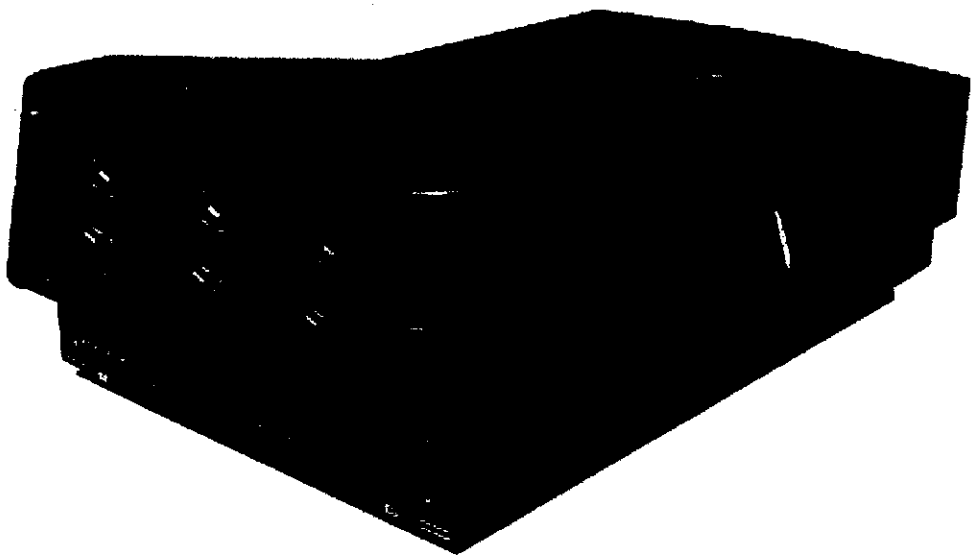
zenith

Zenith & ASC'S
Service Quality Partners

Technical Training Manual



PRO 1200 Technical Training Manual

Product Overview
Installation
Convergence
Circuit Descriptions

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Printed In USA

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ZENITH ELECTRONICS CORPORATION zenith
201 JAMES RECORD ROAD HUNTSVILLE, AL. 35824

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SAFETY INSTRUCTIONS

Important Safety Notice

When servicing this product, under no circumstances should the original design be modified or altered without permission from Zenith Electronics Corporation. All components should be replaced only with types identical to those in the original circuit and their physical location, wiring and lead dress must conform to original layout upon completion of repairs.

Special components are also used to prevent x-radiation, shock and fire hazard. These components are indicated by the letter "x" included in their component designators and are required to maintain safe performance. No deviations are allowed without prior approval by Zenith Electronics Corporation.

Circuit diagrams may occasionally differ from the actual circuit used. This way, implementation of the latest safety and performance improvement changes into the set is not delayed until the new service literature is printed.

Caution: Do not attempt to modify this product in any way. Never perform customized installations without manufacturer's approval. Unauthorized modifications will not only void the warranty, but may lead to property damage or user injury.

Service work should be performed only after you are thoroughly familiar with these safety checks and servicing guidelines.

Graphic symbols

The exclamation point within an equilateral triangle is intended to alert the service personnel to important safety information in the service literature.

The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the service personnel to the presence of noninsulated "dangerous voltage" that may be of sufficient magnitude to constitute a risk of electric shock.

The pictorial representation of a fuse and its rating within an equilateral triangle is intended to convey to the service personnel the following fuse replacement caution notice:

CAUTION: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ALL FUSES WITH THE SAME TYPE AND RATING AS MARKED NEAR EACH FUSE.

Service Information

While servicing, use an isolation transformer for protection from AC line shock.

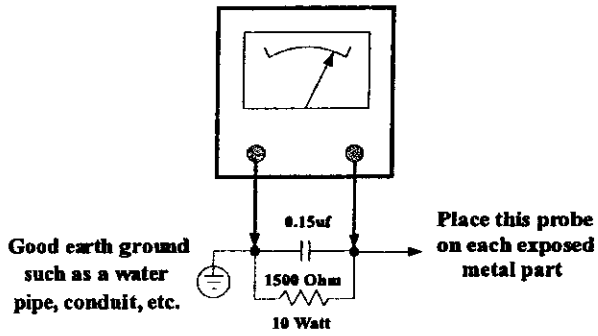
After the original service problem has been corrected, make a check of the following:

Fire and Shock Hazard

1. Be sure that all components are positioned to avoid a possibility of adjacent component shorts. This is especially important on items transported to and from the repair shop.
2. Verify that all protective devices such as insulators, barriers, covers, shields, strain reliefs, power supply cords, and other hardware have been reinstalled per the original design. Be sure that the safety purpose of the polarized line plug has not been defeated.

3. Soldering must be inspected to discover possible cold solder joints, solder splashes, or sharp solder points. Be certain to remove all loose foreign particles.
4. Check for physical evidence of damage or deterioration to parts and components, for frayed leads or damaged insulation (including the AC cord), and replace if necessary.
5. No lead or component should touch a receiving tube or a resistor rated at 1 watt or more. Lead tension around protruding metal surfaces must be avoided.
6. After reassembly of the set, always perform an AC leakage test on all exposed metallic parts of the cabinet (the channel selector knobs, antenna terminals, handle and screws) to be sure that set is safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER DURING THIS TEST. Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner: Connect a 1500 ohm, 10 watt resistor, paralleled by a .15 mfd 150V AC type capacitor between a known good earth ground (water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination of 1500 ohm resistor and .15 mfd capacitor. Reverse the AC plug by using a non-polarized adaptor and repeat AC voltage measurements for each exposed metallic part. Voltage measured must not exceed 0.75 volts RMS. This corresponds to 0.5 milliampere AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.

A.C. VOLTMETER



<< Fig. 1 >>

X-Radiation

1. Be sure procedures and instructions to all service personnel cover the subject of x-radiation. The only potential source of x-rays in current TV receivers is the picture tube. However, this tube does not emit x-rays when the HV is at the factory-specified level. The proper value is given in the applicable schematic. Operation at higher voltages may cause a failure of the picture tube or high-voltage supply and, under certain circumstances, may produce radiation in excess of desirable levels.
2. Only factory-specified CRT anode connectors must be used.
3. It is essential that the service personnel have available an accurate and reliable high-voltage meter.
4. When the high-voltage circuitry is operating properly, there is no possibility of an x-radiation problem. Every time a color chassis is serviced, the brightness should be run up and down while monitoring the high voltage with a meter, to be certain that the high voltage does not exceed the specified value and that it is regulating correctly.
5. When troubleshooting and making test measurements in a product with a problem of excessively high voltage, avoid being unnecessarily close to the picture tube and the high voltage power supply. Do not operate the product longer than necessary to locate the cause of excessive voltage.
6. Refer to HV, B+, and shutdown adjustment procedures described in the appropriate schematics and diagrams (where used).

SAFETY INSTRUCTIONS

Implosion

1. All direct view picture tubes are equipped with an integral implosion protection system; take care to avoid damage during installation.
2. Use only the recommended factory replacement tubes.

Tips On Proper Installation

1. Never install any receiver in a closed-in recess, cubbyhole, or closely fitting shelf space over, or close to, a heat duct, or in the path of heated air flow.
2. Avoid conditions of high humidity such as: outdoor patio installations where dew is a factor, near steam radiators where steam leakage is a factor, etc.
3. Avoid placement where draperies may obstruct venting. The customer should also avoid the use of decorative scarves or other coverings that might obstruct ventilation.
4. Wall- and shelf-mounted installations using a commercial mounting kit must follow the factory-approved mounting instructions. A product mounted to a shelf or platform must retain its original feet (or the equivalent thickness in spacers) to provide adequate air flow across the bottom. Bolts or screws used for fasteners must not touch any parts or wiring. Perform leakage tests on customized installations.
5. Caution customers against mounting a product on a sloping shelf or in a tilted position, unless the receiver is properly secured.
6. A product on a roll-about cart should be stable in its mounting to the cart. Caution the customer on the hazards of trying to roll a cart with small casters across thresholds or deep pile carpets.
7. Caution customers against using a cart or stand that has not been listed by Underwriters Laboratories, Inc. for use with its specific model of television receiver or generically approved for use with TVs of the same or larger screen size.
8. Caution customers against using extension cords. Explain that a forest of extensions, sprouting from a single outlet, can lead to disastrous consequences to home and family.

On AC Power

1. This product should be operated from an AC power source only. This product is designed to operate from either a nominal system voltage of 120V or 240V. However, this product has been shipped from the factory equipped with a standard three conductor North American power supply cordset for connection to a 15 A, 125 V, 60Hz branch circuit receptical outlet. If you are not sure of the type of AC power available, consult your dealer or local power company. If the power supply is not the correct one, consult your dealer.
2. THIS EQUIPMENT MUST BE GROUNDED (EARTHED) via the supplied 3 conductor AC power cable. (If the supplied power cable is not the corret one, consult your dealer.)
3. Do not allow anything to rest on the power cord. Do not locate this product where peoplewill walk on the cord. To disconnect the cord, pull it out by the plug. Never pull the cord itself.
4. If an extension cord is used with this product, make sure that the total of thye ampere ratingson the products plugged into the extension cor does not exceed the extension cord ampere rating. Also make sure that the total of all products plugged into the wall outlet does not exceed 15 amperes.

SAFETY INSTRUCTIONS

On Installation

1. Before operating your projector please read this manual thoroughly, and retain it for future reference.
2. Installation and preliminary adjustments should be performed by qualified ZENITH personnel or authorized ZENITH service dealers.
3. Do not place this projector on an unstable cart, stand, or table. The projector may fall, causing serious damage to it.
4. Do not use this projector near water.
5. Use only the power cord supplied with your projector. While appearing to be similar, other power cords have not been safety tested at the factory and may not be used to power the projector. For a replacement power cord, contact your dealer.
6. Slots and openings in the cabinet and the sides are provided for ventilation; to ensure reliable operation of the projector and to protect it from overheating, these openings must not be blocked or covered. The openings should never be blocked by placing the product on a bed, sofa, rug, or other similar surface. This product should never be placed near or over a radiator or heat register. This projector should not be placed in a built-in installation or enclosure unless proper ventilation is provided.

On Cleaning

1. Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.
2. To keep the cabinet looking brand-new, periodically clean it with a soft cloth. Stubborn stains may be removed with a cloth lightly dampened with mild detergent solution. Never use strong solvents, such as thinner or benzine, or abrasive cleaners, since these will damage the cabinet.
3. To ensure the highest optical performance and resolution, the projection lenses are specially treated with an anti-reflective coating, therefore : avoid touching the lens. To remove dust on the lens, use a soft dry cloth. Do not use a damp cloth, detergent solution, or thinner.

Federal Communication Commission (FCC statement)

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

General Safety Instructions

1. All the safety and operating instructions should be read before using this unit.
2. Never push objects of any kind into this product through cabinet slots as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electrical shock.
3. Never spill liquid of any kind on the product. Should any liquid or solid object fall into the cabinet, unplug the set and have it checked by qualified service personnel before resuming operations.
4. Lightning - For extra protection for this video product during a lightning storm, or when it is left unattended and unused for a long period of time, unplug it from the wall outlet. This will prevent damage to the projector due to lightning and AC power-line surges.

SAFETY INSTRUCTIONS

On Servicing

1. Do not attempt to service this projector yourself, as opening or removing covers may expose you to dangerous voltage potential and risk of electric shock!
2. Refer all projector service to a qualified Zenith service center.

Call for service in the following conditions :

1. When the power cord or plug is damaged or frayed.
2. If liquid has been spilled into the projector.
3. If the product has been exposed to rain or water.
4. If the product does not operate normally when the operating instructions are followed. Adjust only those controls that are covered by the operating instructions since improper adjustment of the other controls may result in damage and will often require extensive work by a qualified technician to restore the product to normal operation.
5. If the product has been dropped or the cabinet has been damaged.
6. If the product exhibits a distinct change in performance, indicating a need for service.

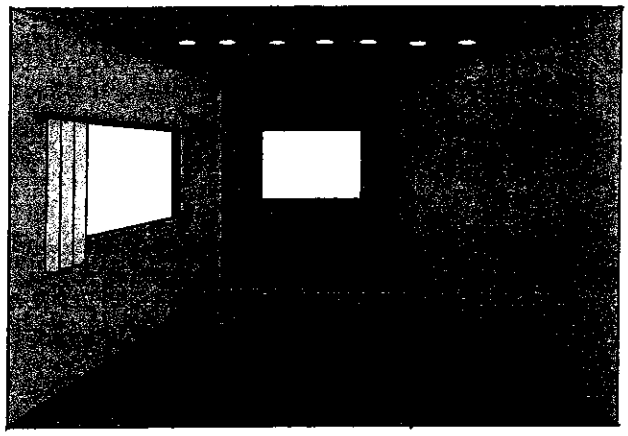
INSTALLATION GUIDELINES

Installation Guidelines

Careful consideration of things such as image size, ambient light level, projector placement and type of screen to use are critical to optimize the use of the projection system.

Environment

Do not install the projection system in a site near heat sources such as radiators or air ducts, or in a place subject to direct sunlight, excessive dust or humidity. Be aware that room heat rises to the ceiling; Make sure the temperature near the installation site is not excessive.

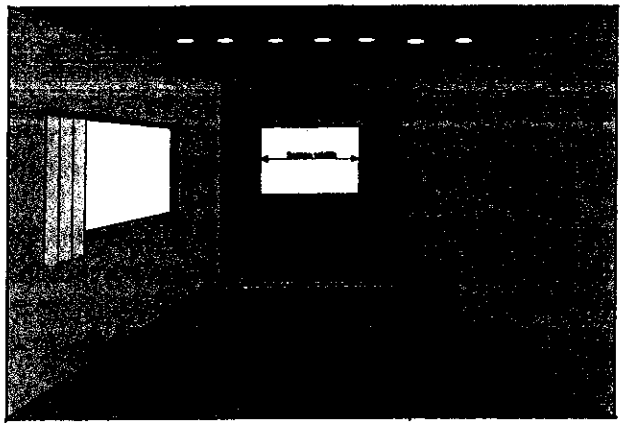


<< Fig. 2 >>

What about ambient light ?

The ambient light level of any room is made up of direct or indirect sunlight and the light fixtures in the room. The amount of ambient light will determine how bright the image will appear. So, avoid direct light on the screen as much as possible.

Windows that face the screen should be covered by opaque drapery while the set is being viewed. It is desirable to install the projecting system in a room whose walls and floor are of non-reflecting material. The use of recessed ceiling lights and a method of dimming those lights to an acceptable level is also important. Too much ambient light results in a 'wash out' of the projected image. This appears as less contrast between the darkest and lightest parts of the image. With bigger screens, the 'wash out' becomes more important. As a general rule, darken the room to the point where there is just sufficient light to read or write comfortably. Spot lighting is desirable for illuminating small areas so that interference with the screen is minimal.



<< Fig. 3 >>

Which screen type?

There are two major categories of screens used for projection equipment. Those used for front projected images and those for rear projection applications.

Screens are rated by how much light they reflect (or transmit in case of rear projection systems) given a determined amount of light projected toward them. The 'GAIN' of a screen is the term used. Front and rear screens are both rated in terms of gain. The gain of screens range from a white matte screen with a gain of 1 (x1) to a brushed aluminized screen with a gain of 10 (x10) or more. Another important consideration is the degree the screen's gain varies with the horizontal and vertical viewing angle. The choice between higher and lower gain screens is largely a matter of personal preference.

INSTALLATION GUIDELINES

In considering the type of screen to choose, determine where the viewers will be located and go for the highest gain screen possible. A high gain screen will provide a brighter picture but reduce the viewing angle.

For more information about screens, contact your local screen supplier.

What image size? How big should the image be?

The projector is designed for projecting an image width from 1.4m (4.6') to 6m (20') with an aspect ratio of 4 to 3. It leaves the factory, adjusted as a ceiling/front projector for a screen width of 2.4m (7.8'). Changing the image size from the factory preset size requires a realignment of the projector.

Where to install the projector ?

To indicate a correct installation position it is necessary to know :

- The distance from projector to ceiling in case of Ceiling mounted or the distance from projector to floor in case of Table mounted;
- The distance from projector to screen.

On Illumination

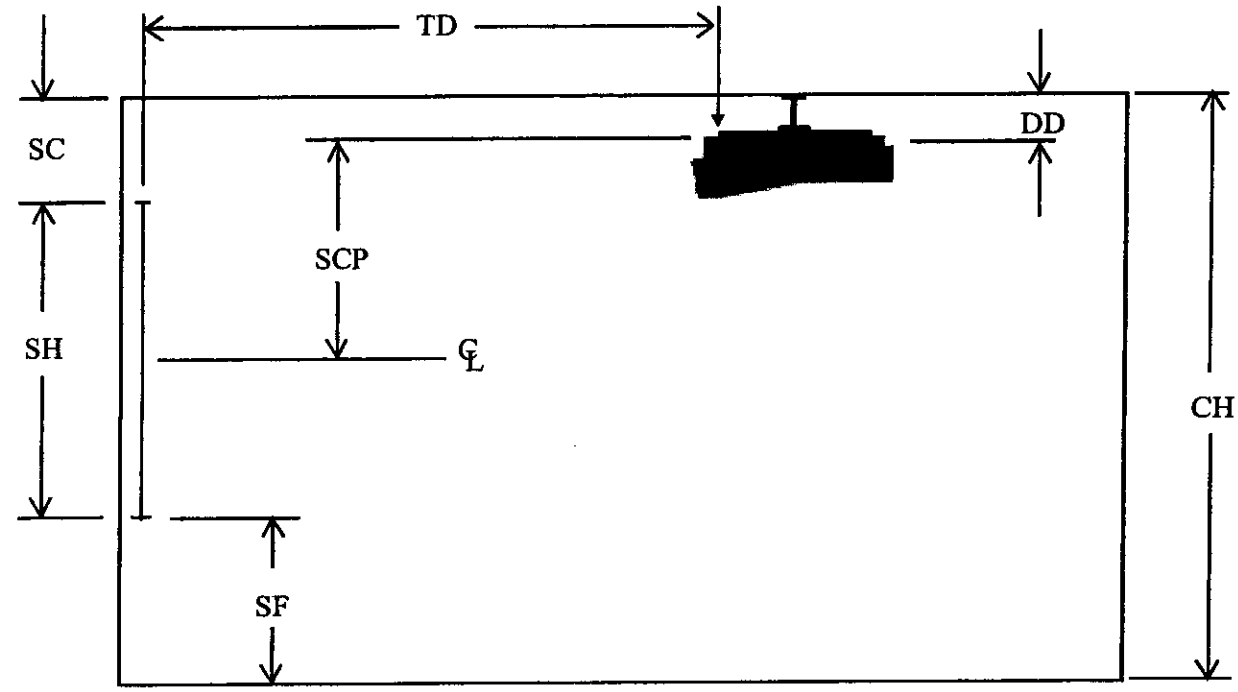
In order to obtain the best quality for the projected image, it is essential that the ambient light which is allowed to fall on the screen be kept to an absolute minimum.

When installing the projector and screen, care must be taken to avoid exposure to ambient light directly on the screen. Avoid adverse illumination on the screen from direct sunlight or fluorescent lighting fixtures.

The use of controlled ambient lighting, such as incandescent spot light or a dimmer, is recommended for proper room illumination. Where possible, care should also be taken to ensure that the floors and walls of the room in which the projector is to be installed are non-reflecting, dark surfaces. Brighter surfaces will tend to reflect and diffuse the ambient light and hence reduce the contrast of the projected image on the screen.

Calculating Projector Placement

Use the following formulas to calculate all measurments needed to properly position your Zenith HD projector. Note: These calculations are for a standard instalation.



<< Fig. 4 >>

Pro1200X Installation Worksheet

CH = Ceiling Height _____ SD = Screen Diagonal _____

DD = Drop Distance _____ SH = Screen Height _____

SC = Screen to Ceiling Dimension _____ SW = Screen Width _____

SCP = Screen Center to Projector Bottom _____ TD = Throw Distance _____

SF = Screen to Floor Dimension _____

Note: Throw Distance is from the screen to the front edge of the foot of the projector.

Main Calculations

SW = _____ TD = (SW x 1.1358) + 7.29" = _____

or

SW = SD(4:3) x 0.8 = _____ then

or

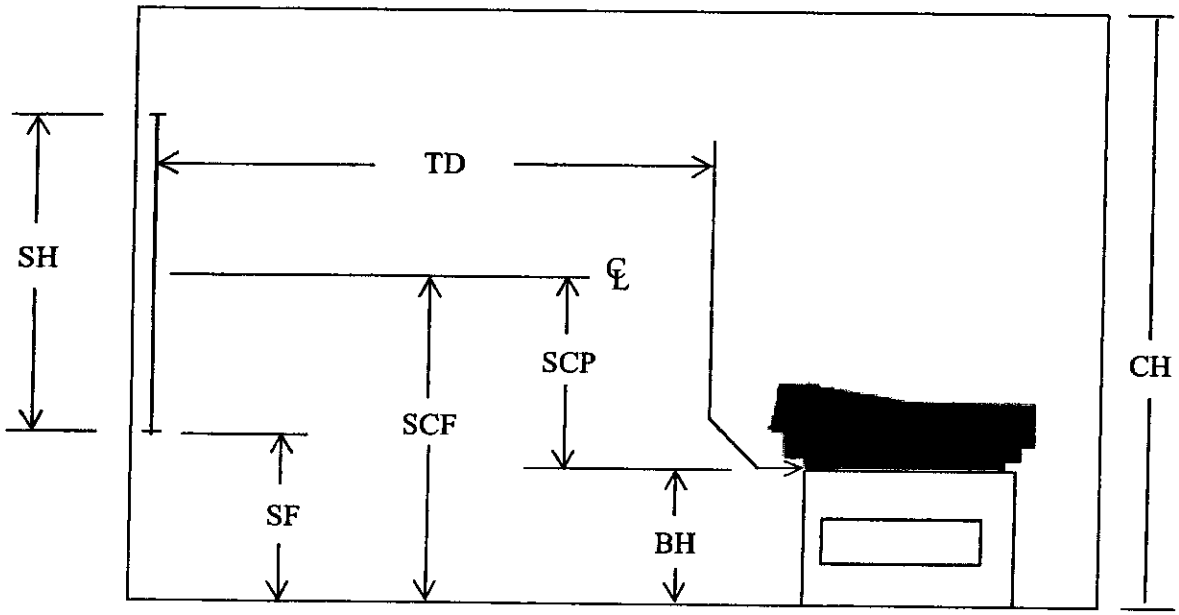
SW = SD(16:9) x 0.87146 = _____ SCP = (SW x 0.233) + 9.94" = _____

Other Calculations

DD = SC + SH/2 - SCP = _____ or DD = CH - SF - SH/2 - SCP = _____

Note: These calculations assume standard installation (i.e., the projector mounted level, with no tilt.).

INSTALLATION GUIDELINES



<< Fig. 5 >>

Pro1200X Installation Worksheet

BH = Base Height _____

SD = Screen Diagonal _____

SCP = Screen Center to Projector Bottom _____

SH = Screen Height _____

TD = Throw Distance _____

SC = Screen Width _____

SF = Screen to Floor Dimension _____

SCF = Screen Center to Floor _____

Note: Throw Distance is from the screen to the front edge of the foot of the projector.

