Turn POWER switch OFF on the CCU.

(2) Unplug the CCU power supply cord.

(3) Using a small Phillips screwdriver, loosen the 4 screws on the sides of the CCU and remove the cover.

(4) Insert the M2502 option card into the connector labeled JA SHADING as illustrated in teh figure below.



(5) Connect the wire harness with keyed male plug (originating from the back side of the shading pots.) to the corresponding keyed female plug on the option card.

(6) Replace the CCU cover making sure that the air vent is located on the left and tighten the 4 holding screws.

Adjustment is as follows :

(1) Adjust CONTRAST ENHANCEMENT to achieve maximum image detail.

(2) Set the SHADING switch to the ON position.

(3) Correct the shading by adjusting the 4 pots. on the front panel of the CCU.

The functions of the pots. are as follows :

(1) Horizontal Parabola 
Adjusting horizontal parabola decreases the difference in the intensity between the center and the corners in the horizontal direction. Turning the adjusting screw CW in the horizontal center becoming brighter. Turning the adjusting screw CCW results in the corners becoming brighter.

(2) Horizontal Sawtooth 
Adjusting horizontal sawtooth decreases the difference in the intensity between the right and left sides of the image. Turning the adjusting screw CW results in the left side of the image becoming brighter. Turning the adjusting screw CCW results in the right side of the image becoming brighter.

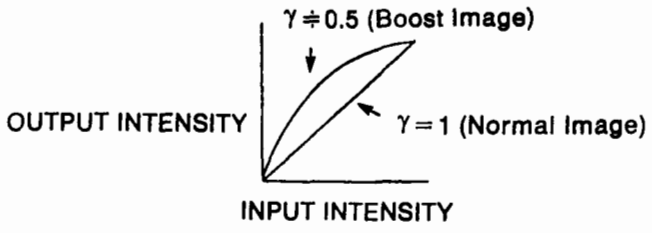
(3) Vertical Parabola 
Adjusting vertical parabora decreases the difference in intensity between the center and the corners in the vertical direction. Turning the adjusting screw CW results in the center becoming brighter. Turning the adjusting screw CCW results in the corners becoming brighter.

(4) Vertical Sawtooth 
Adjusting vertical sawtooth decreases the difference in intensity between the top and bottom of the image. Turning the adjusting screw CW results in the top of the image becoming brighter. Turning the adjusting screw CCW results in the bottom of the image becoming brighter.

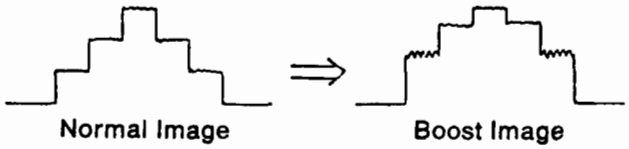
10-2 M2503 VIDEO BOOSTER

In this position (upper), the output characteristics of the camera are modified to enhance the visualization of detail in dark portions of the image. The conversion characteristic(γ) is preset to 0.5 although this value is continuously adjustable from 0.3 to 1.0.

The basic principle of the conversion is as follows:



Example



Installation :

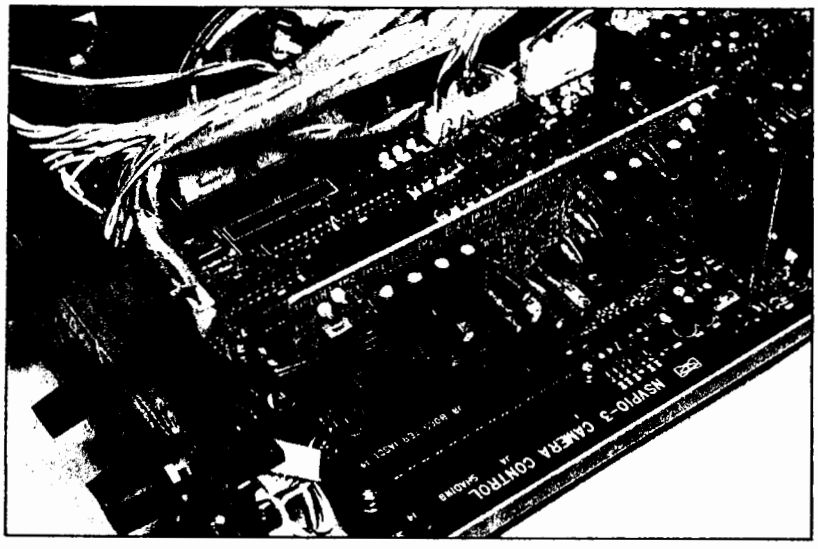
(1) Turn POWER switch OFF on the CCU.