Main Calculations

SW = _____ TD = (SW x 1.1358) + 7.29" = _____

or

SW = SD(4:3) x 0.8 = _____ then

or

SW = SD(16:9) x 0.87146 = _____ SCP = (SW x 0.233) + 9.94" = _____

Other Calculations

BH = SCF – SCP SF = SCF – SH/2

SCF = BH + SCP

Note: These calculations assume standard installation (i.e., the projector mounted level, with no tilt.).

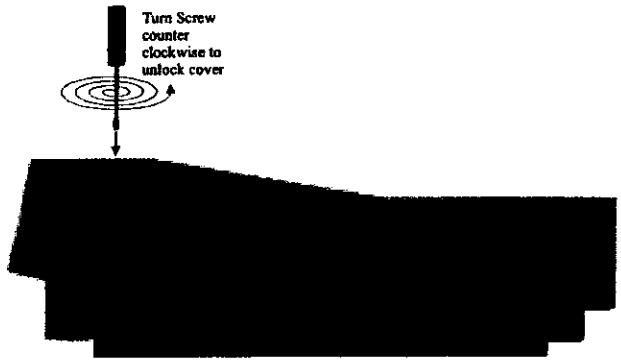
Access to Controls

WARNING : Risk of electric shock ! Installation only by Zenith authorized service personnel !

Opening the top cover

During the projector setup and installation will be necessary to open the top cover. Follow the procedure described below to open the top cover:

- Turn the locking screw with a screwdriver counter clockwise;
- Lift up and pivot the top cover.



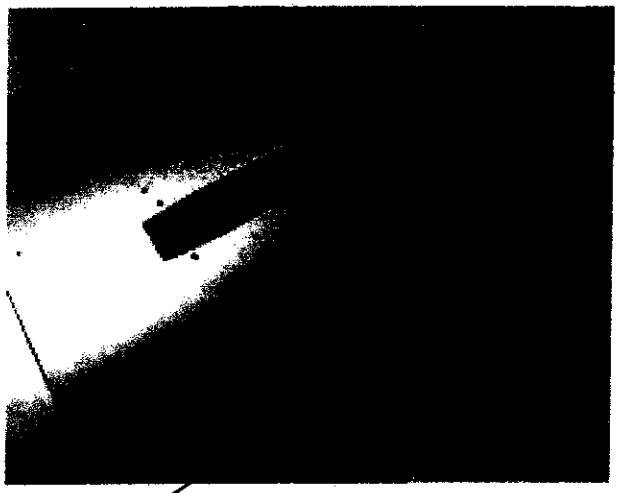
<< *Fig. 7* >>

WARNING : The projector's topcover is not supported with locking hinges. Open with care and support the cover with your hand.

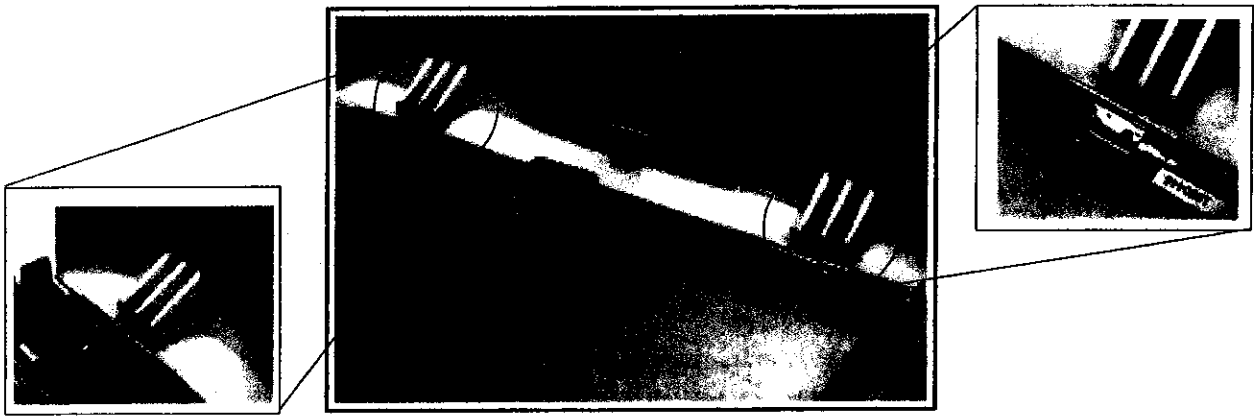
Removing the top cover

During some installations, it will be necessary to remove the top cover from the projector totally. Follow the procedure described below to remove the top cover:

- Pivot the top cover backwards 90° (fully extended);
- Press downwards on the spring tabs next to the hinges. Carefully slide the top cover to the left side (viewing from the rear of the projector) until the hinges are disengaged. Remove the top cover from the projector.



<< *Fig. 8* >>



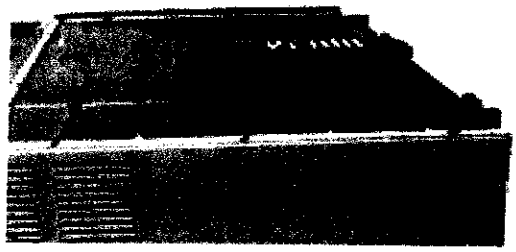
<< *Fig. 9* >>

INSTALLATION SETUP

Reinstalling the top cover

To reinstall the top cover on the projector:

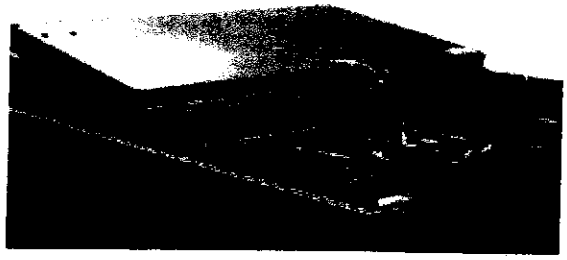
- Place the top cover in front of the hinges and push in the direction of the black arrow until the cover locks into the hinges;
- Pivot the top cover to close;
- Secure the locking screw by turning it clockwise with a screwdriver.



<< Fig. 9 >>

Scan Adaptation

The scan switches must be placed in the correct position which corresponds to the desired scanning configuration. To change the scanning, it is necessary to remove the projector top cover and to open the protection plate. For opening the projector's top cover, see 'Access to controls'.

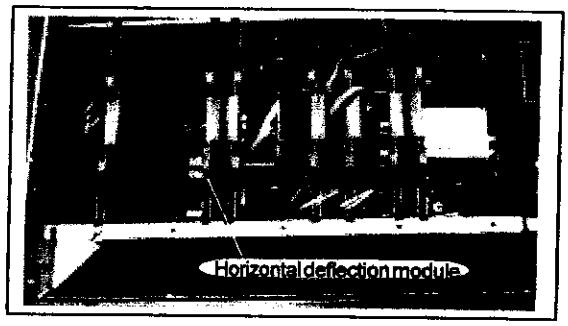


<< Fig. 10 >>

WARNING ! TURN OFF PROJECTOR AND UNPLUG THE POWER CORD BEFORE CHANGING THE SCAN DIRECTION.

Getting access to the scan switches

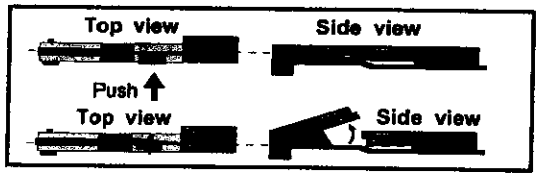
- Open the top cover and remove it from the projector (see p.4-2);
- Loosen the 3 retaining screws on each side of the projector;
- Open the protection plate and pivot it forward (toward lenses).



<< Fig. 11 >>

Horizontal Scan Switches

Three switches are used, one for each CRT. When changing the horizontal scan, insure that all three switches are set in the same position. See positions of the switches (diagram on next page) for the corresponding projector configuration.



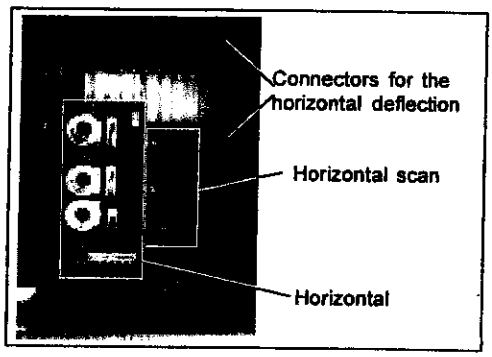
<< Fig. 12 >>

To set the scan switches:

- Remove the horizontal deflection module (the second module viewing from the rear of the projector).

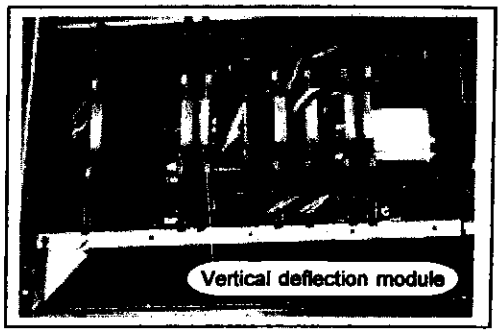
  To remove the horizontal deflection module:

  - Press the module lock and lift up the module handle;
  - Repeat this action on both sides of the module and extract the module out of the main frame.



<< Fig. 13 >>

- Toggle the 3 horizontal scan inversion switches (located just underneath the horizontal amplitude module) to the correct positions (see p.4-4).
- Reinstall the horizontal deflection module.



<< *Fig. 14* >>

Vertical Scan Switch

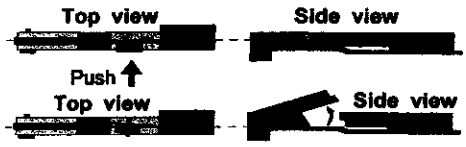
One vertical switch is used for the three CRT's. See position of the switch (diagrams) for the corresponding projector configuration.

To set the vertical scan switch :

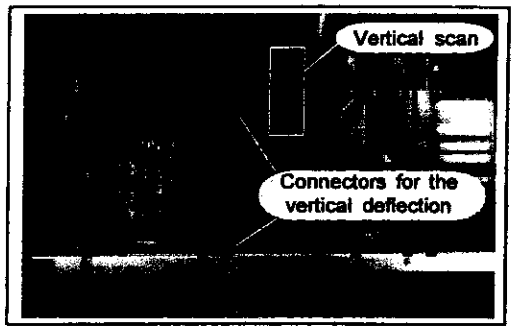
- Remove the vertical deflection module (the third module viewing from the rear of the projector).

  To remove the vertical deflection module : (see fig 14 & 17)

  - Press the module lock and lift up the module handle;
  - Repeat this action on both sides of the module and extract the module out of the main frame.
- Toggle the vertical scan inversion switch to the correct position. (see fig. 16)
- Reinstall the vertical deflection module.



<< *Fig. 15* >>



<< *Fig. 16* >>

Positions of the scan switches for the different mounting configurations are illustrated in fig. 17.
After setting the scan switches, close the metal protection plate and secure it with the retaining screws.

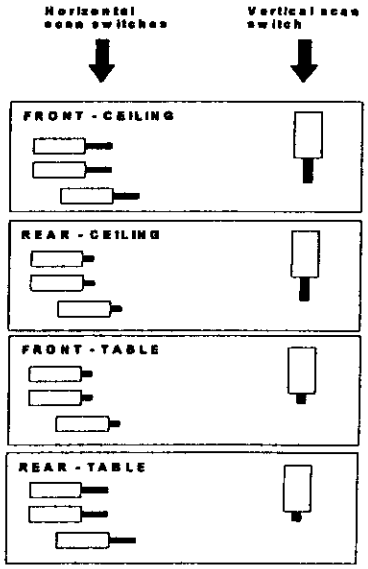
Close the top cover and reconnect the power cord to the wall outlet.

Note : Switching over from Floor to Ceiling or vice versa requires a complete readjustment of picture geometry and convergence.

To check the current positions of the scan switches, proceed as follows:

Attention: This procedure can only be done after power (mains) connection. So, first continue with the projector setup and the connections and then return to this procedure.

- Switch on the projector. The projector starts up on the last selected source.
- Press the <*ADJUST*> key.



<< *Fig. 17* >>

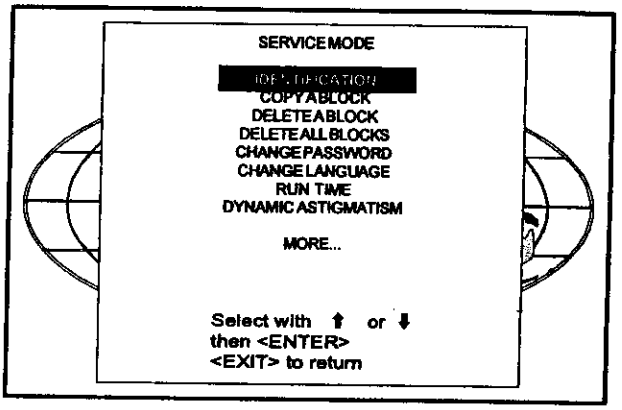
INSTALLATION SETUP

- Highlight *'SERVICE'* by pushing the control disk forward or backward and press the *<ENTER> key*: the *'SERVICE MODE MENU'* will be displayed.
- Highlight *'IDENTIFICATION'* by pushing the control disk forward or backward and press the *<ENTER> key.*

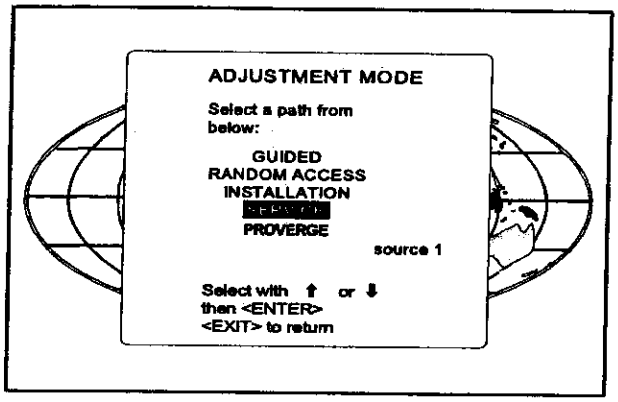
The projector will display the *'IDENTIFICATION SCREEN'.*

This screen gives the current information about the projector configuration in the line entitled *'Config'.*

All projectors leave the factory set for a ceiling/front configuration.

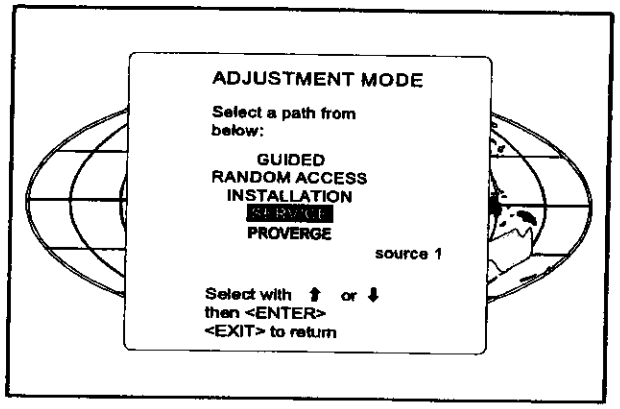


<< Fig. 18 >>



<< Fig. 19 >>

Configuration Display



<< Fig. 20 >>

Projector Setup

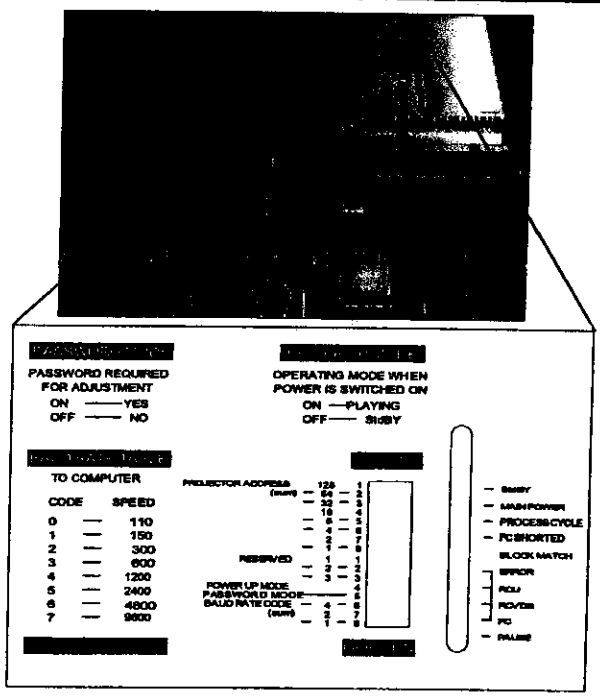
The DIP switches on the controller board allow the *SETUP* of the projector :

- 8 DIP switches for setting the projector address.
- 1 DIP switch for setting the powerup mode.
- 3 DIP switches for setting the baud rate for communication.
- 1 DIP switch for setting the password mode.

Accessing the DIP Switches

- Open the top cover.
- Loosen the retaining screws of the metal protection plate and pivot this plate to the lens side (Please refer to Chapter 4 'Installation setup').

The DIP switches are located on the back side of this metal protection plate.

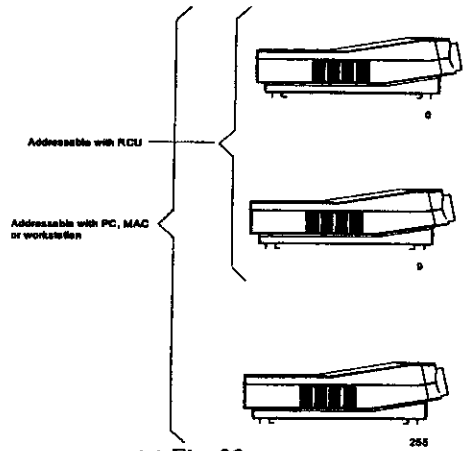


<< Fig. 21 >>

Setting the Projector Address

The projector's address may be set to any value between 0 and 255. When the address is set, the projector can be controlled now by :

- RCU for addresses between 0 and 9.
- IBM PC (or compatible) or Apple MAC for addresses between 0 and 255.



<< Fig. 22 >>

Setting the address is a hardware SETUP of your projector which must be done during installation. Use the 8 DIP switches provided on the controller board labelled 'Projector Address'.

Each DIP switch has its own decimal value. The sum of the values associated to those DIP switches gives the address. As shown in the table, if Switch No. 1 is set to ON, it represents a decimal value of 128, Switch No.2 for 64, Switch No.3 for 32, and so forth. In the given example, the projector address is set to *202 :*

DIP switch No. : 1 2 3 4 5 6 7 8
Position ON/OFF: 1 1 0 0 1 0 1 0

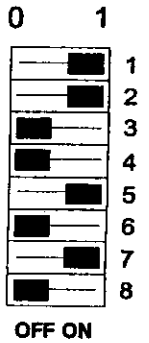
Sum : 1x128 + 1x64 + 0x32 + 0x16 + 1x8 + 0x4 + 1x2 + 0x1 = 202

Factory preset address = 0

Switch No

Value	
1	128
2	64
3	32
4	16
5	8
6	4
7	2
8	1

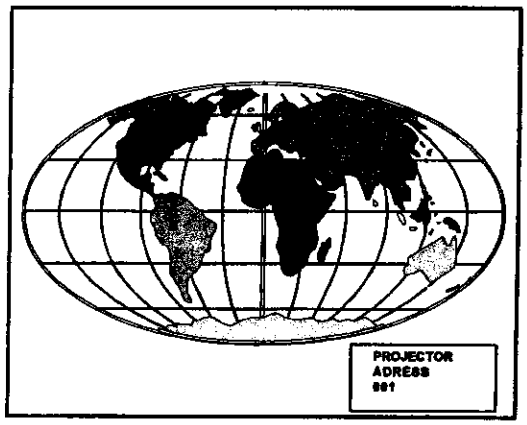
<< Fig. 23 >>



<< Fig. 24 >>

PROJECTOR SETUP

Note : When the address button on the RCU is pressed, the projector will display its own address on the screen. Once the address button is pressed, to continue using your RCU, it is necessary to enter an address, even when the displayed address is correct. Use the numeric keys to enter the address. For more information, please refer to the projector Owner's Manual.



<< *Fig. 25* >>

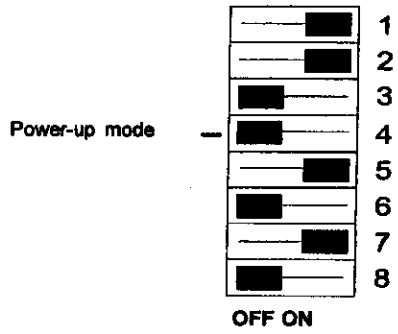
Powerup Mode

The projector can start up in two different modes. The start-up mode is determined by the position of DIP Switch No. 4 of another set of 8 DIP switches on the controller board (one set of 8 switches are used for projector address setting).

Position of the DIP Switch No. 4 (powerup mode) :

ON : operational mode.

OFF: standby mode (Factory preset).



<< *Fig. 26* >>

Operational Mode

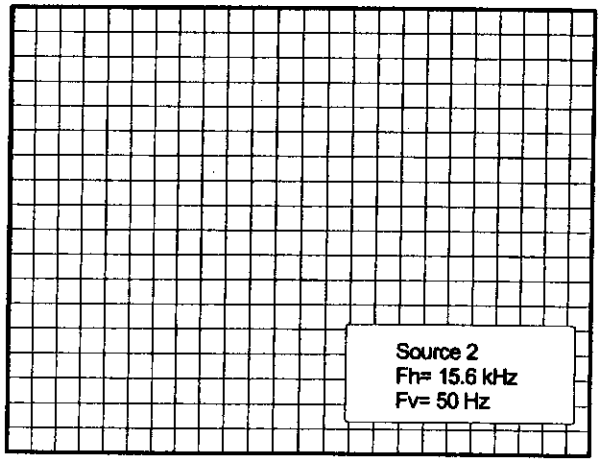
When the power switch on the rear of the projector is pressed, the projector displays the last selected source if available, otherwise it remains on that source number until the source becomes available. The on screen indication is only available when the "Text" function is set to "ON".

Standby Mode

When the power switch on the rear of the projector is pressed, the projector starts up in the standby mode. The standby key on the RCU is used to turn the projector ON and OFF.

Baud Rate for Communication with a Computer

The communication speed between the projector and the computer has 8 possible settings. With DIP Switch No. 6, No. 7 and No. 8 of the 8 DIP switches on the controller board, labelled as 'Baud rate code (sum)', it is possible to select the baud rate (communication speed). Each DIP switch has its own decimal value. The sum of the values associated to those DIP switches gives the baud rate code. Each baud rate code corresponds an communication speed.



<< *Fig. 27* >>

Position of DIP switches and baud rate codes :

Factory preset baud rate = 9600

More information about computer communication with the ZENITH Pro 1200 is available in the Projector Control Software manual.