(2) Unplug the CCU power supply cord.

(3) Using a small Phillips screwdriver, loosen the 4 screws on the sides of the CCU and remove the cover.

(4) Set switch SW1 on the BOOSTER card to the NORMAL(NOR) position.

(5) Insert the M2503 option card into the connector labeled JB BOOSTER.



(6) Replace the CCU cover making sure that the air vent is located on the left, and tighten the 4 holding screws.

Booster Value Adjustment :

The BOOSTER option comes preset with a gamma value of 0.5 however this value is continuously adjustable from 0.3 to 1.0.

MATERIALS :

A2-Channel Oscilloscope (20MHz or greater) with two 10x probes.

SET UP CONDITIONS :

Set Channel 1 and 2 of the oscilloscope as listed below:
Volts Per Division : 0.1V
Seconds Per Division : 20 microseconds

Preliminary adjustments :

1. Turn POWER switch OFF on the CCU.
2. Unplug the CCU power supply cord.
3. Using a small Phillips screwdriver, loosen the 4 screws on the side of the CCU and remove the cover.
4. Set Switch SW1 to the CHECK position (DOWN).
5. Place oscilloscope Channel 1 probe on Test Point #3 (TP3).
6. Place oscilloscope Channel 2 probe on Test Point #2 (TP2).

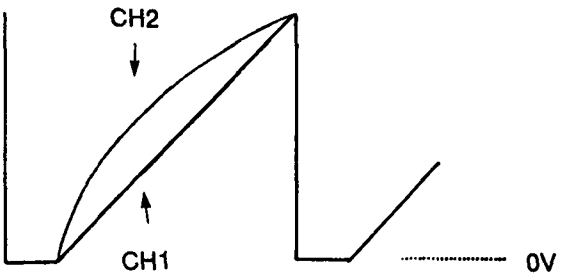
NOTE :

Test Points 2 and 3 are located near the upper right and left corners of the BOOSTER option card.

Calibration :

1. Plug the power supply cord of the CCU into AC cord.

2. Turn on the power to the CCU. The following waveforms should be shown on the oscilloscope display screen.

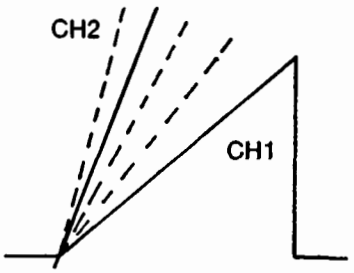


Booster Value Adjustment :

INTENSITY CONVERSION is adjusted using 4 pots.(P1, L1, OFS, GAIN). The meaning of the pots. and adjusting techniques described in the following steps.

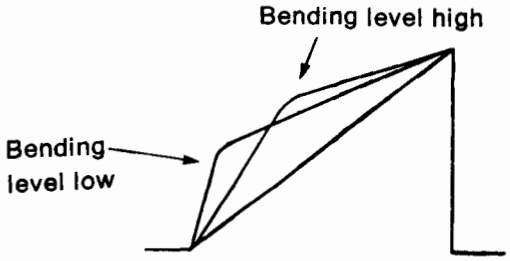
1. Turning pots.(L1,P1,L2,P2) fully CW.

2. Using the GAIN pot., adjust the slope of the waveform at TP2 (Channel 2). GAIN determines the slope of the characteristic. Turning GAIN CW results in an increased slope, CCW in a decreased slope. When gamma is 0.5, the slope is approximately 4.