Binary	Baud rate code	Speed
000	0	110
001	1	150
010	2	300
011	3	600
100	4	1200
101	5	2400
110	6	4800
111	7	9600

<< Fig. 28 >>

Password Mode

With DIP Switch No.5 of the second set of 8 DIP switches on the controller board, the projector adjustments can be protected with a password. When the password feature is enabled, the user has to enter a password before he can enter the adjustment mode (For more information about password setting and reprogramming the password, see Installation Adjustment).

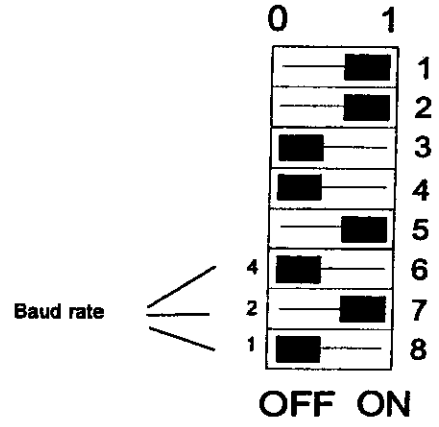
When the password menus are disabled (adjust mode is unprotected), the adjust mode can be selected by pressing the <*ADJUST*> key. This position of the DIP switch is useful for qualified service technicians because they do not need a password to enter the adjust mode.

Position of DIP Switch No.5 :

ON : password mode enabled.

OFF : password mode disabled.

Factory preset password mode : OFF.



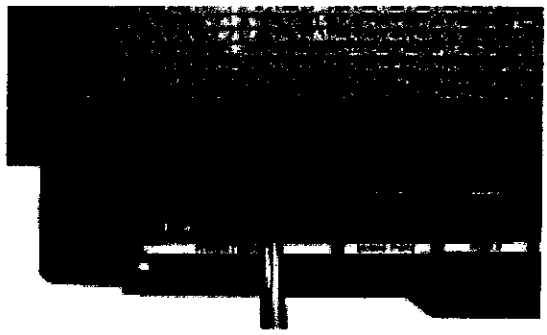
<< Fig. 29 >>

<< Fig. 30 >>

AC POWER CONNECTION

AC Power Cord Connection

Use the supplied cord to connect your projector to the wall outlet. Plug the female power connector into the male connector at the back of the projector.
This projector may also be connected to an IT-power system. The IT-power system is a power distribution system having no direct connection to earth. Instead, the exposed conductive parts of the electrical installation are earthed.



<< *Fig. 31* >>

Preparing your Power Cord

As the colors of the wires in the mains lead of this apparatus may not correspond with the colored markings identifying the terminals in your plug, proceed as follows:

- The yellow/green wire is ground and must be connected to the terminal in the plug which is marked by the letter E or by the safety earth symbol " ⏚ "or colored yellow and green.
- The White wire is neutral and must be connected to the terminal marked with the letter N or colored black.
- The Black wire is the line and must be connected to the terminal marked with the letter L or colored red.

The wires of the delivered mains lead (power cord) are colored in accordance with the following code:

Yellow and Green	: Ground (Earth).
White	: Neutral.
Black	: Hot.

AC Input Power Voltage Adaptation

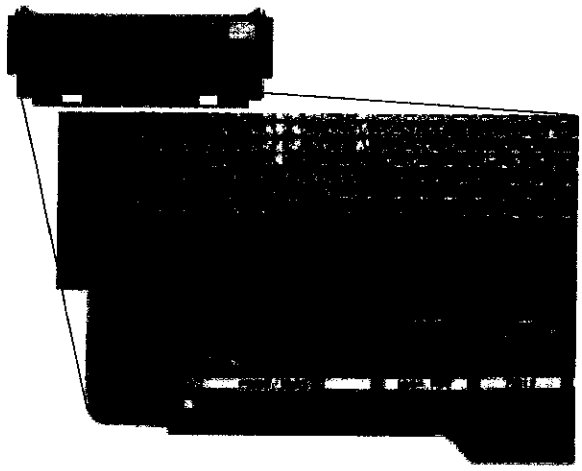
Attention: The Zenith Pro1200 leaves the factory to operate on a main (power) input of 120 VAC.

Switching on the Projector

Push the power switch located on the rear panel of the projector to switch the projector ON and OFF :

- If the switch is pressed in: ON
- If the switch is Not pressed in : OFF

The projector can be started up in the 'Operational mode' (image displayed) or in the 'Standby mode', depending on the position of the 'Powerup' DIP switch on the controller board (see p.5-2). This DIP switch is set during installation by a qualified technician. If you want to change this start-up mode, call a qualified technician.



<< *Fig. 32* >>

Power indication lamp:

- OFF : no power.
- Green : projector in operational mode.
- Red : projector in standby mode.

AC POWER CONNECTION

When switching on the projector, with the power switch or via the standby key on the RCU, the projector can start up in two ways if the "CRT run in cycle" option is switched OFF:

- A full white image (projector warm up) or
- Immediately image display.

The way of starting up can be set in the service mode.

Starting Up with a Full White Image

When the projector is set to start up with a full white image, the "Projector warm up" menu will be displayed for 30 seconds.

Start Up with "Warm Up Period"

If no action is taken, a white image will be displayed for 20 minutes. This white image will be shifted on the faceplate of the CRT to avoid CRT burn-in.

During this warm up period, it is possible to interrupt this white image projection by pressing the <*EXIT*> key. The "Projector warm up" menu will be redisplayed for another 30 seconds but with the remaining time indicated.
If the <*EXIT*> key is pressed again, the remaining warm up period will be skipped.

During the warm up period, every 30 seconds a text box with the remaining time will be displayed on the screen for 2 seconds. This text box will be displayed every time on another place to avoid CRT burn-in.
If a key, other than the <*EXIT*> key, is pressed, a text box with the following text will be displayed:
"Please use <EXIT> to leave this procedure."

Start Up Without "Warm Up Period"

If the <*EXIT*> key is pressed, the warm up period will be skipped and the projector is immediately ready for use.

PROJECTOR WARM UP

A FULL WHITE PATTERN WILL BE GENERATED FOR 20 MINUTES.
FOR IMMEDIATE USE OF THE PROJECTOR, PRESS <EXIT>.

WARNING: SKIPPING THIS PROCEDURE CAN REDUCE THE INITIAL PICTURE QUALITY OF THE PROJECTED IMAGE.

THIS OPTION CAN BE DISABLED IN THE SERVICE MENU.

<< Fig. 33 >>

REMAINING
PROJECTOR
WARM UP
TIME
18.5 MIN

<< Fig. 34 >>

PLEASE USE
<EXIT> TO
LEAVE THIS
PROCEDURE

<< Fig. 35 >>

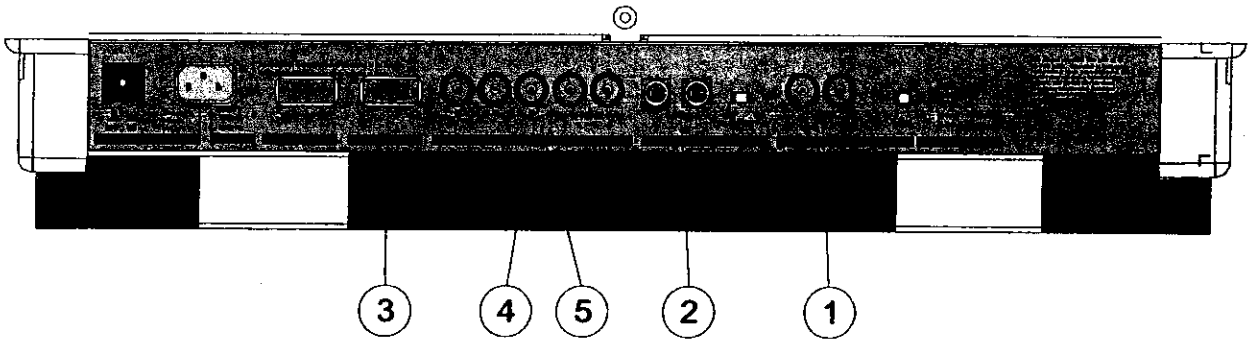
Warning : Skipping this warm up procedure can reduce the initial picture quality of the projected image.

SOURCE CONNECTIONS

Signal Input Connection

The following signals can be connected to the projector through the inputs on the back panel of the projector:

- Composite Video
- S-Video
- RGB
- Component Video
- RGB with Tri-level sync
- Component video with Tri-level sync



<< *Fig. 36* >>

Port No	Projector input	Numeric button	Description of input signal
1	Composite Video	1	
2	S-Video/Composite Video	2	S-video : Y/C (luma/chroma). The Composite video can also be connected to Port 2. It can be selected inside the "Picture Tuning" menu. Please refer to the Owner's Manual of this projector.
3	RGB	3	R, G and B with composite sync on Green; R, G and B with separate composite or with separate Horizontal and Vertical sync.
4/5	RGB	4 or 5	R, G and B with composite sync on Green; R, G and B with separate composite or with separate Horizontal and Vertical sync.
4/5	Component video	6	R-Y, Y, B-Y with composite sync on Y; or with separate composite or with separate Horizontal and Vertical sync.
4/5	RGB with Tri-level sync	7	R, G and B with Tri-level sync on Green; R, G and B with separate Tri-level sync or with separate Horizontal and Vertical Tri-level sync.
4/5	Component video with Tri-level sync	8	R-Y, Y, B-Y with Tri-level sync on Y; or with separate Tri-level sync or with separate Horizontal and Vertical Tri-level sync.

<< *Fig. 37* >>

Connecting a Composite Video Source to Port 1

Composite video signals coming from a VCR, OFF air signal decoder and so on can be connected to Port 1.

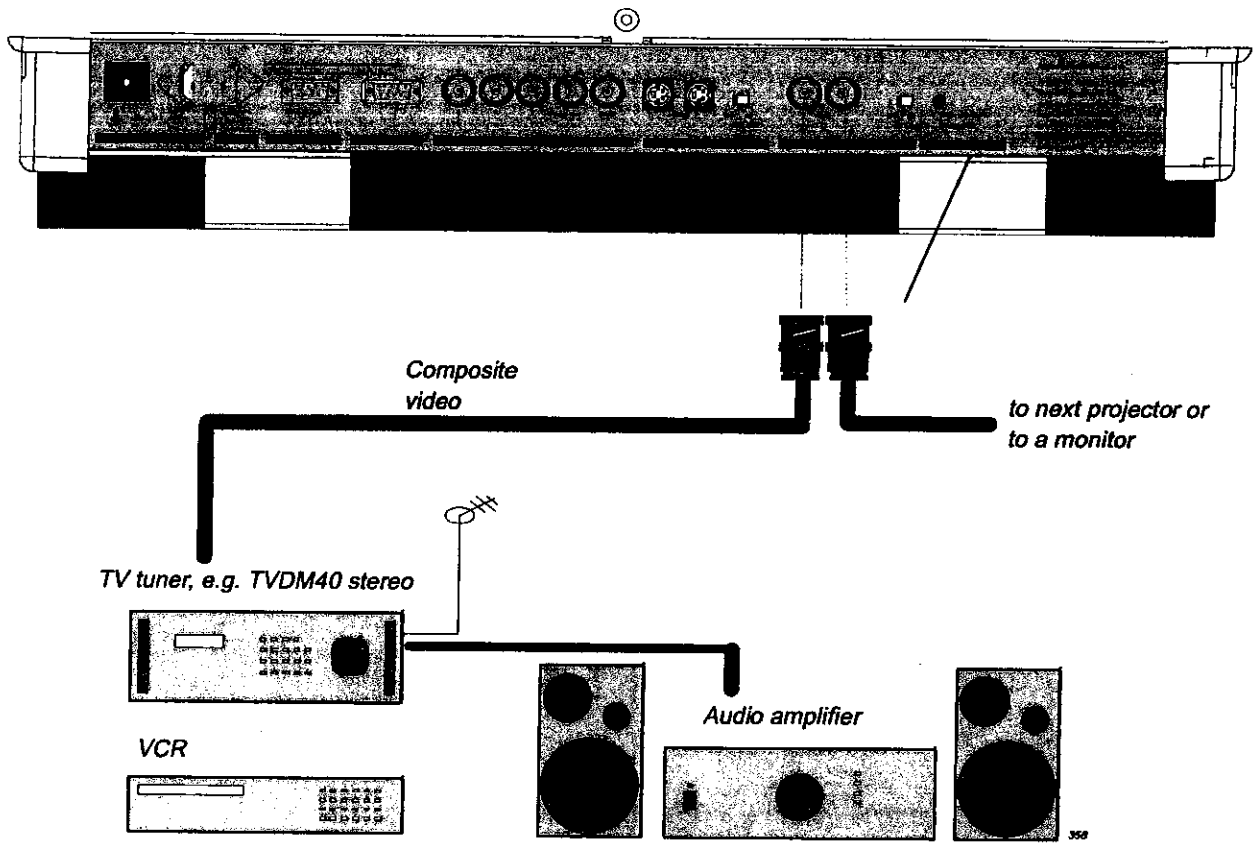
To Select the Video Input

Press the *numeric button 1* on the RCU or the local keypad.

75 W Termination Switch for Video

Terminate the video input of the projector using the 75 W switch next to the video input, when the projector operates alone or when the projector is the last unit in a loop-through configuration.

The switch is set to "ON" : signal terminated.
The switch is set to "OFF": signal not terminated.



<< Fig. 38 >>

SOURCE CONNECTIONS

Connecting a S-Video (or Composite Video) Source to Port 2

Separate Y-luma/C-chroma signals for higher quality playback of Super VHS signals can be connected to Port 2 . The composite video can also be connected to this port.

To Select the S-video Input

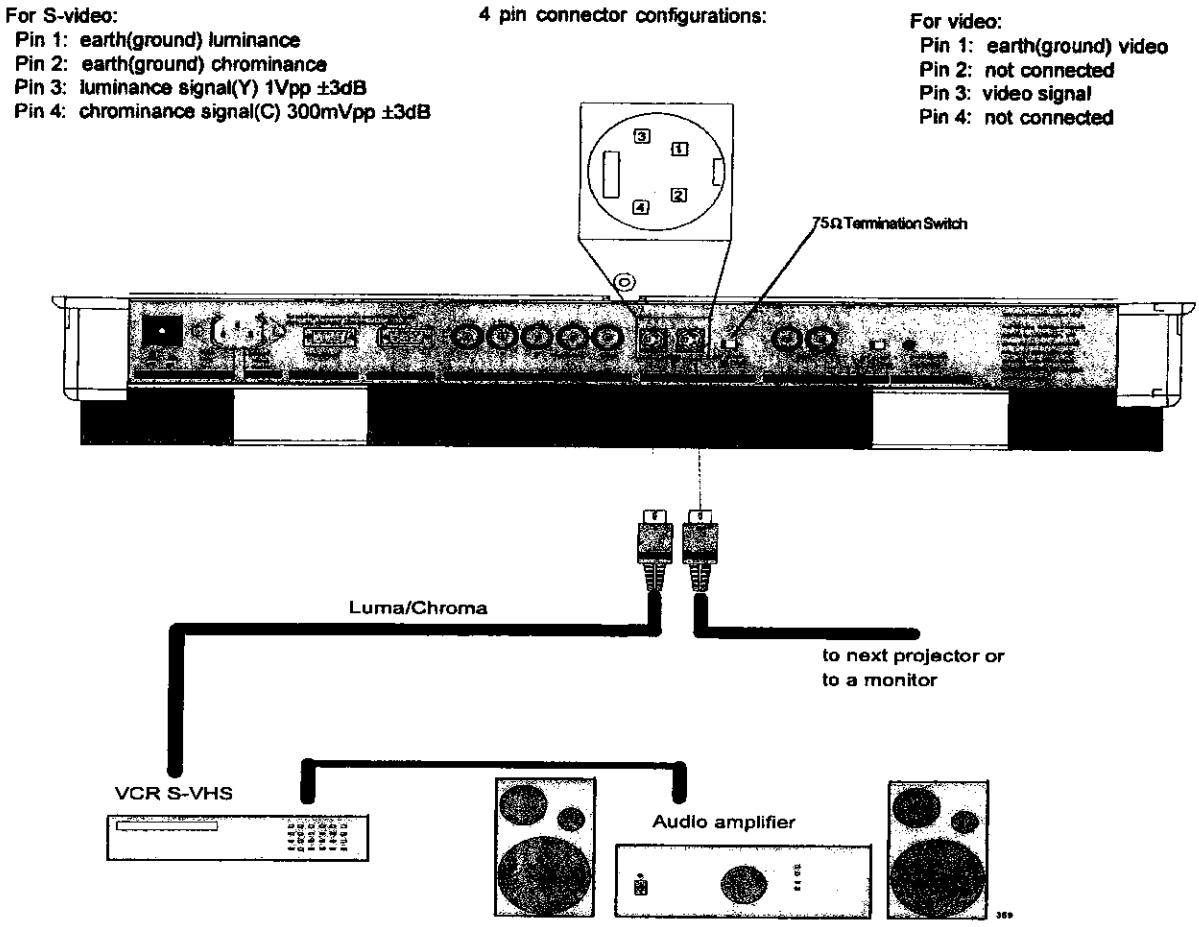
Press the *numeric button 2* on the RCU or the local keypad.

If your are using Port 2 for connecting the Composite Video, the selection of this source must be done inside the "Picture Tuning" menu. Please refer to the Owner's Manual of this projector.

75 W Termination Switch for S-video

Terminate the S-video input of the projector using the 75 W switch next to the S-video input when the projector operates alone or when the projector is the last unit in a loop-through configuration.

The switch is set to "ON": signal terminated.
The switch is set to "OFF": signal not terminated.



<< Fig. 39 >>

Connecting a RGB Analog Source to Port 3

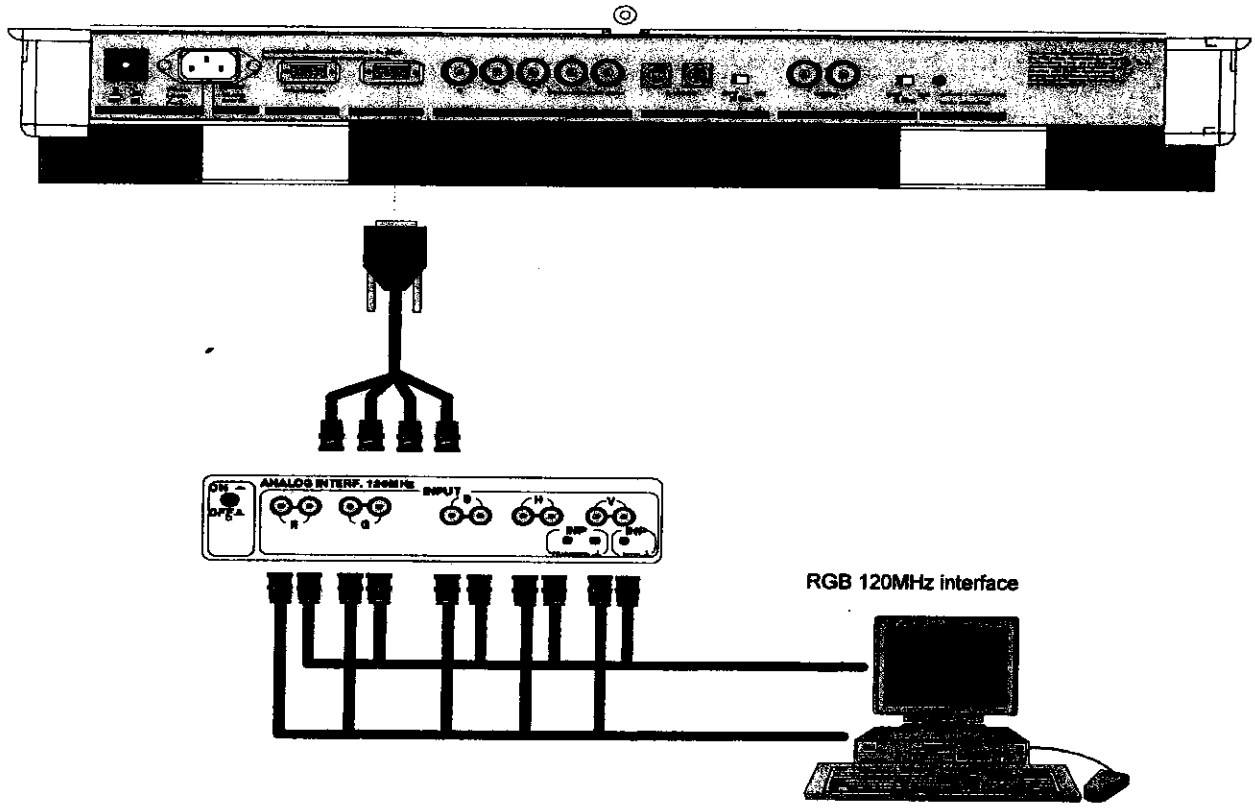
Connect a RGB Analog signal via an interface (e.g. RGB 120MHz interface, part number 98 26570) to Port 3: RGB analog input with automatic sync detection (Separate H and V sync inputs, with composite sync input or with sync signals on green).

Pin configuration of the D9 (male) connector of the Analog input:

1 Not connected
2 Ground RGBS
3 RED
4 GREEN
5 BLUE
6 Ground RGBS
7 Ground RGBS
8 Horizontal/composite sync
9 Vertical sync

To Select the RGB Analog Input :

Press the *numeric button 3* on the RCU or the local keypad.



<< Fig. 40 >>

SOURCE CONNECTIONS

Termination Resistors and Switches on the RGB Input Auto Sync Tracking Module

When changing a switch position or removing a resistor, turn off the projector and unplug the power cord from the wall outlet.

75 W Termination Resistors

In case of chaining (loop-through) the projectors, the 75 W line termination resistors must be removed from the RGB Input Auto Sync Tracking Module when the projector is NOT the last unit in the chain.
In case of a stand-alone projector, do not remove the resistors.

75 W resistors on the module: line terminated.

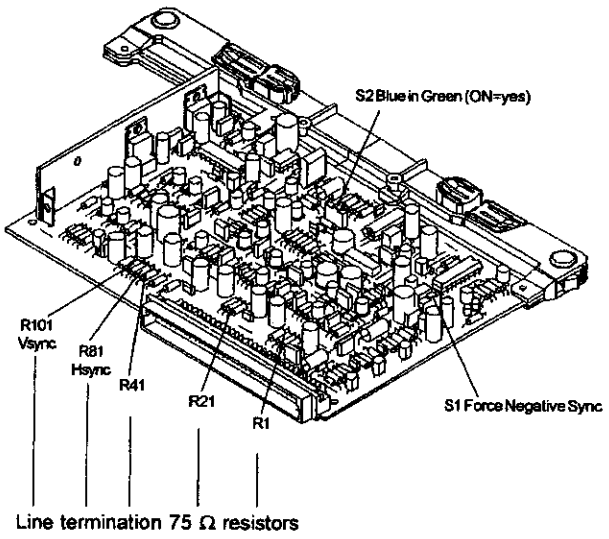
75 W resistors removed: line not terminated.