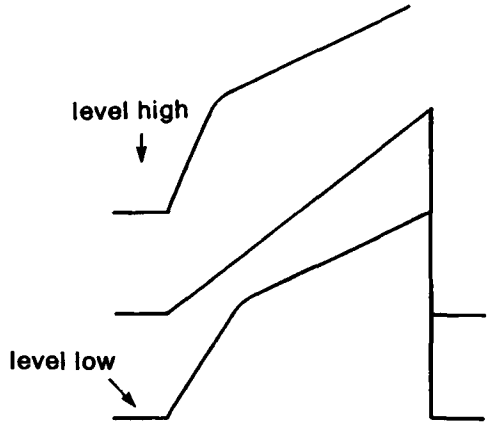


3. Turn P1 fully CCW.

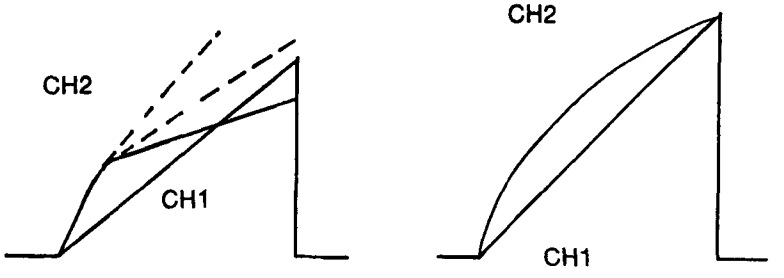
4. Using L1 pot., adjust the bending level of the waveform on TP2 (Channel 2). L1 determines the bending level of the characteristic. Turning L1 CW will set a higher level, CCW a lower level.



5. Using the OFS pot., adjust the OFFSET to make the 0V level of Channel 1 and Channel 2 identical. Turning the OFS pot. determines the 0V DC level of the characteristic, turning CW results in the level decreasing, CCW increasing.

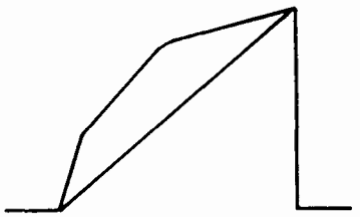


6. Using P1, adjust the waveform of Channel 2 to be the same height as Channel 1. P1 determines the tip bending rate of the characteristic; turning P1 CW results in a decreased rate, CCW an increased rate.



NOTE :

Should the characteristic bend at 2 levels as illustrated below, adjust P1 so the highest level of the waveform on Channel 2 is higher than that of Channel 1.
Adjust P2 and L2 as same as 3 to 6.