Procedure to Remove the Line Termination Resistors

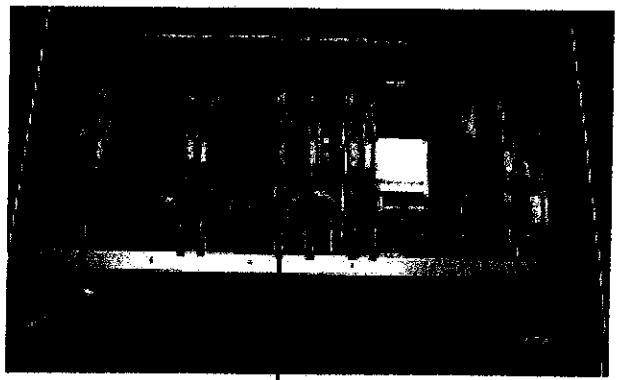
- Turn off the projector and unplug the projector power cord.
- Remove the top cover from the projector (see p.4-1).
- Remove the RGB Input Auto Sync Tracking Module from the main frame.
- Unsolder and remove the resistors.

To remove the RGB Input Auto Sync Tracking Module, follow the same procedure as described in p.4-2 for removing the Horizontal Deflection module:

- Press the module lock and lift up the module handle;
- Repeat this action on both sides of the module and extract the module out of the main frame.



<< *Fig. 41* >>



RGB Input Auto Sync Tracking Module

<< *Fig. 42* >>

Blue in Green Switch on the RGB Input Auto Sync Tracking Module

Blue characters are difficult to read, therefore the blue text will be displayed as cyan so that the readability becomes better.

Switch in the ON position: Blue in Green active.
Switch in the OFF position: Blue in Green disabled.

WARNING : Leaving the switch in the ON position will result in abnormal color balance of the projected image.

Force Negative Sync on the RGB Input Auto Sync Tracking Module

Switch in the ON position: the sync pulses must be negative.
Switch in the OFF position: the sync polarity will be automatically detected.

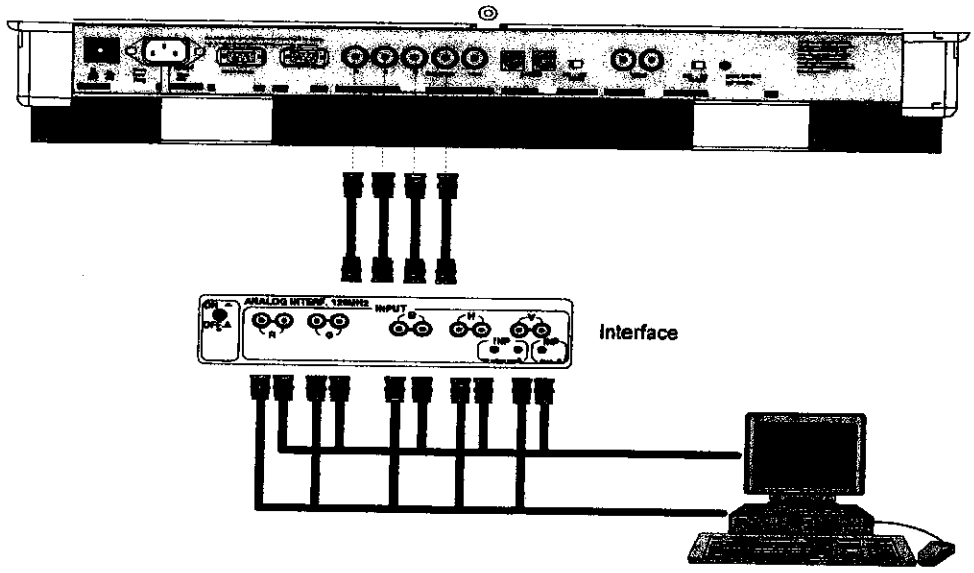
Connecting a RGB Analog source to Port 4/5

RGB analog input terminals with separate H and V sync inputs, composite sync input or sync signals on green can be connected to the projector via Port 4/5. The projector automatically detects where the sync signal is located.

An interface is recommended when connecting a computer and local monitor to the projector.

To Select the RGB input

Press the *numeric button 4 or 5* on the RCU or the local keypad.



<< Fig. 43 >>

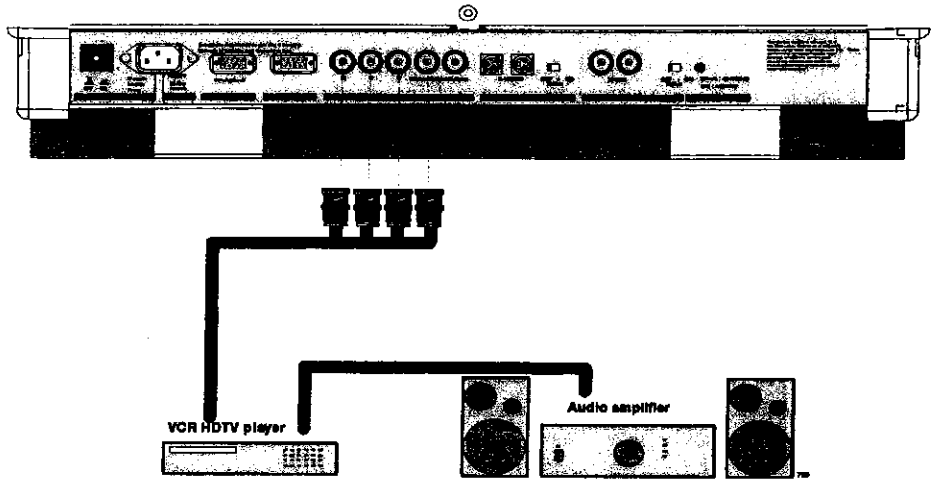
SOURCE CONNECTIONS

Connecting a Component Video source to Port 4/5

A component video (R-Y, Y, B-Y) with sync signals can be connected to the projector via Port 4/5. The projector automatically detects where the sync signal is located. An HDTV interface is recommended when connecting a computer and local monitor to the projector.

To select the component video input :

Press the *numeric button 6* on the RCU or the local keypad.



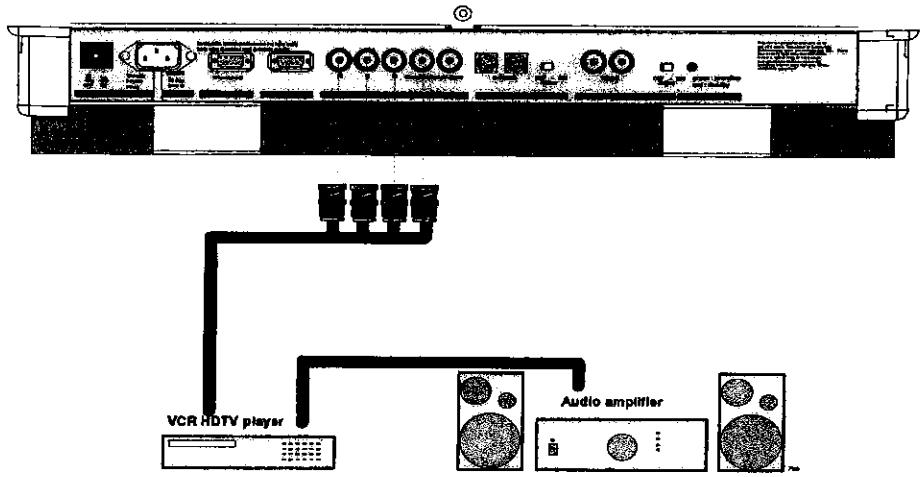
<< Fig. 45 >>

Connecting a RGB Analog Source with Tri-level Sync to Port 4/5

RGB analog input terminals with Tri-level sync input or with Tri-level sync on green can be connected to the projector via Port 4/5. The projector detects automatically where the sync signal is located. This feature requires an optional Tri-Level Sync Module.

To Select the Input :

Press the *numeric button 7* on the RCU or the local keypad.



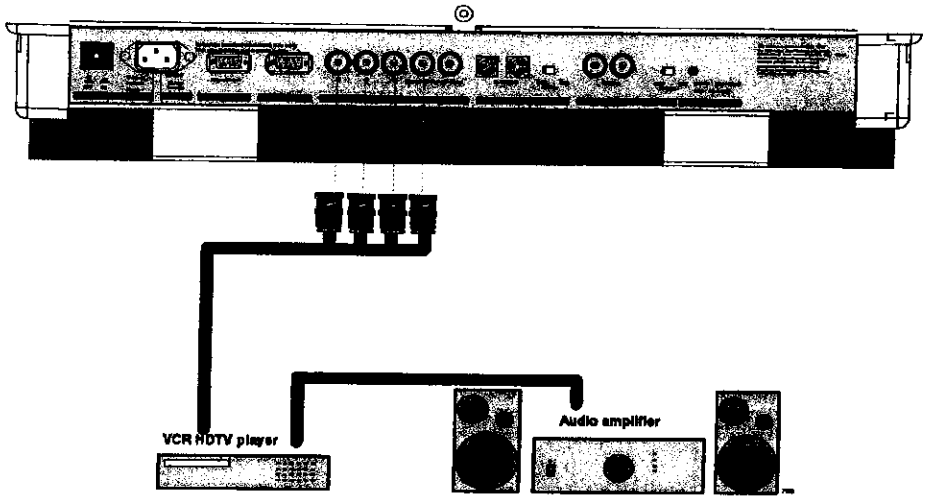
<< Fig. 46 >>

Connecting a Component Video Source with Tri-level Sync to Port 4/5

Component video inputs with Tri-level sync signal can be connected to the projector via Port 4/5. The projector detects automatically where the sync signal is located. This feature requires an optional Tri-Level Sync Module.

To Select the Input

Press the *numeric button 8* on the RCU or the local keypad.

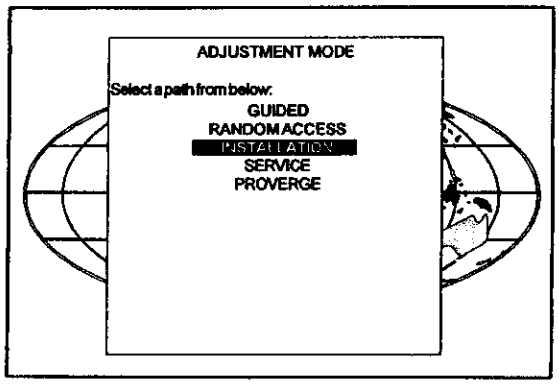


<< Fig. 47 >>

INSTALLATION ADJUSTMENT MODE

Access to Installation Adjustment Mode

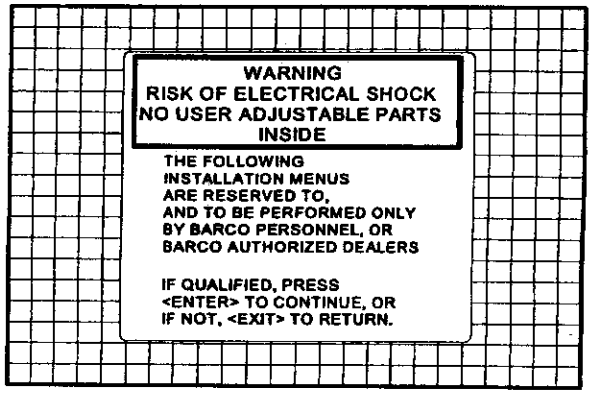
It will be necessary to perform several mechanical adjustments while in the Installation Adjustment Mode. It will be nessasary to open and remove the projector's top cover in order to gain access to the adjustment points.



<< Fig. 48 >>

To Enter into the Installation Adjustment Mode

- Press the <*ADJUST*> key to start up the adjustment mode.
- Push the control stick forward or backward to highlight the path *INSTALLATION* in the "Adjustment mode" menu and then press the <*ENTER*> key.
- A warning will be displayed on the screen. If you are a qualified and authorized service person, press the <*ENTER*> key to start up the installation mode. Otherwise, press the <*EXIT*> key to return.
- When entering the installation mode, the projector will automatically switch to the internal pattern on 15 kHz/50 Hz.
- When the password mode is active (see p.8-2), you will be requested to enter the 4 digit password.

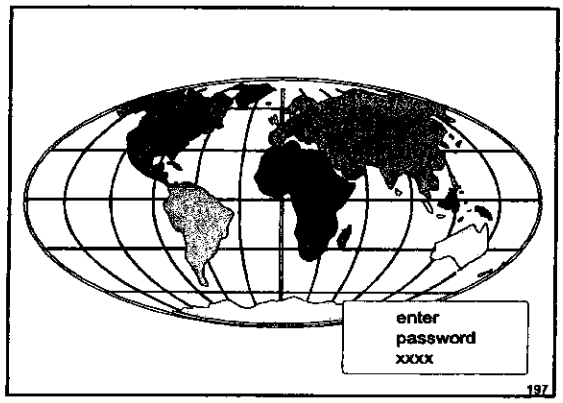


<< Fig. 49 >>

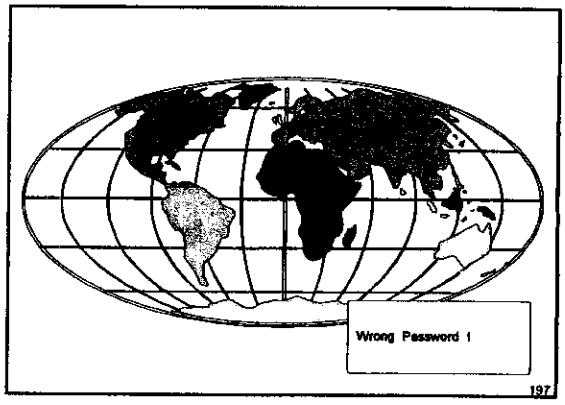
- Enter the four digit password with the numeric keys on the RCU or the local keypad.

Example : Password as 2 3 1 9

For each digit entered, a 'X' appears on the screen under the displayed text 'enter password'. If the entered password is correct, you be allowed access to the 'Installation Adjustment Mode'. If the entered password is wrong, The message *"Wrong password!!!"* will be displayed. The projector stays on the previous selected item. Factory programmed password : **0 0 0 0**



<< Fig. 50 >>



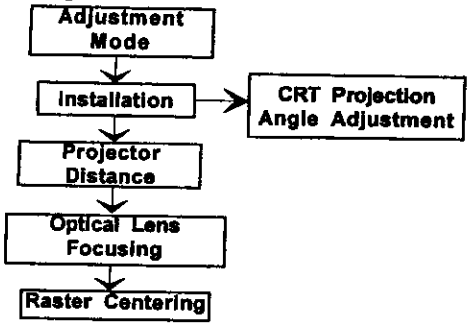
<< Fig. 51 >>

INSTALLATION ADJUSTMENT MODE

Access to Adjustments

The top cover of the projector should be removed in order to gain access to the adjustments.
Please refer to p.4-1 for how to remove the top cover.

Overview flowchart of the Installation Adjustment



<< *Fig. 52* >>

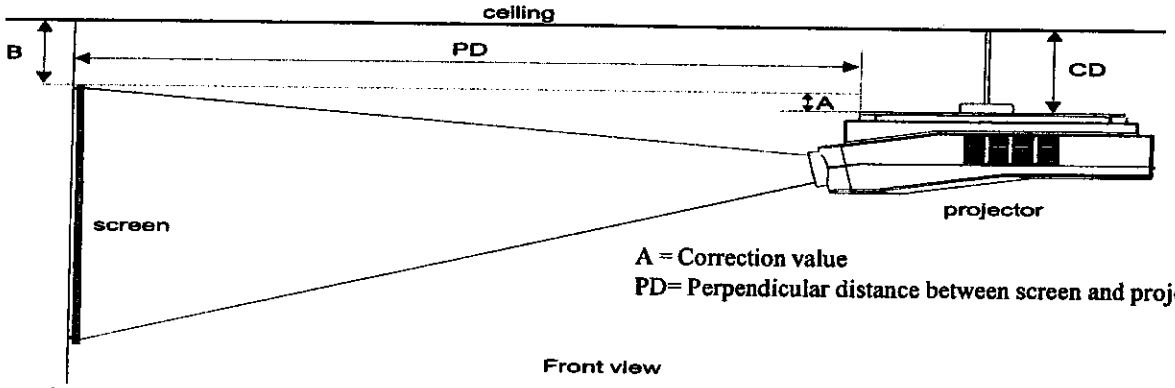
Projector Distance

On the screen, a drawing will be displayed together with parameters indicating a correct installation position.

To Change the Screen Width

- Push the control stick to the left or to the right to highlight the item *SW* in the "Projector Distance 1" menu and then press the <*TEXT*> key.
- If the <*ENTER*> key is pressed, the "Optical Lens Focusing" will be displayed.
- If the <*EXIT*> key is pressed, the projector will return to the previous menu.
- After the <*TEXT*> key is pressed, the next menu "Projector Distance 2" will be displayed on the screen. It allows the user to change the Screen width.
- Push the control stick to the left or to the right to highlight the digit needed to be changed, and enter the desired digit with the numeric keys on the RCU or the local keypad.
- Press the <*ENTER*> key to confirm the changes. The projector will redisplay the "Projector Distance 1" menu with updated values for the three parameters.
- Press the <*ENTER*> key to continue with the "Optical Lens Focusing".
  If the <*EXIT*> key is pressed, the projector will return to the previous menu.

The same applies to the PD (projector distance). You can use the above-mentioned procedure to obtain a correct updated value of SW (screenwidth) after entering a new value of PD (projector distance).



A = Correction value
PD= Perpendicular distance between screen and projector

SW = **2.6 m** PD=3.64m A=12 cm
Select with arrow keys; <TEXT> to reprogram; <ENTER> to continue; <EXIT> to return.

WARNING: ONLY FOR STANDARD PROJECTORS!!

SCREENWIDTH = 2.60 m

Select with arrow keys; reprogram with numeric keys and then <ENTER> to confirm.
Maximum screenwidth = 6 m

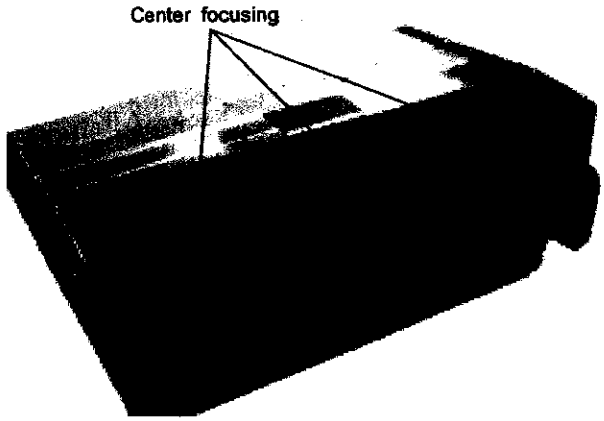
<< *Fig. 53* >>

INSTALLATION ADJUSTMENT MODE

Optical Lens Focusing

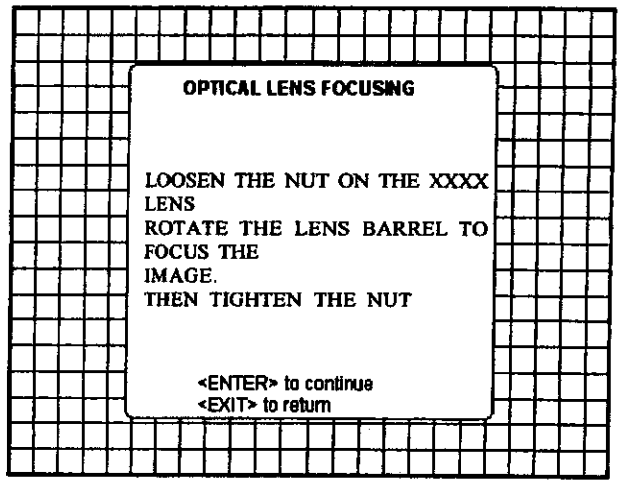
The optical focusing procedure is performed separately for each lens. The appropriate CRT will be switched on as the user proceeds through the optical focusing adjustment sequence.

Each lens has one focus adjustment point. The projected image is focused by loosening the wing nut and rotating the lens barrel until the image is clearly focused. The corners of the projected image are focused by loosening the wing nut at the front end of the lens and rotating the lens barrel until the corners of the image are clearly focused. Repetition of these adjustments may be necessary to optimize optical focusing.



<< *Fig. 54* >>

Press the <*ENTER*> key to continue. After finishing focusing of the three lenses, press the <*ENTER*> key to enter the Raster centering.
Press the <*EXIT*> key to return to operational mode.
Press the <*ADJUST*> key to return to operational mode.



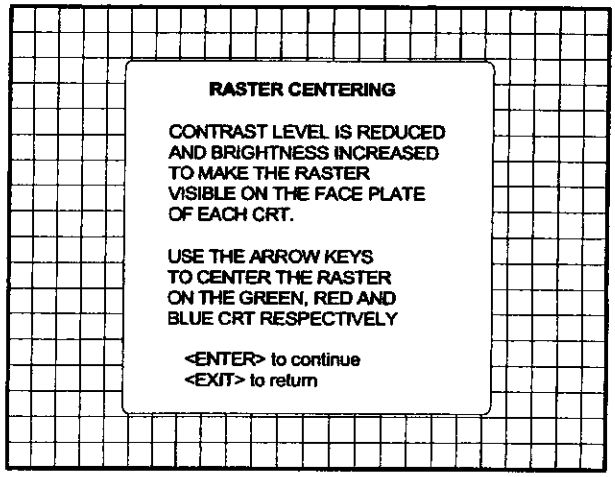
<< *Fig. 55* >>

Raster Centering

The raster must be centered on the CRT faceplate of each tube, therefore, it is necessary to look into the lenses.