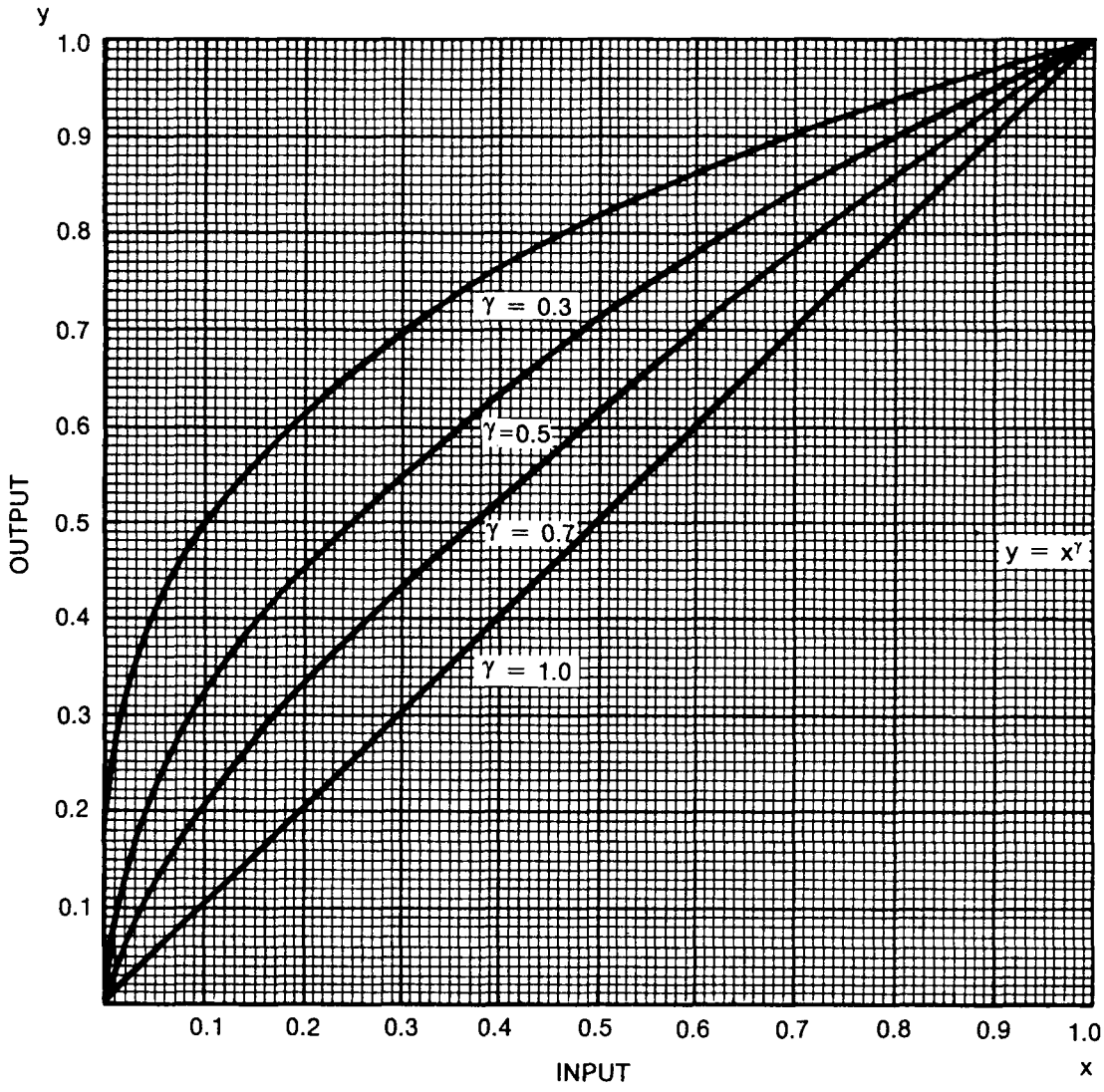


7. Remove the oscilloscope probes.

8. Reset the switch SW1 to the NOR position (UP).

9. Replace the CCU cover making sure that the air vent is located on the left.

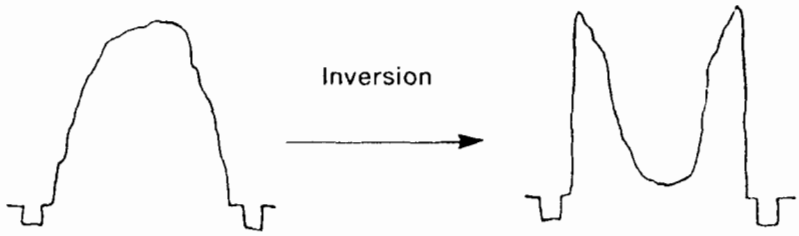
10. Adjust BOOSTER according to chart (See next page.).



Characteristic of VIDEO BOOSTER

10-3 M2504 VIDEO INVERTER

In this position (lower), the output video signal is inverted with regard to input intensity as indicated below.



The VIDEO INVERTER option comes completely adjusted and ready for use.

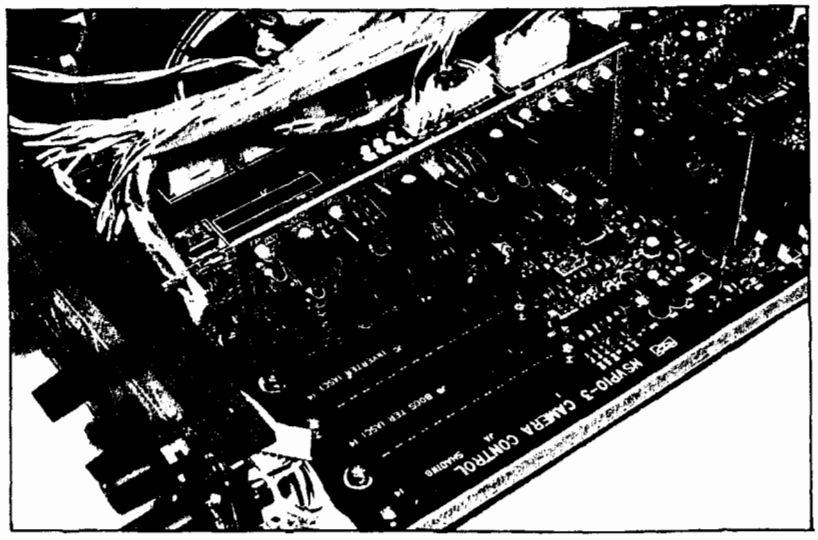
Installation :

1. Turn POWER switch OFF on the CCU.

2. Unplug the CCU power supply cord.

3. Using a small Phillips screwdriver, loosen the 4 screws on the side of the CCU and remove the cover.

4. Insert the M2504 option card into the connector labeled JC INVERTER as illustrated in the figure below.



5. Replace the CCU cover making sure that the air vent is located on the left and tighten the 4 holding screws.

10-4 M2505 EXTERNAL SYNC

The EXTERNAL SYNC option comes completely adjusted and ready for use.

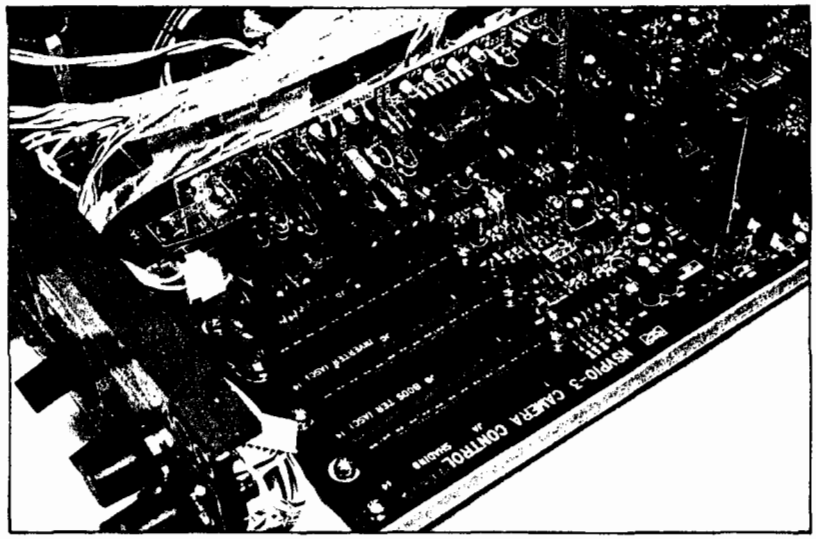
Installation :

1. Turn POWER switch OFF on the CCU.

2. Unplug the CCU power supply cord.

3. Using a small Phillips screwdriver, loosen the 4 screws on the side of the CCU and remove the cover.

4. Insert the M2505 option card into the connector labeled JD SYNC as illustrated in the figure below.



5. Disconnect the EXT SYNC control wires from connector J6. Connector J6 is found on the Master Control board of the CCU near the front control panel. Connect this group of wires to the EXT SYNC connector JB.

6. Set switch SW1 to the NEGA or POSI position depending on the type of synchronization wave pulse used for external control of the camera.

7. Replace the CCU cover making sure that the air vent is located on the left and tighten the 4 holding screws.

8. Specifications :

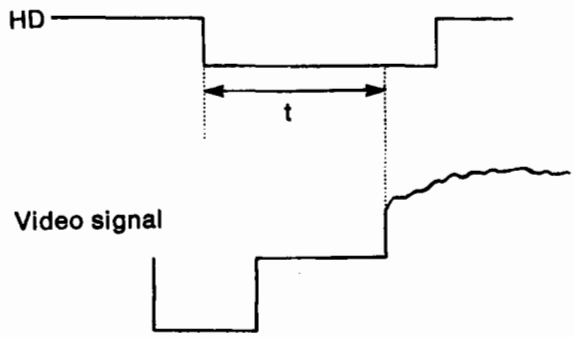
Voltage

2.0Vp-p ≤ Signal ≤ 15.0Vp-p

Scanning Frequency

	HORIZONTAL	VERTICAL
EIA RS170	15.750KHz	60Hz
CCIR SYSTEM B	15.625KHz	50Hz

Horizontal Delay time of the picture from the front edge of the HD signal.



ETA RS170 t=5.4μsec
CCIR SYSTEMB t=7.0μsec

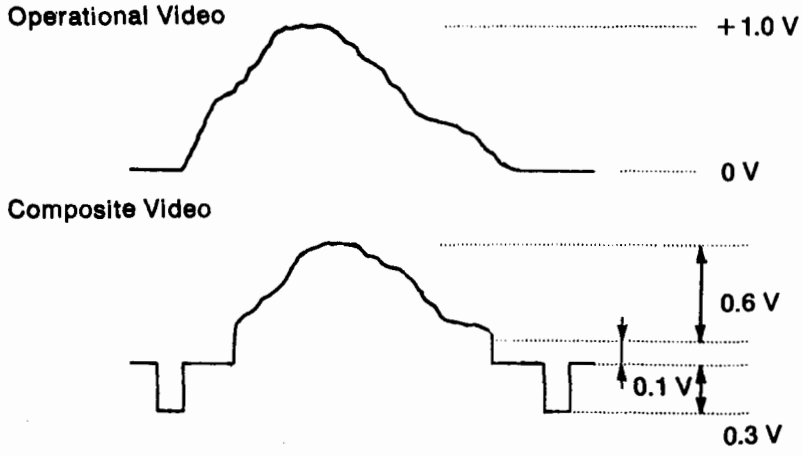
Vertical Delay time of the picture from the front edge of the VD signal.