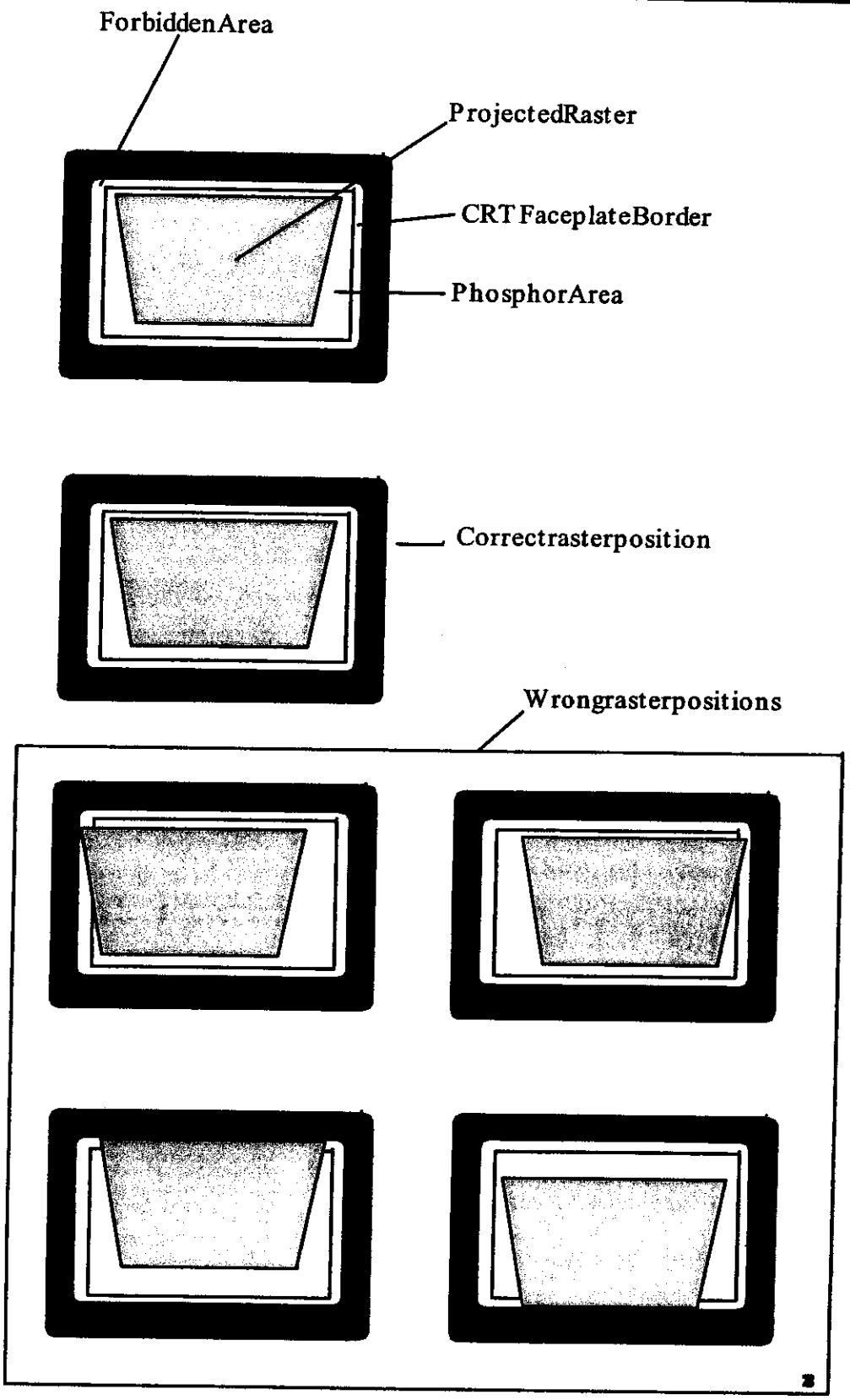
Caution : To avoid eye discomfort while performing these adjustments, reduce the contrast and gradually increase the brightness level until the raster becomes visible behind the image. ***Warning : In order to ensure maximum CRT longevity and to avoid CRT damage, do not shift the raster outside the phosphor area of the CRT.***

- Press the <*ENTER*> key to display the raster on the green CRT.
- Look into the green lens and shift the raster with the control stick until it is centered in the middle of the CRT faceplate.
- Press the <*ENTER*> key to activate the raster on the Red CRT faceplate.
- Shift the Red raster with the control stick until the raster is centered on the CRT faceplate.



<< *Fig. 8* >>

INSTALLATION ADJUSTMENT MODE



<< Fig. 57 >>

INSTALLATION ADJUSTMENT MODE

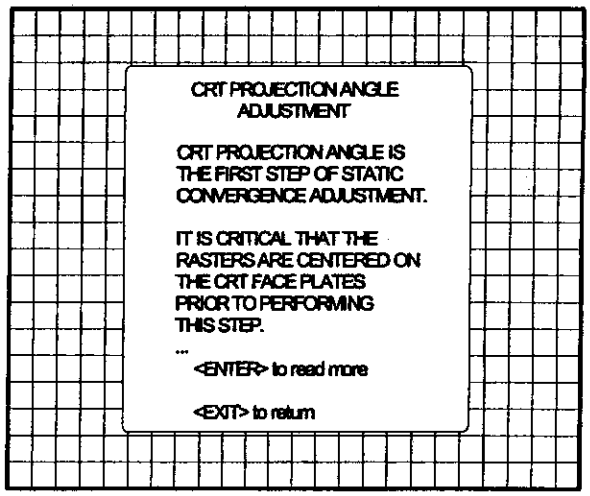
- Press the <*ENTER*> key to activate the raster on the Blue CRT faceplate.
- Shift the Blue raster with the joy stick until the raster is centered on the CRT faceplate.
- Press the <*ENTER*> key to continue with the CRT projection angle adjustment.
- Press the <*EXIT*> key to return to Optical focusing.
- Press the <*ADJUST*> key to return to Operational mode.

CRT Projection Angle Adjustment

The projection angle of the red and blue CRT's is dependent on the desired size of the projected image. If the centers of green, blue and red do not coincide, the CRT projection angle must be adjusted.

NOTES : Never try to correct this misalignment with the shift correction or the static convergence controls. These controls may only be applied to correct small errors which cannot be corrected by the CRT angle adjustment.
The Horizontal Shift and Vertical Shift for Red and Blue should be set near 50%.
Be sure that the rasters are centered on the CRT faceplate.

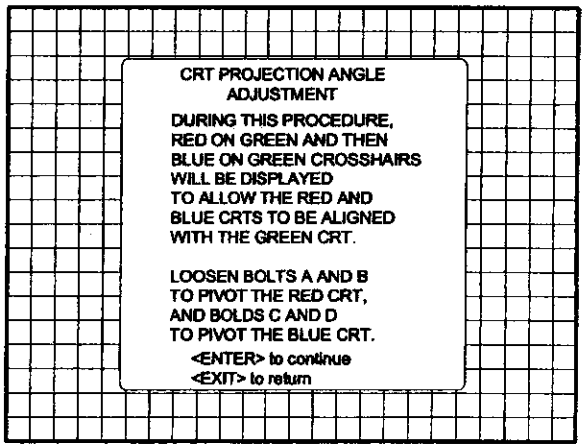
- Press the <*ENTER*> key to start the CRT angle adjustment procedure.
- Press the <*ENTER*> key to continue with the second part of the CRT projection angle adjustment.
- Press the <*ENTER*> key to continue with the crosshairs alignment.
- Press the <*EXIT*> key to return to the previous menu.
- Press the <*ADJUST*> key to return to Operational mode.



<< Fig. 59 >>

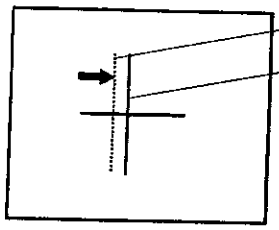
Loosen bolts A, B, C and D to pivot the red CRT until the center of the Red image and the center of the Green image coincide. When the angle of the red CRT is corrected, tighten the four bolts.
Press the <*ENTER*> key to continue with blue and green crosshairs.
Press the <*EXIT*> key to return to the CRT projection angle adjustment menu.

Loosen bolts E, F, G and H to pivot the blue CRT until the center of the Blue image and the center of the Green image coincide. When the angle of the blue CRT is corrected, tighten the four bolts.
Press the <*ENTER*> key to continue with the diagonal focusing menu.
Press the <*EXIT*> key to return to the CRT projection angle adjustment.



<< Fig. 60 >>

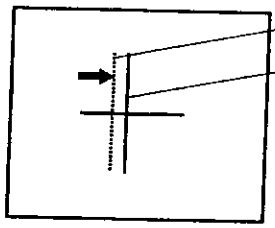
INSTALLATION ADJUSTMENT MODE



Red crosshair

Green crosshair

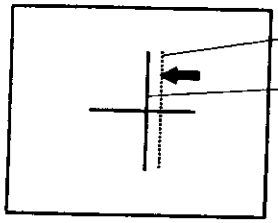
Move the red CRT towards the green CRT



Blue crosshair

Green crosshair

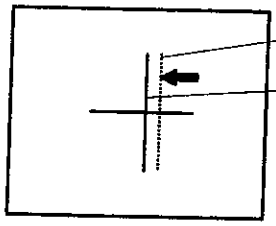
Move the blue CRT to the outside, away from the green CRT



Red crosshair

Green crosshair

Move the red CRT to the outside, away from the green CRT

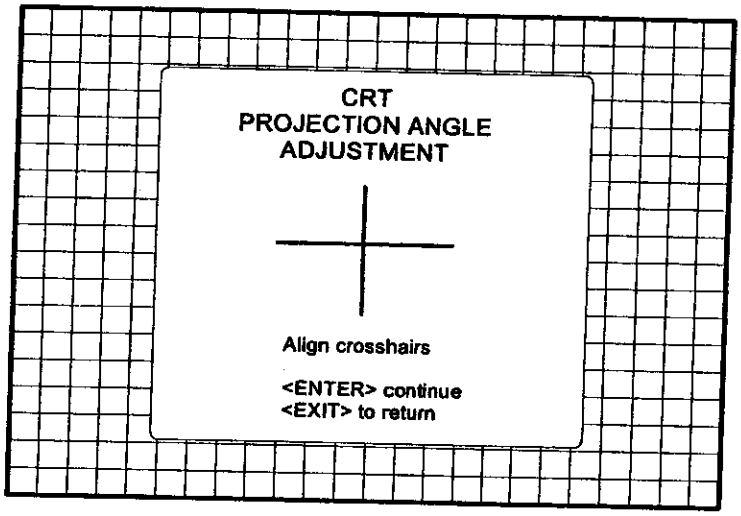


Blue crosshair

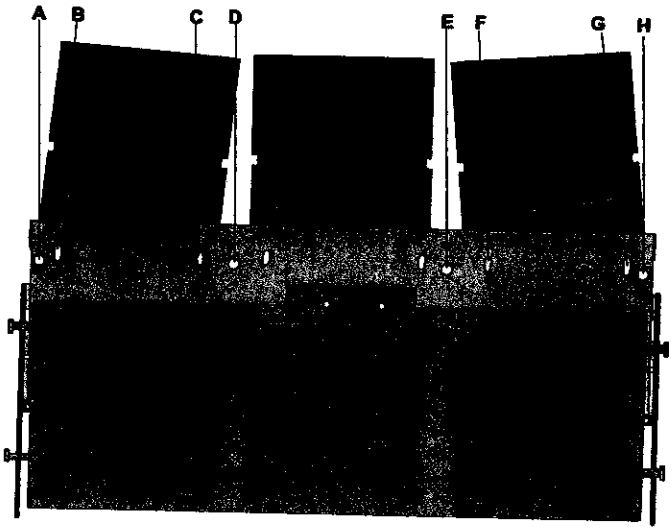
Green crosshair

Move the blue CRT towards the green CRT

<< Fig. 60 >>



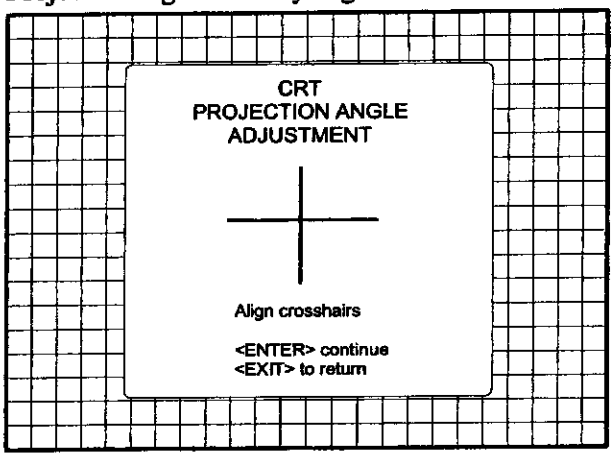
<< Fig. 61 >>



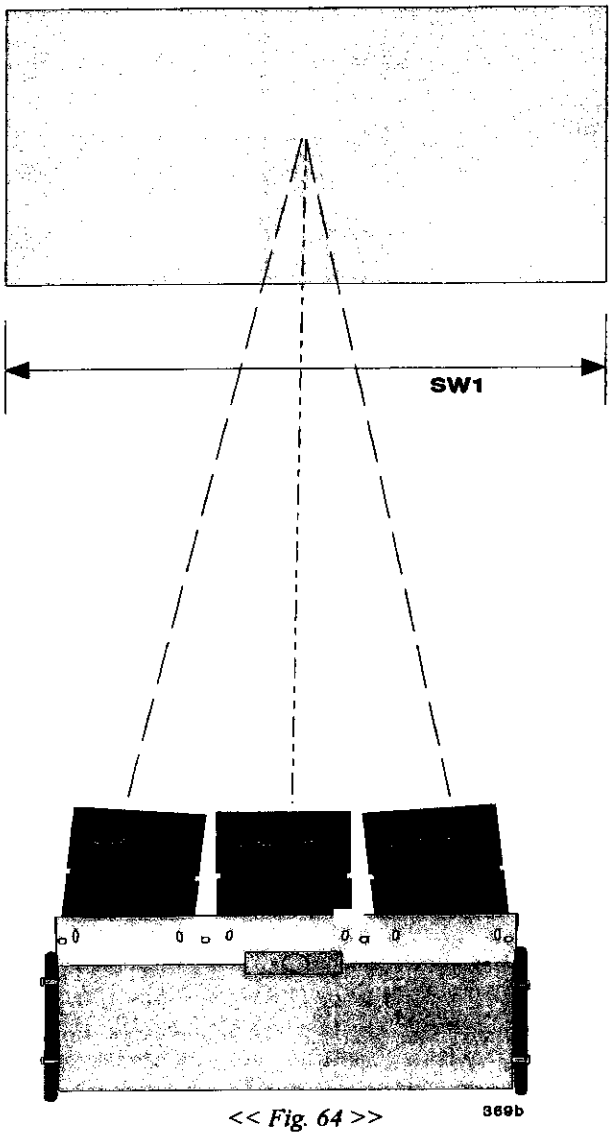
<< Fig. 62 >>

INSTALLATION ADJUSTMENT MODE

Projection angle correctly aligned for screen width SW1.

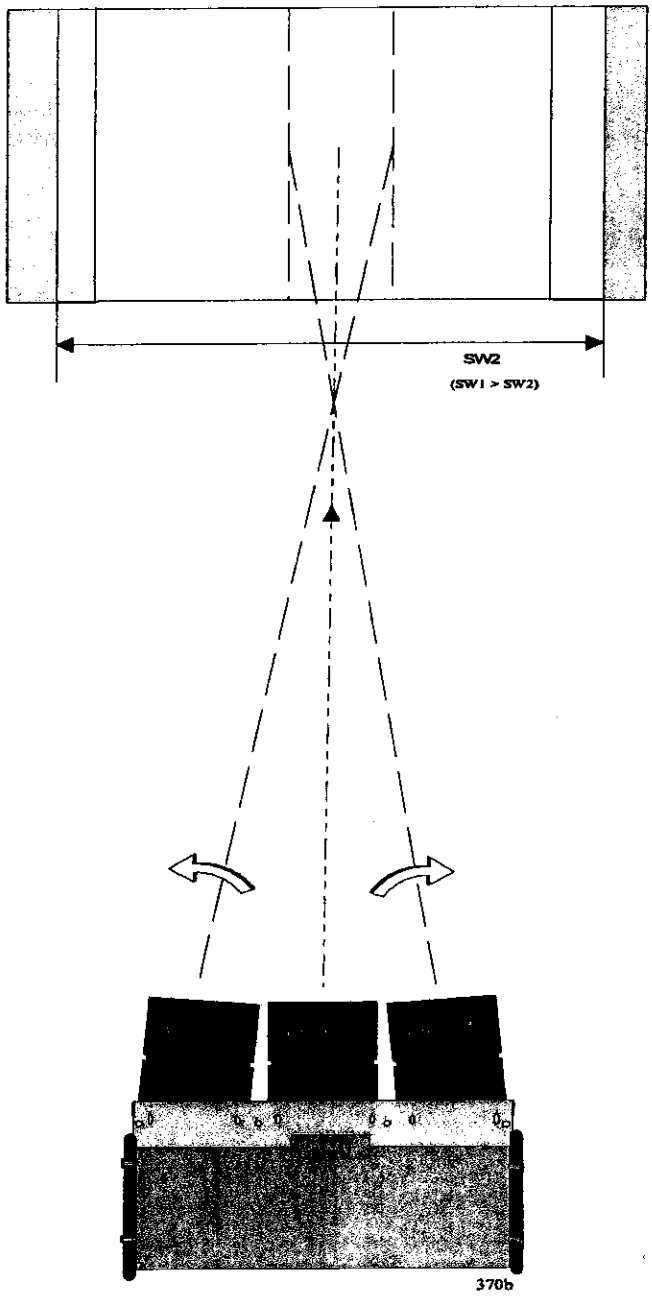


<< *Fig. 63* >>



<< *Fig. 64* >>

The same projection angle is misaligned for new screen width SW2. Realignment is necessary. Each screen width change requires readjustment of the projection angle.



<< *Fig. 65* >>

INSTALLATION ADJUSTMENT MODE

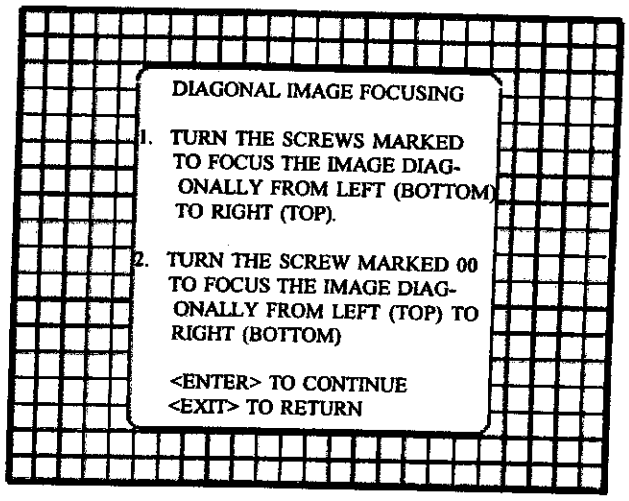
Scheimpflug Adjustment (Diagonal Image Focusing)

With the diagonal image focusing corrections, it is possible to obtain uniform focus for the total projected image.

These corrctions must be repeated for each color. The Diagonl image focusing is repeated 3 times, first for green, thrb foren and then for red and then for blue.

First, be sure that the CRT projection angle is correctly adjusted, otherwise it is not possible to obtain proper focuse of the image.

Press the <ENTER> key to start the green adjustment.
Press the <EXIT> key to to return to CRT Projection Angle Adjustment.
Press the <ADJUST> key to return to Operational mode.



<< *Fig. 66* >>

Adjustment Procedure

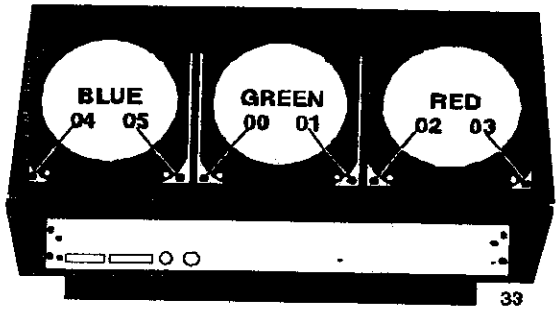
Eample: diagonal focusing of the Green image.
Equalize diagonally the focus from left (bottom) to right (top) byturining screw 01 of the projected color.
Equlize now diagonally the focus from the left (top) to the right (bottom) by turning screw 00 located under the green lens.

Repeat the same procedure for the red and blue image using the corresponding screws. To optimize the image focusing, repeat the optical lens focusing.

After finishing the Installation Adjustment Procedures, the main menu returns on the screen. You are now able to start the alignment procedure for the projector. You have the choice between:

- Guided adjustment procedure;
- Random Access Adjustment procedure.

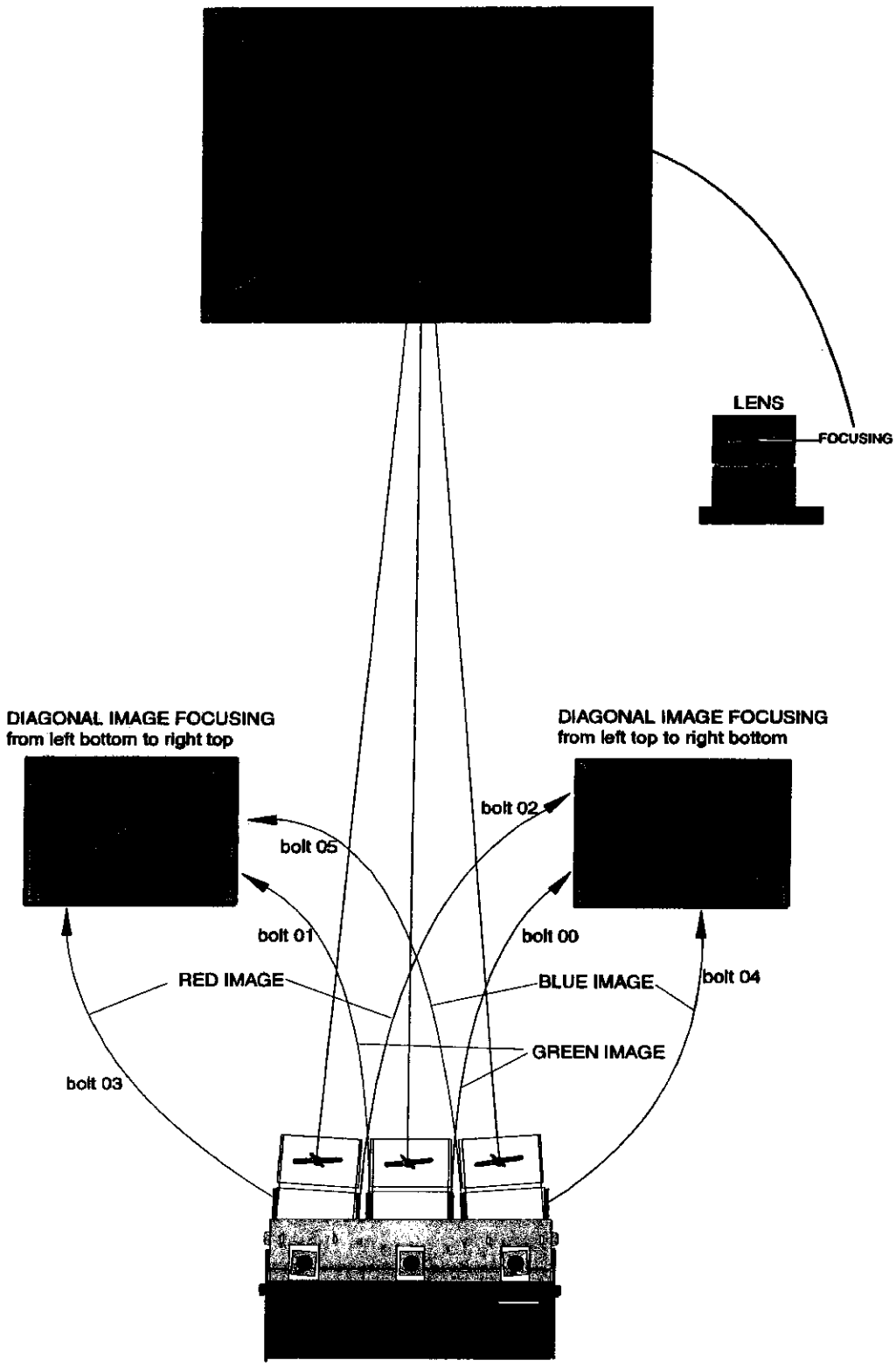
Press the <ENTER> key to continue with thee chosen path.
Press the <EXIT> key to return to Operational mode.
Press the <ADJUST> key to return Operational mode.



	Left / Right	Right / Left
GREEN	00	01
RED	02	03
BLUE	04	05

<< *Fig. 67* >>

INSTALLATION ADJUSTMENT MODE



e.g. : Turning bolt 03 will influence the dialgonal focus for Red from left bottom to tight top

<< Fig. 68 >>

MESSAGES, WARNINGS AND FAILURE CODES

SOURCE 01 **Fh= 15.6 kHz** **Fv=050 Hz**	When selecting a new source, information about this source will be displayed on the screen. Source number, horizontal and vertical frequencies of the displayed source.
SOURCE 01 **Fh= 15.6 kHz** **Fv=050 Hz**	Announcement of the selected source.
enter **password** **xxxx**	Message to enter your password. Password contains 4 digits.
text on	These messages will be displayed on the screen when pushing the <*TEXT*> key. Text ON : the *'Bar scale indication'* will be enabled during the change of an analog control in the *'Operational mode'*. All warning and failure messages will be displayed.
text off	Text OFF : the *'Bar scale indication'* will be disabled during the change of an analog control in the *'Operational mode'*. All warning and failure messages will not be displayed.
PROJECTOR **ADDRESS:** **003**	Indication of the projector address when activating the *'ADDRESS'* button on the RCU with a pencil or other small object.
WARNING: **input not** **available**	When using the projector with the RCVDS, this warning will be displayed when selecting an input slot of an RCVDS where the input board is missing.
WARNING: **source not** **available**	The input is a valid input but the source is not connected to the input terminals or the input source is switched off.
WARNING: **invalid** **key entry**	When a wrong key is pressed on the RCU.
WARNING: **invalid** **code entry**	Message when the entered password is wrong.
WARNING: **end of ad-** **just range**	End of adjustment range.
WARNING: **input no** **longer** **available**	Message will be displayed when the input source is no longer available. The following message then appears: *'check input signal or select new source'*.
check input signal **or select** **new source**	This message will be displayed after the message *'input no longer available'*. It asks to check the connections between the source and the projector or to check if the source is switched on.
WARNING: **input selector** **not** **available**	It warns you to check the power connection or the power status of the RCVDS. Next message will appear immediately on the screen : *'go to standby'*.

DIAGNOSTICS

WARNING: go to stand by	Projector will switch to *'Standby'* when the RCVDS is no longer available.
WARNING: invalid frequency input	The entered frequency or applied frequency of the source is out of the projector's range.
WARNING: default settings loaded in the E2PROM	Adjustment settings are lost. Reload using Projector Control Software via PC or MAC (if this option is available), or readjust image.
table is deleted	Message to inform that selected table is deleted. This message will be followed by *'confirm message'*, on which the user has to answer.
FAILURE invalid RWI soft version	Wrong software version in your projector. Call for technical support.
FAILURE I^2C error addr.: 7FH3	Hardware failure. Call a qualified service technician for repair.
FAILURE short circuit on I^2C bus	Hardware failure. Call a qualified service technician for repair.
FAILURE RCVDS communication error	Serial communication error between RCVDS and projector.
FAILURE RWI communication error	Hardware failure. Call a qualified service technician.
FAILURE IRIS communication error	Communication error between IRIS and the projector. Call a qualified service technician.
WAIT starting up IRIS	Message during the start up of the IRIS. Message will disappear when the IRIS is ready to accept commands.

Geometry Adjustments

The geometry adjustments have to be done only on the green image. These adjustments are automatically implemented for the other color images: Left-right (EW) and Top-Bottom Corrections, Blanking, Horizontal Amplitude, Vertical Amplitude, Vertical Linearity and Horizontal Phase.
Highlight *GEOMETRY* by pushing the control disk up or down and press **ENTER** to display the geometry menu.

- **ENTER** will display Geometry menu.
- **EXIT** will return to Internal Crosshatch Selection or Setup Pattern Selection Menu.
- **ADJUST** returns to operational mode.

Within the Geometry Adjustment menu, the following adjustments are available:

- Horizontal Phase (not for internal # pattern).
- Raster Shift
- Left-Right Corrections
- Left Side Corrections
- Top-Bottom Corrections
- Horizontal Size
- Vertical Linearity
- Vertical Size
- Blanking

The convergence corrections are disabled during geometry corrections. The blanking corrections are only enabled during the blanking adjustments.

Horizontal Phase Adjustment

Push the control disk up or down to highlight *H PHASE* on *Geometry menu* and then press **ENTER**.

Note: No horizontal phase adjustment is available on the internal # pattern.

For external sources:
If the raster shift is correctly adjusted, the H Phase text box is projected in the middle of the raster. At that moment, the "><" icon indicates the middle of the raster.
Adjust the H Phase control until the middle of the projected image is equal with the middle of >< icon.

Note: If the genlocked pattern was selected, the external source will be displayed.

A bar scale and a number indicator (between 0 and 100) on the screen give a visual indication of the horizontal phase adjustment.

ENTER continues to geometry menu.

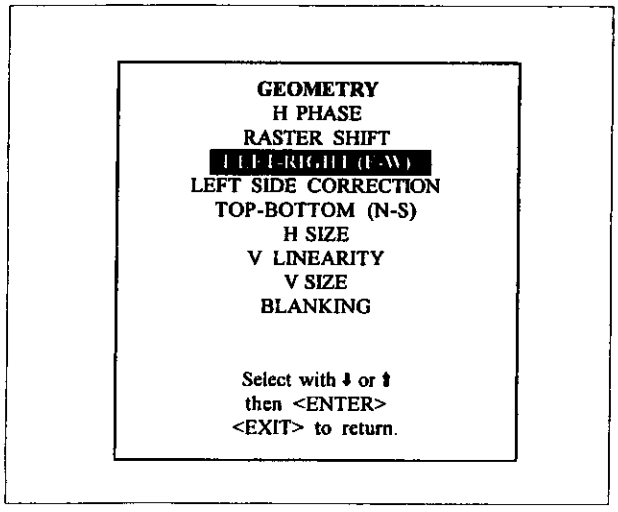
GEOMETRY SETUP

Left-Right (East-West) Adjustments

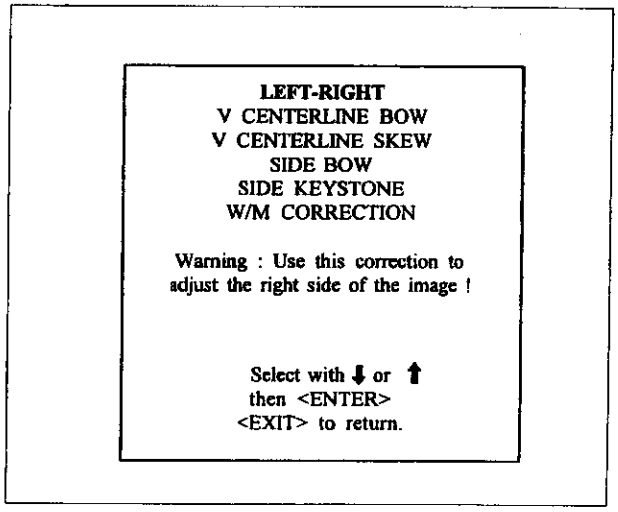
Left-right adjustments affect only the vertical lines of the projected image. Only the green image is displayed while making left-right adjustments. The red and blue images will automatically be corrected in the same manner. Convergence corrections are automatically disabled for the duration of these adjustments.
The following adjustments can be executed:

- Vertical Centerline Bow
- Vertical Centerline Skew
- Side Bow
- Side Keystone
- W/M correction

Push the control disk up or down to highlight *LEFT-RIGHT (E/W)* on the geometry menu and then press **ENTER**.
ENTER will select Left-Right adjustment menu.
EXIT returns to random access adjustment mode main menu.
ADJUST returns to operational mode.
The warning: "Use this correction to adjust the right side of the image" appears on the screen when selecting 'Side Bow' or 'Side Keystone'. When the right side is correctly adjusted, use 'Left Side Correction' to correct the left side of the image.
All adjustments are indicated on the screen with the function name, a bar scale and a number between 0 and 100. Adjust the next alignments until the vertical lines are straight. For side bow and side keystone, look only to the right side of the image.
To enter an alignment, push the control disk up or down to highlight a function and press **ENTER** to activate this function.
Press **EXIT** to return.



<< *Fig. 69* >>

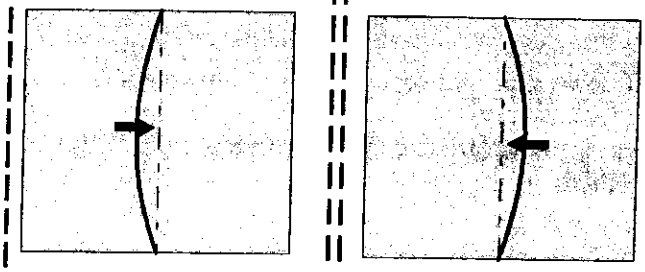


<< *Fig. 70* >>

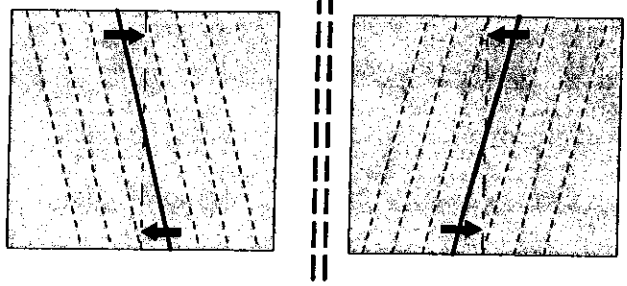
LEFT-RIGHT

V CENTERLINE BOW
V CENTERLINE SKEW
SIDE BOW
SIDE KEYSTONE
W/M CORRECTION

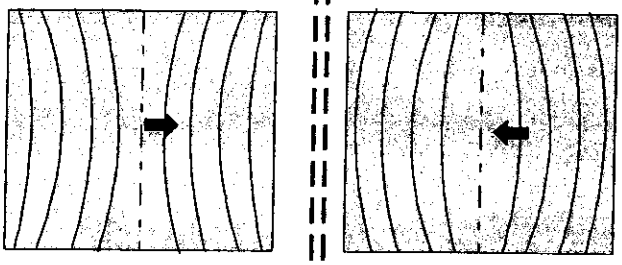
Select with ↓ or ↑
then <ENTER>
<EXIT> to return.



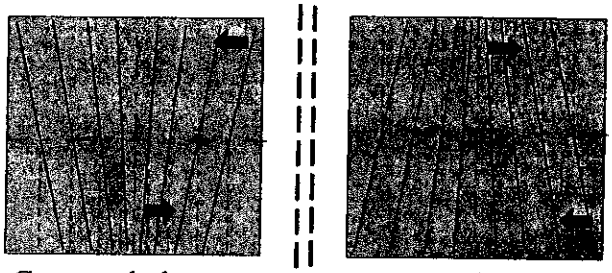
Corrects for curvature of the vertical lines in the middle of the image.



Corrects the tilting of the vertical lines in the middle of the image.



Corrects for curvature of the vertical lines on the right side



Corrects the keystone geometry correction of the vert. lines on the right side

Correct by pushing the control stick to the right

Correct by pushing the control stick to the left

<< Fig. 71 >>

GEOMETRY SETUP

W/M Correction

Use this correction only if, after adjusting the vertical lines with the side bow or side keystone, still a 'S' deformation is visible on the left and the right side of the image.
The default value on the bar scale for this correction is 50.

Push the control disk up or down to highlight *W/M CORRECTION* on the Left-Right menu and then press **ENTER**.

Eliminate the deformation by pushing the control disk to the left or to the right until a straight line is obtained.

Left Side Correction

Left side corrections affect only the vertical lines of the set up pattern. Only the green image is displayed while making the left side adjustments. The red and blue images will automatically be corrected in the same manner.

Convergence corrections are automatically disabled for the duration of these adjustments.

Look only to the left side of the image while adjusting these fine tunings (bow and keystone). Before starting the left side correction, insure that the side bow and keystone adjustments are done prior to these fine adjustments!

The following adjustments can be executed :
- Left keystone
- Left bow

Push the control disk up or down to highlight *LEFT SIDE CORRECTION* on the geometry menu and then press **ENTER**.

ENTER will select the Left Side Correction menu.
EXIT will return to the random access adjustment menu.
ADJUST returns to operational mode.

All adjustments are indicated on the screen with the function name, a bar scale and a number between 0 and 100. Adjust the next alignments until the vertical lines on the left side are straight.

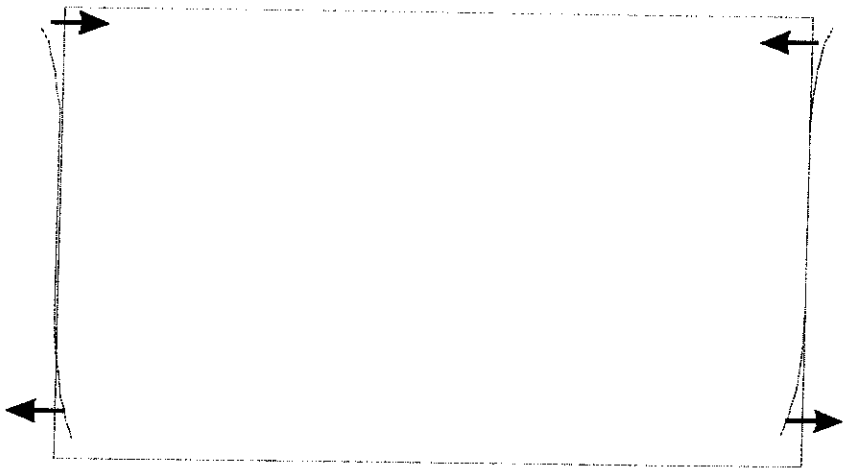
To enter an alignment, push the control disk up or down to highlight a function and press **ENTER** to activate this function.

Press **EXIT** to return.

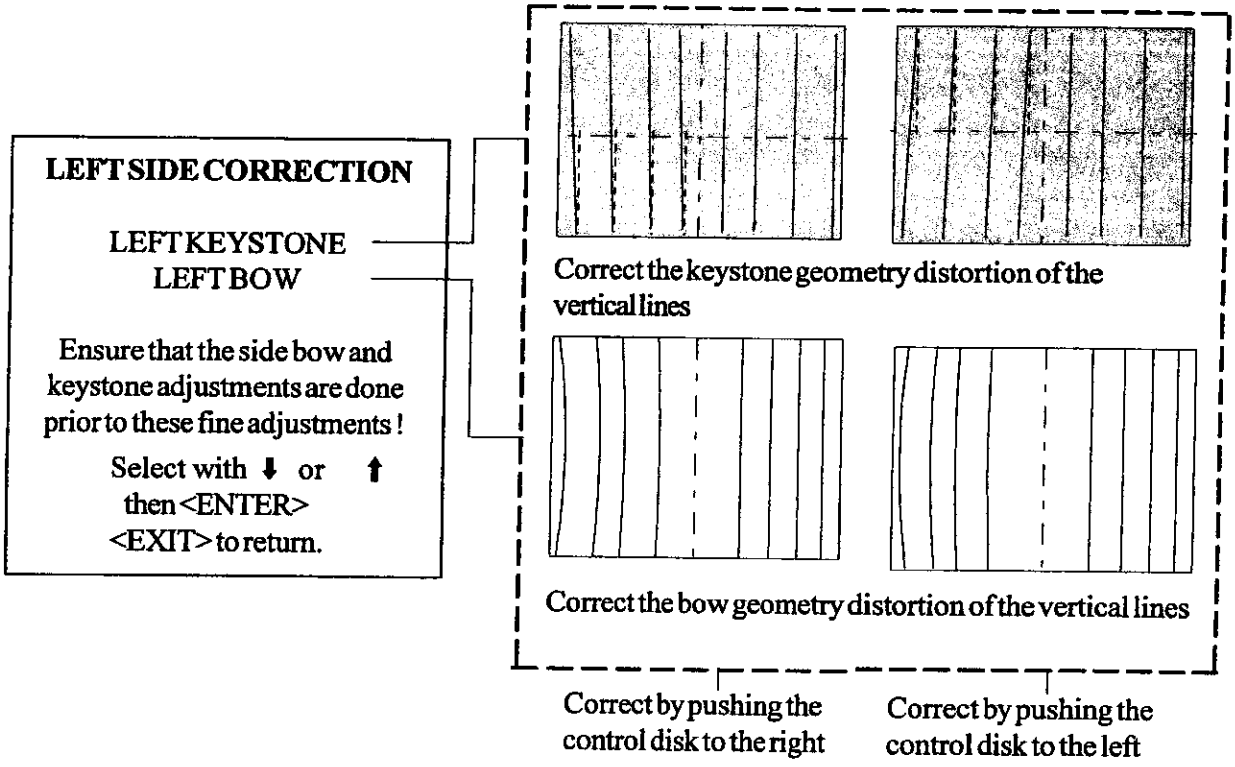
Top-Bottom (North-South) Adjustments

Top-Bottom and center adjustments affect only the horizontal lines of the projected image.
To start up the Top-Bottom and center corrections, follow the next procedure :

Push the control disk up or down to highlight *TOP-BOTTOM (N/S)* on the geometry menu and then press **ENTER**.



<< *Fig. 72* >>


LEFT SIDE CORRECTION
LEFT KEYSTONE
LEFT BOW
Ensure that the side bow and keystone adjustments are done prior to these fine adjustments !
Select with ⬇ or ⬆ then <ENTER>
<EXIT> to return.
Correct the keystone geometry distortion of the vertical lines
Correct the bow geometry distortion of the vertical lines
Correct by pushing the control disk to the right
Correct by pushing the control disk to the left

<< *Fig. 73* >>

GEOMETRY SETUP

Only the green image is displayed while making top-botton adjustments. The red and blue images will automatically be corrected in the same manner. Convergence corrections are automatically disabled for the duration of these adjustments.

The following adjustments can be executed:

- Horizontal centerline bow
- Horizontal centerline skew
- Top bow
- Top keystone
- Bottom bow
- Bottom keystone
- W/M correction

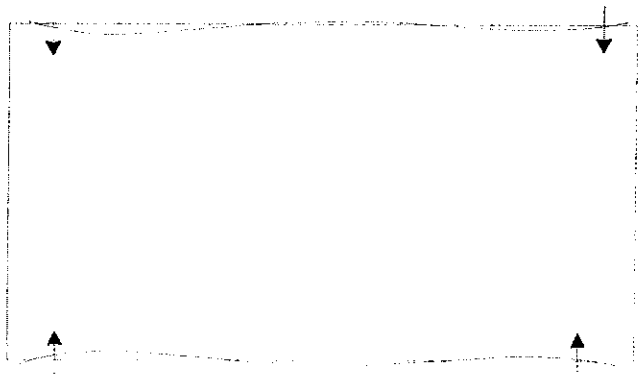
All adjustment are indicated on the screen with the function name, a bar scale and a number between 0 and 100.

Adjust the next alignments until the vertical lines are straight.
To enter an alignment, push the control disk up or down to highlight a function and press **ENTER** to activate this function.
Press **EXIT** to return.

W/M Correction

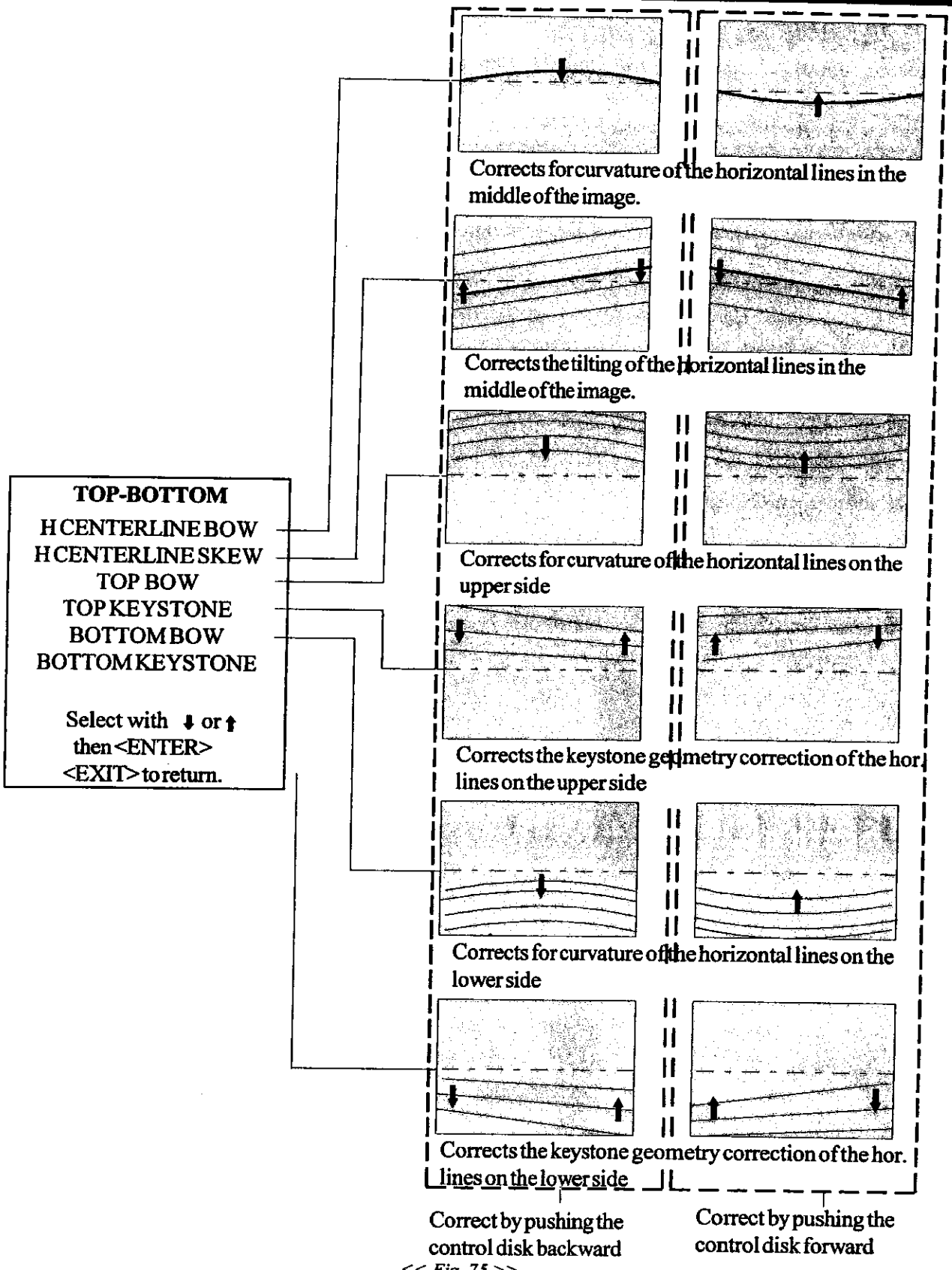
Use this correction after the image has been adjusted with top and bottom bow and keystone. If still a deformation (like a W/M) on top and bottom of the image is visible, proceed to the W/M correction. Due to interaction, it is possible that the top and bottom bow have to be readjusted after adjusting the W/M correction to obtain an improved image. The default value on the bar scale of this correction is 50.
Push the control disk up or down to select the 'W/M Correction' and press **ENTER** to select.
Eliminate the deformation by pushing the control disk up or down until a straight line is obtained.