EIA RS170	16 Horizontal time
CCIR SYSTEM B	25.5 Horizontal time

Termination resistance is normally 75Ω. For conditions requiring greater termination resistance, consult your authorized C2400 representative.

10-5 OPERATIONAL VIDEO OUTPUT

As described in the features secion, OP VIDEO is output from VIDEO OUT 2 and non-composite in nature. Illustrated below is the OP VIDEO waveform compared to the C2400 composite signal. For modification details consult your authorized C2400 camera representative.



NOTE :

With 75Ω termination, 1.0Vp-p of operational video corresponds to 0.6Vp-p composite video.

10-6 M3322 AUTOMATIC SENSITIVITY CONTROL FOR SIT

As for this option, modification of internal circuit is required, and this option is set at our factory. In case of adding this option after shipping, our factory will take the camera in charge.

Operation :

1. Turning ASC switch on the rear panel to ON position, this function works. This time, the SENSITIVITY pot. on the front panel does not work.
2. When the picture on the monitor repeats the intensity conversion, and when the red LED on the front panel of CCU lights, They show the incident light is excessive. Then stop down the iris.
   After powering on and then about 15 seconds, the ASC function works.
3. The correction range against the incident light is 64:1
   (It corresponds to the iris at 6 levels.) or more.
4. When using this function, it is impossible to use either M2503 or M2504, also the AGC function.

Hamamatsu Video Enhancer.

8. OPERATION

8.1 Preliminary Adjustments

(1) Confirm that all cables are properly connected. (Refer to **Section 6** for cable connection.)

(2) Preset each control on the front panel as specified below:

(a) Turn the **GAIN** control knob fully counterclockwise.
(b) Turn the **OFFSET** control knob fully clockwise.
(c) Turn the **SENSITIVITY** control knob fully counterclockwise.
(d) Set the **VIDEO SELECT** switch to the neutral (middle) position.
(e) Set the **SHADING** switch to the **OFF** position.

(3) Turn on the TV monitor and confirm that the **POWER** pilot lamp is lit. Adjust the **CONTRAST** control and **BRIGHTNESS** control to a position in which the raster lines can be clearly observed. It will take aproximately 20 to 30 seconds for raster to appear on the screen after power is turned on.

(4) Ensure that the light path to the camera head is blocked.

(5) Turn on the CCU power switch and confirm that the green POWER LED is lit on the front panel. If the display picture rolls, adjust the H. HOLD control and/or the V. HOLD control of the TV monitor.

8.2 Adjustment of Video Level

The light intensity directed to the camera faceplate is critical. Too little light will result in a poor quality image. Excessive light intensity will likewise degrade image quality and if too high, can result in permanent damage to the image tube.

NOTE:
The -00, -03 and -08 camera heads are particularly susceptible to damage from excessive light intensity *,**.

(1) Minimize image intensity

(2) Direct light to the camera head

(3) Slowly increase the image intensity until the green video level indicator comes on. This point represents the minimum intensity needed to produce a high quality image.

(4) Continue to carefully increase image intensity until the red LED just begins to come on. This condition represents the optimal image intensity.

* ***For -00, -03 Camera Heads***
These imaging tubes employ a target with adjustable voltage. Increasing the voltage to the target (**SENSITIVITY**) results in increased tube sensitivity. The highest quality image is obtained when the **SENSITIVITY** control is turned to its minimum position (fully counterclockwise). Increased target voltage results in a poorer S/N, reduced dynamic range and increased lag; therefore, the **SENSITIVITY** control should be increased only when the imaging system cannot supply enough illumination or it is intentionally desired to reduce object illumination. In this case, increase the sensitivity until the upper range of the green LED is reached.

**** For -08 Camera Head**

This imaging tube employs a intensifier with adjustable voltage. Increasing this voltage increases the sensitivity accordingly. The best quality image is obtained when the **SENSITIVITY** control is turned to its minimum position. Increased voltage results in a poorer S/N, therefore, the **SENSITIVITY** control should be increased only when the imaging system cannot supply enough illumination or it is intentionally desired to reduce object illumination. In this case, increase the sensitivity until the upper range of the green LED is reached.