ENTER will return to Top-Bottom adjustment menu **EXIT** will return to Geometry menu.



<< Fig. 74 >>

GEOMETRY SETUP



<< *Fig. 75* >>

GEOMETRY SETUP

Horizontal Size Adjustment

Push the control disk up or down to highlight *HSIZE* on the Geometry menu and then press **ENTER**.

ENTER will select horizontal size adjustment.
EXIT returns to random access adjustment mode menu.
ADJUST returns to operational mode.

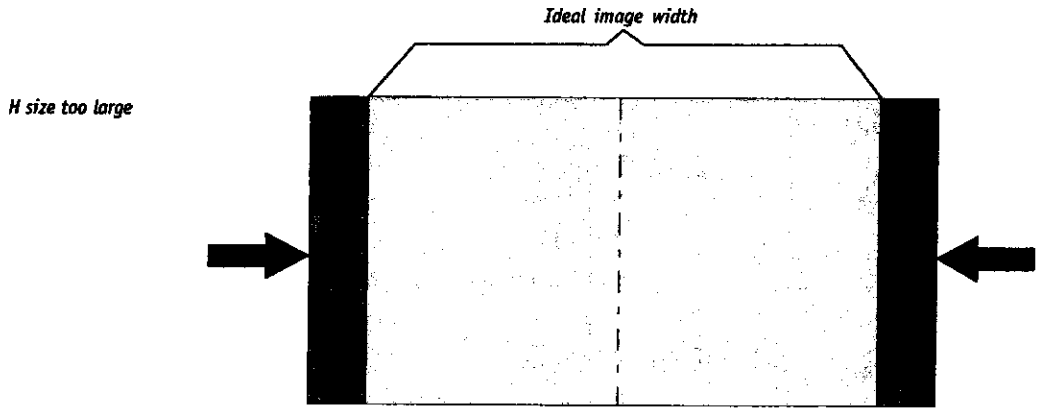
Adjust the horizontal size by the control disk to the right or to the left until the exact image width is obtained.

Note: If the internal # pattern was selected, this pattern remains on the screen.
If the genlocked pattern was selected, the external source will be displayed.

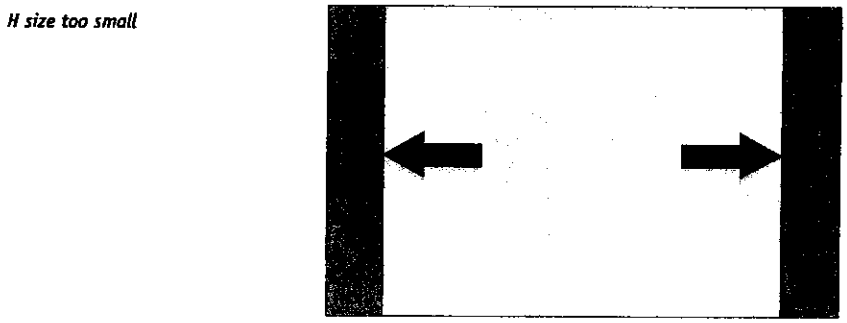
A bar scale and a numeric indicator help to gauge the horizontal size adjustment.

Hint : In order to avoid loss of resolution in the projected image and to ensure maximum CRT longevity, do not use an excessively small horizontal size setting.

EXIT will return to Geometry.



<< *Fig. 76* >>



<< *Fig. 77* >>

Vertical Linearity Adjustment

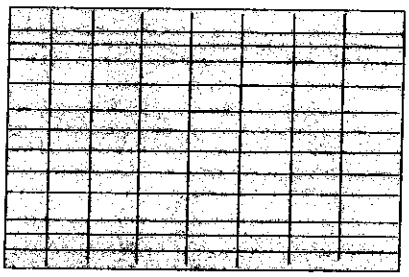
The vertical linearity adjustment function corrects for vertical non-linearities which extend from the center of the image to the top and bottom of the image.

Push the control disk up or down to highlight *V LINEARITY* on the Geometry menu and then press **ENTER**.

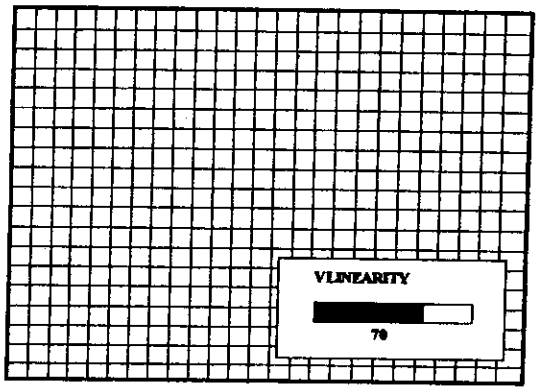
ENTER will select vertical linearity adjustment.
EXIT returns to random access adjustment mode menu.
ADJUST returns to operational mode.

Adjust the vertical linearity with the control disk until the distances between the horizontal lines of the set up pattern are equal from top to bottom.

EXIT will return to the Geometry menu



<< Fig. 78 >>



<< Fig. 79 >>

Vertical Size Adjustment

Push the control disk up or down to highlight *V SIZE* on the Geometry menu and then press **ENTER**.

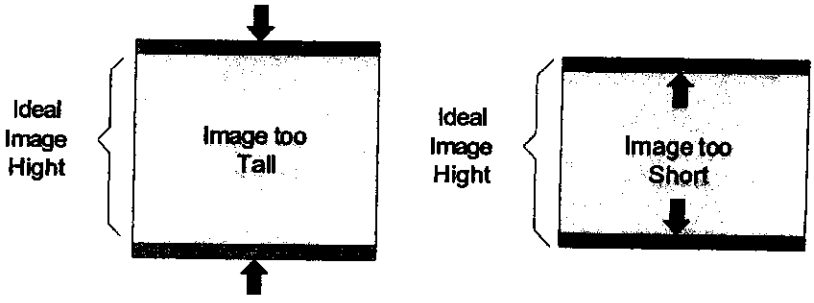
ENTER will select vertical size adjustment.
EXIT returns to random access adjustment mode menu.
ADJUST returns to operational mode.

Adjust the vertical size by pushing the control disk up or down until the correct image height is obtained.

Note: -if the internal # pattern was selected, this pattern remains on the screen.
- if the genlocked pattern was selected, the external source will be displayed.

A bar scale and a numeric indicator give a visual indication of the vertical size adjustment.

Hint : In order to avoid loss of resolution in the projected image and to ensure maximum CRT longevity, do not use an excessively small vertical size setting.



<< Fig. 80 >>

EXIT will return to Geometry

GEOMETRY SETUP

Blanking Adjustments

Blanking adjustments affect only the edges of the projected image and are used to frame the projected image on to the screen and to hide or black out unwanted information (or noise). A 0% on the bar scale indicates no blanking.

To start up the Blanking adjustments, follow the next procedure :

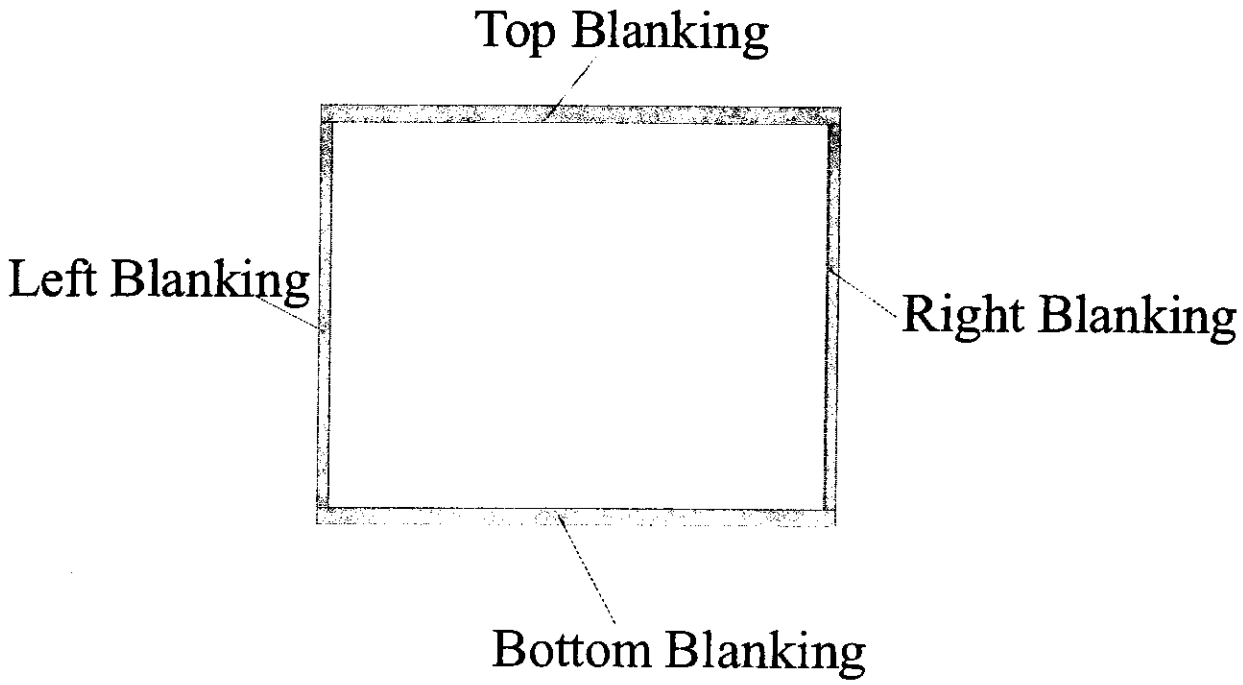
Push the control disk up or down to highlight *BLANKING* on the Geometry menu and then press **ENTER**.

The following blanking corrections are possible :
- Top blanking
- Bottom blanking
- Left blanking
- Right blanking

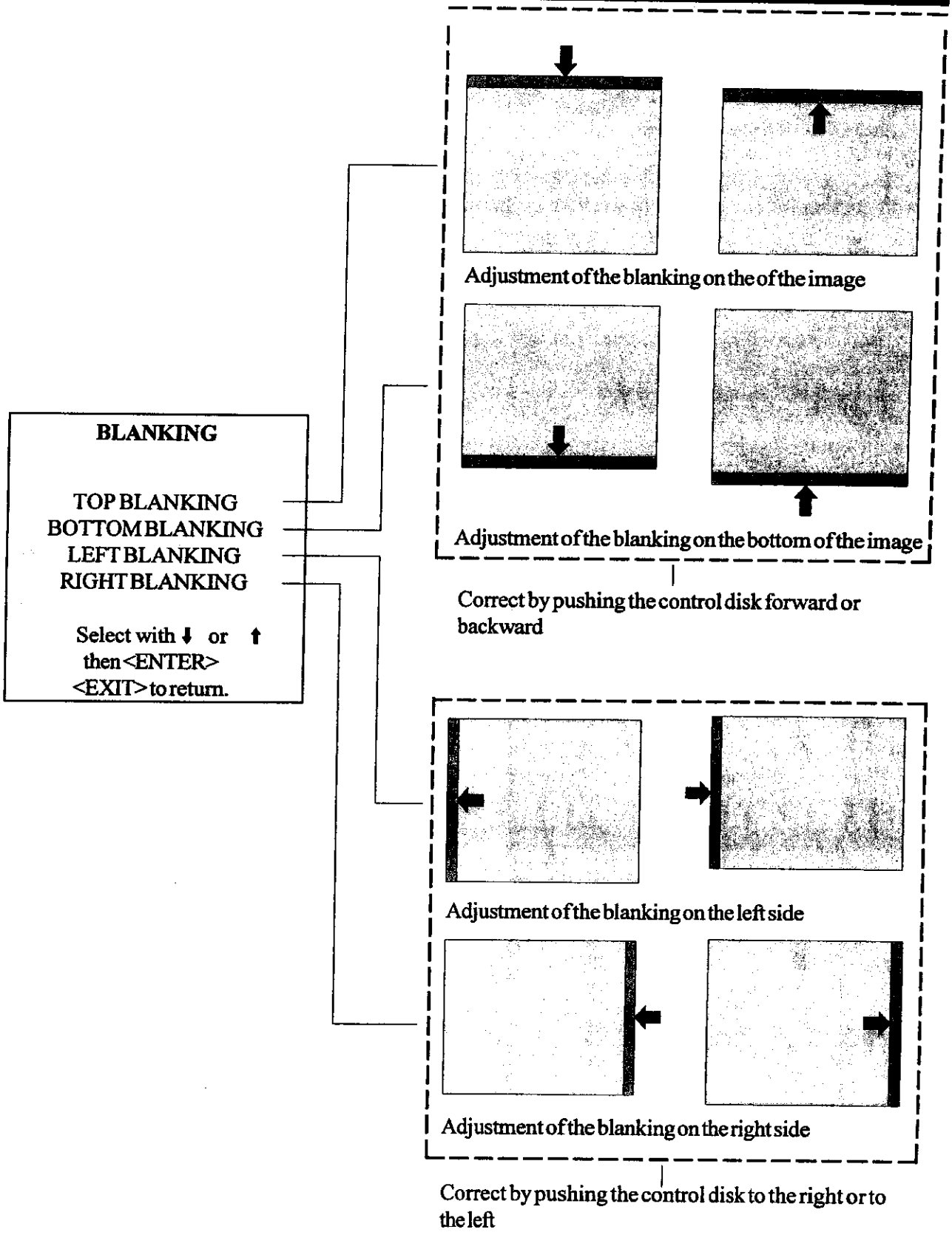
Therefore :
- If the internal # pattern was selected, this pattern remains on the screen.
- If the genlocked pattern was selected, the external source will be displayed.

Adjust the next blanking alignments until the image is correctly framed or the unwanted information is blanked out.
To enter a blanking alignment, push the control disk up or down to highlight a function and press ENTER to activate this function.

Press **EXIT** to return.



<< Fig. 81 >>


BLANKING
TOP BLANKING
BOTTOM BLANKING
LEFT BLANKING
RIGHT BLANKING
Select with ⬇ or ⬆
then <ENTER>
<EXIT> to return.
Adjustment of the blanking on the of the image
Adjustment of the blanking on the bottom of the image
Correct by pushing the control disk forward or backward
Adjustment of the blanking on the left side
Adjustment of the blanking on the right side
Correct by pushing the control disk to the right or to the left

<< Fig. 82 >>

GEOMETRY SETUP

Convergence Adjustment

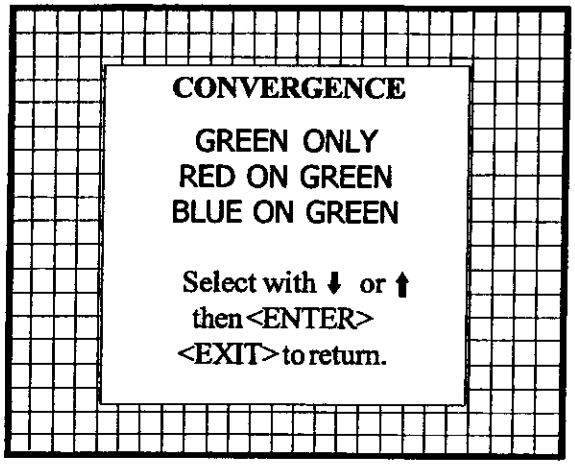
Convergence adjustments affect both the horizontal and vertical lines of the setup pattern. These adjustments are performed on the red image while superimposed on the green image and then on the blue image while superimposed on the green image.

Note : the green convergence adjustments can be added as an option. When these are available, always start with 'green only'. This option will also be indicated on the convergence menu.

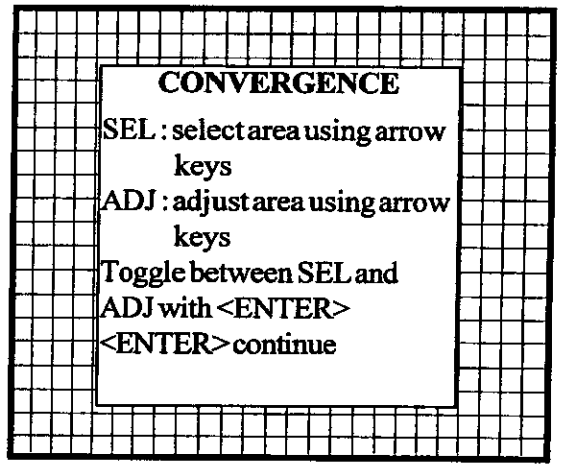
Highlight first 'Green only' when available with the control disk and press **ENTER** to display the convergence adjustment menu.

The screen area is divided into 25 areas. Use the control disk to move the box to the desired zone and then press **ENTER** to begin the convergence adjustment. Start the convergence adjustment with zone one and continue as mentioned in the diagram hereafter.

Use the control disk to make horizontal or vertical convergence adjustments in the selected zone and then press **ENTER** to move the box to another zone or **EXIT** to return to the Convergence menu.
ENTER toggles the control disk between zone selection and zone adjustment.
EXIT returns to convergence menu.



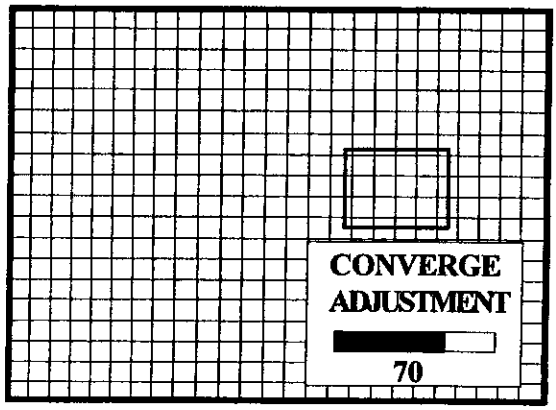
<< Fig. 83 >>



<< Fig. 84 >>

25	23	9	15	17
24	22	8	14	16
5	4	1	2	3
20	18	6	10	12
21	19	7	11	13

<< Fig. 85 >>



<< Fig. 86 >>

PROVERGE ADJUSTMENT

The **PROVERGE** is a fully automatic convergence and geometry system for the PRO1200 CRT-based projection systems. Using the **PROVERGE's** user friendly on-screen displays, the unit effortlessly aligns the projected image on the screen with extreme accuracy in the shortest possible time. This makes the unit perfectly useful for a wide range of applications.

Easy-to-use, High Precision Automatic Convergence System

Various options on the menu offer you the optimal solution for your own individual needs. They include the following:

- **Align :** convergence starts from the current image situation
- **Align from midposition :** convergence starts from midposition.
- **Touch-up :** convergence starts when the source switches or after a user-defined time : alignment of static convergence is almost invisible for the audience.

<< Fig. 87 >>

Easy-to-use, High Precision Automatic Geometry System

Various options on the menu offer a comprehensive solution to your geometry requirements. They include:

- **Quick auto-picture :** aligns geometry within 45 seconds.
- **Full auto-picture :** aligns geometry very accurately followed by auto convergence. This option offers a very powerful adjustment tool.
- **Compact, built-in system:** A very compact, monochrome CCD camera. Use of Sub-Pixel solution Techniques, a state-of-the-art proprietary Digital Signal Processing System.

Preparing your Proverge

When the lens of the **PROVERGE Iris** is covered with the lens protection cap, besure to remove this cap first before starting the adjustment procedure for the lense.

Access to Proverge On-Screen Menus

Press the <ADJUST> button on the RCU (Remote Control Unit) or the local keypad of the projector to enter the 'Adjustment mode' (please refer to the projector Owner's Manual). The PROVERGE path will be displayed in the menu:

1. Highlight **PROVERGE** by pushing the Up or Down keys of the control disk (on RCU).
2. Press the <ENTER>. button to enter the **PROVERGE** menu. The **PROVERGE** menu will be displayed after the path **PROVERGE** is selected. Six items are available :

TOUCH UP

AUTOCONVERGENCE

QUICK AUTOPICTURE

FULL AUTOPICTURE

PROVERGE SETUP

PROVERGE DIAGNOSTICS

PROVERGE ADJUSTMENT

Choose **PROVERGE** SETUP first to carry out the SETUP procedures. Then use **PROVERGE** DIAGNOSTICS to check whether the **PROVERGE** is functioning normally.

Proverge Setup

The **PROVERGE** SETUP procedure needs to be done only once after the projector is correctly installed or whenever the projector is reinstalled in another position.

To Enter the Proverge Setup Menu

- Highlight **PROVERGE** SETUP by pushing the UP or DOWN keys of the control disk.
- Press the <ENTER>. button to display the **PROVERGE** SETUP menu.

Setting the Configuration

The option is available for all PRO1200 projectors. When using a retro-projector, this option must be set to rear. Follow the steps described below to set the right configuration

- Highlight FRONT (OR REAR) by pushing the UP or DOWN keys of the control disk.
- Press the <ENTER>. button to set the correct projector configuration.

The **PROVERGE** SETUP menu provides you with easy to use methods to focus the camera lens and to center the camera.

Please pay attention while doing it, as a properly focused camera lens and correctly centered camera are prerequisites for a automatic convergence.

Focusing the Camera Lens

The lens of the camera must be focused properly on the projection screen. Follow the steps described below:

- In the **PROVERGE** SETUP menu, highlight FOCUS THE LENS by pushing the UP or DOWN keys of the control disk.
- Press the <ENTER>. button to start the process.
- A pattern of horizontal alternating green/black bars will be projected onto the screen, together with a text box. Inside the box, the text "CAMERA FOCUS" indicates the item subject to adjustment and under the text, a numeric bar scale (from 0 to 99) will visualize the correction.
- To obtain a correctly focused camera, turn the lens until maximum readout. The value of the stabilised maximum readout will be in the range between 60 and 90, depending on ambient light. In rear projection, the maximum value can be less than 60 dependant on ambient light.

After finishing the correction, press the <EXIT> button to return to the **PROVERGE** SETUP menu.

Centering the Camera

The camera must be centered in the middle of the projection screen. Follow the steps described below:

- Highlight CENTER CAMERA by pushing the UP or DOWN keys of the control disk;
- Press the <ENTER>. button to start up the process.

Note: It is critical that the green raster of the presently selected source is centered on the CRT faceplate. Otherwise, the camera will not be centered properly.

Centering the Camera Horizontally

One vertically centered green bar will be projected onto the screen, together with a text box. Inside the box, the text of "CAMERA ALIGNMENT HORIZONTAL" indicates the item subject to adjustment and a symmetrical bar scale (from -50 to +50) under the text. If the indicated value below the bar scale is not equal to zero (i.e. the black highlight is not in the middle of the bar scale), the camera is not centered horizontally. Follow the steps below to center the camera horizontally:

- Turn the screw situated on the upper-right corner of the camera clockwise or counter clockwise until the highlight is in the middle of the bar scale (i.e. the indicated value becomes zero);
- Press the <ENTER>. button to continue with the camera vertical centering.

Note: When centering a retro projector this option is not required as the camera is fixed inside the retro using the camera support plate.