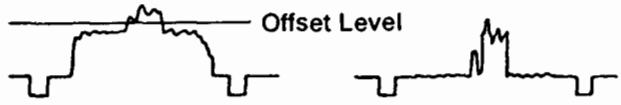
8.3 Adjustment of Contrast Enhancement

When observing a specimen with low contrast, image contrast can be increased through the proper use of the **GAIN** and **OFFSET** controls.

(1) While watching the monitor screen, turn the **GAIN** control knob clockwise until the intensity appears slightly more than suitable.

(2) Slowly turn the **OFFSET** control knob counterclockwise until the image is displayed as desired.

(3) Repeat adjustments of both (1) and (2) until the desired part of the image is displayed most clearly.



Before enhancement After enhancement

8.4 Adjustment of Shading Corrector (OPTION)

When the M2502 SHADING CORRECTOR is installed in the CCU, shading introduced by the camera and the optical system can be corrected. This feature allows for the most effective utilization of the contrast enhancement function.

Adjustment is as follows:

(1) Adjust **CONTRAST ENHANCEMENT** to achieve maximum image detail.

(2) Set the **SHADING** switch to the **ON** position.

(3) Correct the shading by adjusting the 4 potentiometers on the front panel of the CCU with a small slotted screwdriver.

The functions of the potentiometers are as follows:

1. Horizontal Parabola
   Adjusting horizontal parabola decreases the difference in the intensity between the center and the corners in the horizontal direction. Turning the adjusting screw clockwise results in the horizontal center becoming brighter. Turning the adjusting screw counterclockwise results in the corners becoming brighter.

2. Horizontal Sawtooth
   Adjusting horizontal sawtooth decreases the difference in the intensity between the right and left sides of the image. Turning the adjusting screw clockwise results in the left side of the image becoming brighter. Turning the adjusting screw counterclockwise results in the right side of the image becoming brighter.

3. Vertical Parabola
   Adjusting vertical parabola decreases the difference in intensity between the center and the corners in the vertical direction. Turning the adjusting screw clockwise results in the center becoming

Adjustment of Shading Corrector (OPTION)

brighter. Turning the adjusting screw counterclockwise results in the corners becoming brighter.

4. Vertical Sawtooth /
Adjusting vertical sawtooth decreases the difference in intensity between the top and bottom of the image. Turning the adjusting screw clockwise results in the top of the image becoming brighter. Turning the adjusting screw counterclockwise results in the bottom of the image becoming brighter.

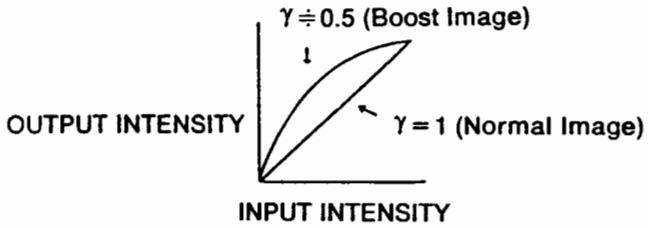
8.5 Video Select

When the M2503 VIDEO BOOSTER or the M2504 VIDEO INVERTER is installed, this switch allows for the selection of the desired video display mode. The three positions of the **VIDEO SELECT** switch are **NEUTRAL, BOOST** and **NEGA.**

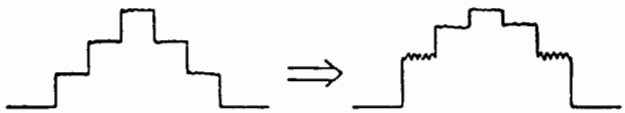
1. Neutral
In this position (middle), a normal, positive video signal is output/displayed.

2. BOOST
In this position (upper), the output characteristics of the camera are modified to enhance the visualization of detail in dark portions of the image. The conversion characteristic(γ) is preset to 0.5 although this value is continuously adjustable from 0.3 to 1.0 (See **Section 10-2** for γ characteristic adjustment).

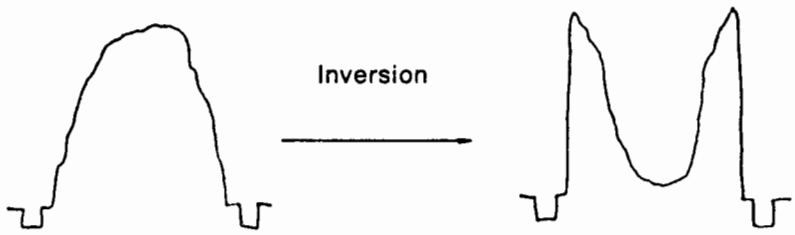
The basic principle of the conversion is as follows:



Example



3. INVERTER
In this position (lower), the output video signal is inverted with regard to input intensity as indicated below.



9. MAINTENANCE AND TROUBLESHOOTING

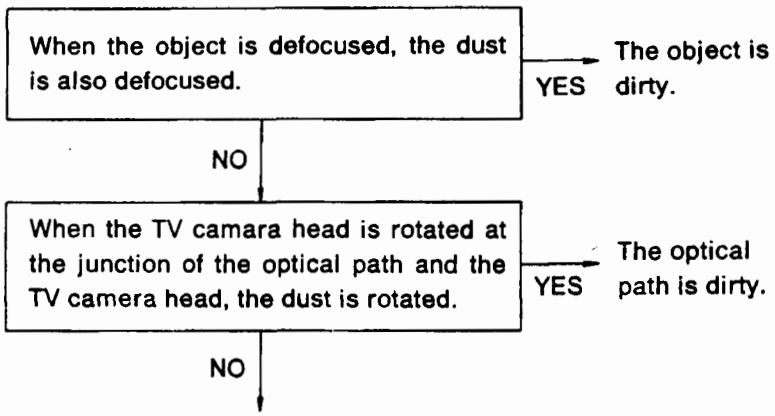
9.1 CCU Cleaning

Cleaning the inside of the ccu is not normally required. However, should the CCU be exposed to abnormally dusty conditions, clean the inside of the CCU periodically, as follows:

1. Unplug the power supply cable of the CCU.
2. Loosen the 4 screws on the sides of the CCU and take off the CCU cover.
3. Blow away the dust using an air gun or gently brush with a soft cleaning brush. Take care not to damage electrical parts.
4. Install the cover ensuring that the air vents are located on the left.

9.2 Camera Faceplate Cleaning

The camera faceplate is carefully cleaned at the time of shipment. However, dust may be deposited on the faceplate during installation of the camera to the imaging system. To ensure the highest quality image, evaluate the entire imaging system for the presence of dust or dirt. Identify the location of any contaminate using the following scheme and remove, if possible.



Procedure:

1. Attempt to remove the dust or dirt with an air gun or optical cleaning brush.
2. If dirt or dust is still present, gently clean the faceplate with a cotton stick or lens paper dipped in ethyl alcohol working from the center to the periphery in a circular fashion.
3. Wipe the faceplate more time carefully with lens paper lightly moistened with ethyl alcohol. Check for dust or dirt. If the surface is not absolutely clean repeat the procedure.
4. Confirm that faceplate is clean by attaching the camera to the optical system and check utilizing a uniform image.

9.3 C2400 TROUBLESHOOTING CHART

No image on the TV monitor	Are the pilot lamps of the CCU and TV monitor on? Are the video Out of the CCU and the video In of the TV monitor properly connected? Are the CCU and the TV camera head properly connected? Is the **OFFSET** potentiometer on the front panel turned fully clockwise? Is the **GAIN** potentiometer on the front panel turned fully counterclockwise? Is there an optical path between the object and the TV camera head? Is the green indicator LED on the front panel of the CCU on?
Image on the TV monitor is not clear.	Is the green indicator LED on the front panel of the CCU on? Are the **CONTRAST** and **BRIGHTNESS** on the TV monitor adjusted correctly? Is the object in focus? Is the resolution of the optical path (microscopy) satisfactory? Is the optical aberration satisfactory? Is the camera facaplate surface clean?
Noisy image	Is the green indicator LED on the front panel of the CCU on? Is the 75 Ω termination of the TV monitor on? Is the system properly grounded? Are the optical path and the TV camera head connected correctly? (Electrical connection is required.) Are there sourses of electrical noise in the vicinity of the system?
Distorted image	Are there any sources of magnetic field around the TV camera head and the TV monitor? Is the optical imaging system properly aligned? Are the H. HOLD and V. HOLD of the TV monitor adjusted correctly?
Shaded image	Are the potentiometers of the shading corrector adjusted correctly? Is the shading of the optical path satisfactory?