Centering the Camera Vertically

One horizontally centered green bar will be projected onto the screen, together with a text box. Inside the box, the text of "CAMERA ALIGNMENT VERTICAL" indicates the item subject to adjustment and a symmetrical bar scale (from -50 to +50) under the text. If the indicated value below the bar scale is not equal to zero (i.e. the black highlight is not in the middle of the bar scale), the camera is not centered vertically. Follow the steps below to center the camera vertically:

- Turn the screw situated on the lower-left corner of the camera clockwise or counter clockwise until the highlight is in the middle of the bar scale (i.e. the indicated value becomes zero).

After finishing the vertical centering, press the <ENTER>. button to return to the **PROVERGE** SETUP menu. When installed in a retro projector, the centering procedure is not necessary and not possible as the camera mounting is fixed.

Set Touch-Up Options

For convergence purpose, the screen is divided into 25 areas. Every area has its unique number from 1 to 25. Touch-up adjusts the Area No. 1. This adjustment is also called the "static convergence".

The Touch-Up can be set on Source or on Timer

Touch-up on Source means when switching from one source to another, the static convergence will be carried out automatically.

Touch-up on Timer means whenever the user-defined period of time has elapsed the static convergence will be adjusted automatically.

PROVERGE ADJUSTMENT

Touch-Up on Source On/Off

Follow the steps below to set the option ON or OFF :

- Push UP or DOWN keys of the control disk to highlight ON SOURCE SWITCH: off
- Press the <ENTER>. button to toggle between 'ON /' OFF'.
- Press the <EXIT> button to return to the **PROVERGE** menu.

Note:Touch-up on Timer

This option allows the static convergence to be carried out automatically after a user-defined time, which can be programmed in hours and/or minutes.

To program the touch-up on Timer :

- Push UP or DOWN keys of the control disk to highlight ON TIMER :off
- Press the <ENTER>. button to switch it to ON and the preset time will be displayed
- Press the <TEXT> button to enter the TOUCH-UP TIMER menu
- Push left or right keys of the control disc to highlight the digit to be changed;
- Use the numeric keys to enter a desired value;
- Press the <ENTER>. button to confirm and the **PROVERGE** SETUP menu will return on the screen; or press the <EXIT> button to leave the preset value untouched and return to the **PROVERGE** SETUP menu.
- Press the <EXIT> button to return to the **PROVERGE** menu.

Touch-Up and Auto-Convergence Adjusting Screen Size

In case the projection screen is not greater than the desired size or the screen has a frame around it (i.e. projection impossible outside the frame), the following blanking adjustments have to be done before starting the automatic convergence :

When using a video source : adjust the top, bottom, left and right blanking until the whole projected image of video is just still visible;

When using a screen with a frame : adjust the top, bottom, left and right blanking until the whole projected image is just still visible.

So that the selected screen area after blanking adjustments corresponds with the projected image size. In this way, the screen size is set correctly to ensure the successful convergence.

Note: For blanking adjustments, please refer to the projector owner's manual.

To enter the AUTOCONVERGENCE menu :

- Highlight AUTOCONVERGENCE by pushing UP or DOWN keys of the control disk;
- Press the <ENTER> button.

The AUTOCONVERGENCE menu allows the automatic convergence either on the currently selected source or on all sources (all filled memory blocks of the projector.)

On Current Source

The on current source includes three options, the first of which is selectable in the iris menu:

Touch Up (in iris menu)

Align

Align from midposition

Touch-Up

When TOUCH-UP is selected, only the static convergence of the currently selected source will be carried out automatically. Follow the steps below to select:

- Highlight TOUCH-UP by pushing UP or DOWN keys of the control disk;
- Press the <ENTER> button to start up the static convergence.

If the process is successfully completed, the projector will return to image display of the current source.

Align on Current Source

When ALIGN is selected, the automatic convergence on the current source will be carried out automatically, starting from the existing settings.

By projecting alternately red and blue lines, 25 convergence areas are aligned to the green pattern.

Follow the steps below to select:

- Highlight ALIGN below ON CURRENT SOURCE by pushing UP or DOWN keys of the control disk;
- Press the <ENTER>. button to start up the automatic convergence of the entire screen.

If the process is successfully completed, the projector will return to image display of the current source.

Use this option when the convergence is close to proper alignment.

Align from Mid-Position on Current Source

When ALIGN FROM MIDPOSITION is selected, the automatic convergence on the current source will be carried out automatically, but starting from the midposition settings.

By projecting alternately red and blue lines, 25 convergence areas are aligned to the green pattern.

Follow the steps below to select:

- Highlight ALIGN FROM MIDPOSITION by pushing UP or DOWN keys of the control disk;
- Press the <ENTER>. button to start up the automatic convergence of the entire screen.

If the process is successfully completed, the projector will return to image display of the current source.
Use this option when the convergence is far from proper alignment.

PROVERGE ADJUSTMENT

On All Sources

The "On all sources" functions as the "On current source".
It includes also three options:

- Touch-up
- Align
- Align from midposition

The difference is that the convergences will be carried out on all sources of the projector, i.e. all available memory blocks of the projector. The total number of sources is displayed between the brackets.

Touch-Up on all Sources

When TOUCH-UP is selected, only the static convergence of all sources will be carried out automatically. Follow the steps below to select:

- Highlight TOUCH-UP below ON ALL SOURCES by pushing é or ê keys of the control disc;
- Press the <ENTER>. button to start up the static convergence.

The process will repeat for as many times as the total number of the sources until all sources are perfectly aligned. If the process is successfully completed, the projector will return to image display of the current source.

Align on all Sources

When ALIGN is selected, the automatic convergence on all sources will be carried out automatically, starting from the existing settings. By projecting alternately red and blue lines, 25 convergence areas are aligned to the green pattern. The process will repeat for as many times as the total number of the sources until all sources are perfectly aligned.

Follow the steps below to select:

- Highlight ALIGN below ON ALL SOURCES by pushing UP or DOWN keys of the control disk;
- Press the <ENTER>. button to start up the automatic convergence of the entire screen.

If the process is successfully completed, the projector will return to image display of the current source. Use this option when the convergence is close to proper alignment.

Align from Midposition on all Sources

When ALIGN FROM MIDPOSITION is selected, the automatic convergence on all sources will be carried out automatically, but starting from the midposition settings. By projecting alternately red and blue lines, 25 convergence areas are aligned to the green pattern. The process will repeat for as many times as the total number of the sources until all sources are perfectly aligned.

Follow the steps below to select:

- Highlight ALIGN FROM MIDPOSITION below ON ALL SOURCES by pushing UP or DOWN keys of the control disk.

• Press the <ENTER> button to start up the automatic convergence of the entire screen.

If the process is successfully completed, the projector will return to image display of the current source. Use this option when the convergence is far from proper alignment.

Interrupting the Automatic Convergence Process

The process of the above-mentioned automatic convergence can be interrupted at any moment by pressing the <EXIT> button.

After the <EXIT> button is pressed, the projector will leave the automatic convergence process and a message will be displayed informing of the action:

Status: Forced <EXIT>

Error Messages

The status line in the AUTOCONVERGENCE menu gives three possible messages:

Ready: before automatic convergence starts

Forced <EXIT>: when interrupting the process

Forced break: error message.

Error messages are displayed when the automatic convergence is not successfully completed.

No Pattern Error

After starting up the automatic convergence, the projector will start to calculate and locate 5 horizontal and 5 vertical lines which are used to divide the screen into 25 areas. If the projector does not succeed in finding the pattern, it will try two times. If the two attempts fail, the projector will quit the process and display the Error menu.

The AUTOCONVERGENCE selection will be followed by the error window displaying the following possibilities.

Error occurred, please check:

- the lens cap is removed
- the lens of the camera is correctly focused;
- the camera is correctly centered;
- if hardware problems exist, do diagnostics;
- the ambient light is too high;
- the blanking adjustments are correct;

Press the <ENTER> button to start **PROVERGE** diagnostics

PROVERGE ADJUSTMENT

Status Reporting Forced Break

After starting up the automatic convergence, if unexpected trouble such as the interruption of source input occurs, the projector will quit the process and display the AUTOCONVERGENCE menu on the screen.

The status line in the AUTOCONVERGENCE menu will display the following message :

Status : **Forced break**

The possible causes of such an error :

- The source is disconnected during the convergence:
  On the screen a message "Source not available" will be displayed and the projector waits until the source is reconnected or selected;
- Switching sources during the convergence:
  After the source is available again, the AUTOCONVERGENCE menu will be displayed with the status line reporting "Forced break".

Adjustment of Geometry

When one adjusts geometry by hand, a reference screen and a reference pattern are required. There are a lot of possibilities for a reference screen. The reference pattern is mostly a pattern with a border and centre lines for adjustment of horizontal and vertical linearity. Once a selection of a reference screen and a reference pattern is made, adjusting geometry is only a matter of converging these two elements.

PROVERGE requires a reference for adjusting geometry. The simplest way to have a reference screen is to adjust one source by hand, which then serves as reference for all other sources. After adjusting a source, the reference is learnt by **PROVERGE** and stored in non-volatile memory. Having this Reference Source in memory **PROVERGE** can adjust all other sources to have the same geometry as the Reference Source.

Reference Source

Before any geometric adjustment can be done, the user **must** learn a Reference Source. This process is **only done once** since the Reference will be stored in non-volatile memory. If however the projector is moved from its position, then the Learn Reference procedure must be repeated. After learning a Reference do not touch the camera (for focusing and centering.)

Adjusting Other Sources

Once a Reference Source is in memory, other sources are aligned with the same geometry as the Reference Source. If no Reference Source is learned, the resulting geometry will be unpredictable.

Learning a Reference Source

Adjust one Reference Source with perfect geometry. This source can have either horizontal or vertical frequency. Remember that other sources will have the same geometry as this Reference Source. This means that if a source has a 4:3 aspect ratio, all sources will be adjusted with a 4:3 aspect ratio and the same horizontal and vertical amplitudes.

PROVERGE ADJUSTMENT

Follow the steps below to select:

- Enter into the Adjustment Mode and select **PROVERGE**, by pushing UP or DOWN keys of the control disk. Now select SETUP using the UP or DOWN keys, finally select LEARN REFERENCE.

PROVERGE will now project the Reference Source with a horizontal green line inserted at the top region and a horizontal green line inserted at the bottom region of the image.

- Pushing the UP or DOWN keys of the control disk adjust the horizontal green line at the top until it matches the top edge of the Reference Source perfectly, then press <ENTER>.

- Using the UP or DOWN keys of the control disk adjust the horizontal green line at the bottom until it matches the bottom edge of the Reference Source perfectly, then press <ENTER>.

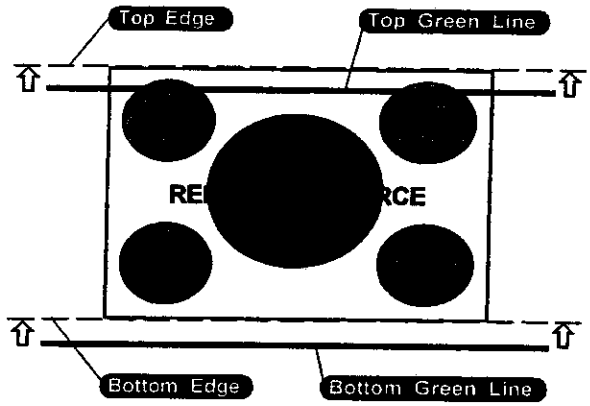
Now **PROVERGE** projects the Reference Source with a vertical green line inserted at the left and a vertical green line inserted at the right.

- Pushing the LEFT or RIGHT keys of the control disk changes the position of the vertical green lines simultaneously; they are being shifted symmetrically inwards and outwards with respect to the scan of the projector.

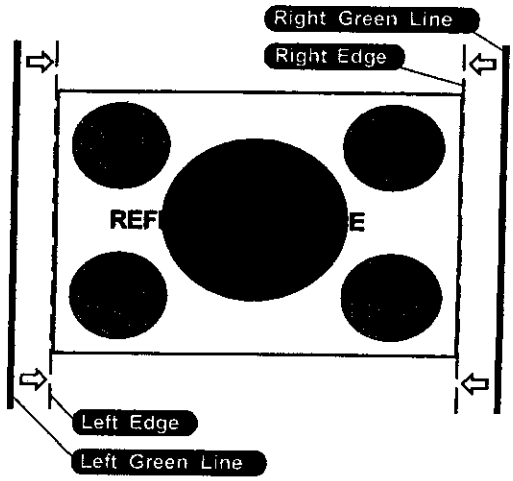
- Use UP or DOWN keys of the control disk to change the phase of the Reference Source. Use both UP or DOWN and LEFT or RIGHT so that the green vertical lines perfectly match the right-left edges of the reference image, then press <ENTER> (this will initiate the learning procedure.)

NOTE: If you had to use the arrow keys LEFT or RIGHT to adjust the phase, this means that the phase of the Reference Source was originally not adjusted correctly. Hence the Reference Source may now fall short of the physical screen. To avoid this, re-adjust the Horizontal Raster Shift (in the Random Access Adjustment mode, refer to Owner Manual) so that the Reference Source falls on the physical screen and repeat the Learn Reference selection. Do not adjust the phase when repeating the Learn Reference procedure.

Pressing <EXIT> will interrupt the Learn Reference procedure if required.



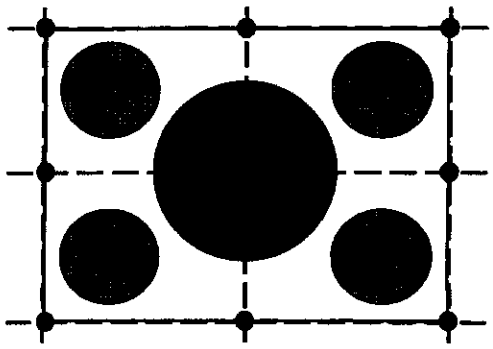
<< Fig. 88 >>



<< Fig. 89 >>

PROVERGE ADJUSTMENT

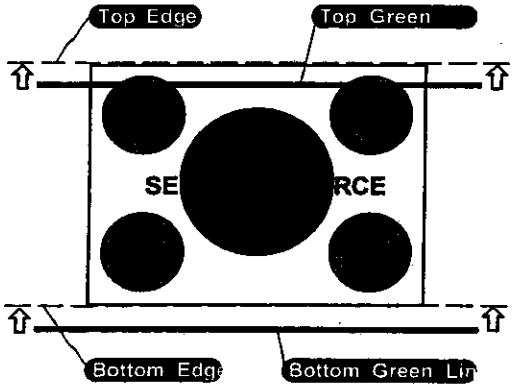
What is Being Measured by PROVERGE



<< Fig. 90 >>

Using the borderlines defined above, **PROVERGE** knows exactly when the image starts and stops with respect to time scale. **PROVERGE** is now able to project lines at the edges. Using the border lines left and right, **PROVERGE** projects three vertical thick green lines at positions 5, 50 and 95 %. Using the border lines top and bottom, **PROVERGE** projects three horizontal thick lines at positions 5, 50 and 95 %. **PROVERGE** then calculates the intercepts of the three vertical and three horizontal lines resulting in nine points. These nine points are the reference points for other geometry sources and are stored into memory.

NOTE: "delete all blocks" in the Service menu does not delete the Reference Source parameters.

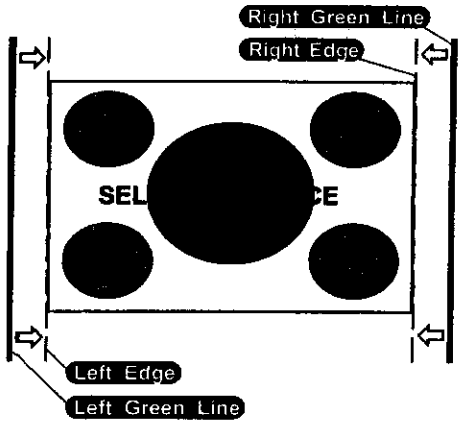


<< Fig. 91 >>

Adjustment of Geometry of other Sources

Follow the steps below to select:

1. Enter into the Adjustment Mode and select **PROVERGE**, by pushing UP or DOWN keys of the control disk. Now select FULL AUTOPICTURE.
2. A 'Define Image' screen will be shown stating, "define the top and bottom border by adjusting the projected line with UP or DOWN in order to frame the projected image horizontally, adjust the projected lines with UP or DOWN and correct the phase of the image with LEFT or RIGHT." Press <ENTER> to continue the process, or press <EXIT> to quit.



<< Fig. 92 >>

If continuing **PROVERGE** will project the source with a horizontal green line inserted at the top and a horizontal green line inserted at the bottom of the image.

3. Pushing the UP or DOWN keys of the control disc adjust the horizontal green line at the top until it matches the top edge of the image perfectly, then press <ENTER>.

4. Using the UP or DOWN keys of the control disk adjust the horizontal green line at the bottom until it matches the bottom edge of the image perfectly, then press <ENTER>.

Note: Now **PROVERGE** ***projects the source with a vertical green line inserted at the left and a vertical green line inserted at the right.***

- Pushing the LEFT or DOWN keys of the control disc changes the position of the vertical green lines simultaneously; they are being shifted symmetrically inwards and outwards with respect to the scan of the projector.

- Use LEFT or RIGHT keys of the control disk to change the phase of the Source. Use both (UP or DOWN) or (LEFT or RIGHT) so that the green vertical lines perfectly match the right-left edges of the image, then press <ENTER>.

Geometry

Note: After pressing <ENTER> in the previous step, the geometry begins alignment. The alignment consists of the following three adjustment steps :

1. Coarse adjustment of geometry.
Adjustments performed are:
- Simultaneous adjustment of vertical amplitude, shift and linearity.
- Simultaneous adjustment of horizontal amplitude and shift.
- Simultaneous adjustment of East-West side bow, East-West side skew, East-West midline bow and East-West midline skew.

2. Fine adjustment of geometry
Note: Once the coarse geometry has been adjusted,* PROVERGE *starts to adjust the geometry using a higher precision.

Further adjustments performed are:
- Simultaneous adjustment of vertical amplitude, shift and linearity.
- Simultaneous adjustment of horizontal midline bow and skew.
- Simultaneous adjustment of horizontal top bow and skew.
- Simultaneous adjustment of horizontal bottom bow and skew.
- Simultaneous adjustment of horizontal amplitude, shift, East-West side bow, East-West side skew, East-West midline bow and East-West midline skew.
- Simultaneous adjustment of left skew and bow.
- Adjustment of W/M.
- Adjustment of W/M.

3. Once the coarse and fine adjustments are completed the geometry is almost perfect. Each geometry setting is now swept around its location to fine tune the alignment.

Convergence

When the geometry is finished, **convergence is automatically started**. Using the border lines defined in the geometry **PROVERGE** is immediately able to project five vertical and horizontal lines which are perfectly spread all over the image. No blanking adjustments are required.

PROVERGE ADJUSTMENT

Quick autopicture

The quick autopicture option adjusts geometry without using the border lines. Pressing quick autopicture **immediately** starts geometry adjustment. This means that the resulting image will be orthogonal, but a slight adjustment to the phase shift, and vertical and horizontal amplitude corrections can be needed. The quick option performs only the coarse geometry adjustments. The procedure only takes 45 seconds, and results in a quick usable projector. After these 45 seconds, an internal RGB pattern is projected to be able to check it for convergence adjustment is needed or not.

Pressing <ENTER> will initiate convergence correction.

Pressing <EXIT> quits alignment.

Proverge Diagnostics

This option allows a check-up of the **PROVERGE**.

To start up the **PROVERGE** Diagnostics :

1. Highlight **PROVERGE** DIAGNOSTICS by pushing UP or DOWN keys of the control disk;
2. Press the <ENTER>. button.

After the <ENTER>. button is pressed, the **PROVERGE** Diagnostics menu will be displayed and the Tests start instantly.
It includes check-ups on four items :

- Interface Test;
- Generic Test;
- Sync Test;
- Ram Test.

After completing each test, the status report will give the test result :

- Pass; or
- Failed plus the error number.

During the Interface Test, the following messages will be displayed one after another on the screen:

- Ready and Config Test;
- Ready and Config OK;
- Config Ackn. Test;
- Config Ackn. OK;
- Full Config Test;
- Full Config OK;
- Interface Test OK.

In case of failures, the error message will be shown:
- FAILED... Error 01; or
- FAILED... Error 02; or
- FAILED... Error 03.

During the Generic Test, the following messages will be displayed one after another on the screen:
- Config for Generic;
- Config for Generic OK;
- Chipselects Test;
- Chipselects OK;
- Addressability Test;
- Addressability OK;
- Crystal and Reset Test;
- Crystal and Reset OK;
- Generic Test OK.

In case of failures, the error message will be shown:
- FAILED... Error 11; or
- FAILED... Error 12; or
- FAILED... Error 13; or
- FAILED... Error 14; or
- FAILED... Error 15.

During the Sync Test, the following messages will be displayed one after another on the screen:
- Config for Sync;
- Config for Sync OK;
- Horizontal Sync Test;
- Horizontal Sync OK;
- Vertical Sync Test;
- Vertical Sync OK;
- Frame and Field Test;
- Frame and Field OK;
- Sync Test OK.

In case of failures, the error message will be shown:
- FAILED... Error 21; or
- FAILED... Error 22; or
- FAILED... Error 23; or
- FAILED... Error 24; or
- FAILED... Error 25; or

- FAILED... Error 26; or
- Sync Test Error 27
  No Syncs found
  Check Camera & Cabling.

During the Ram Test, the following messages will be displayed one after another on the screen:

- Config for Ram;
- Config for Ram OK;
- Ram Data Lines Test;
- Ram Data Lines OK;
- Ram Address Lines Test;
- Ram Address Lines OK;
- Ram Full Content Test;
- Ram Full Content OK;
- Ram Test OK.

In case of failures, the error message will be shown :

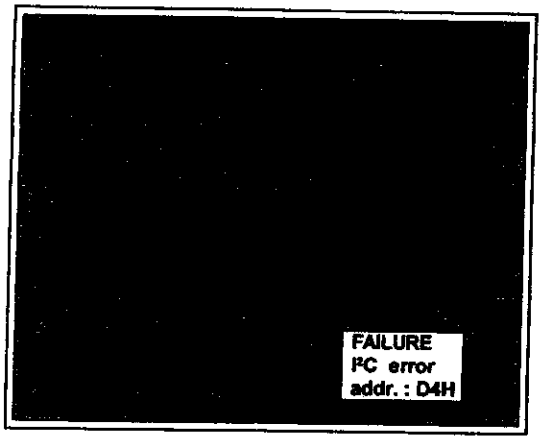
- FAILED... Error 31; or
- FAILED... Error 32; or
- FAILED... Error 33; or
- FAILED... Error 34.

If all the tests are successful, the **PROVERGE Diagnostics** menu will be as follows :
Press the <EXIT> button to return to the **PROVERGE** menu.

Refer to the Installation Adjustment Mode section for On Screen Convergence Alignment.

CONVERGENCE / ERROR CODES

I²C error is displayed on the screen together with the respective address, as illustrated on screen picture: The table below indicates which IC corresponds to the displayed address. Replacement of the module 809-10451 solves the I²C error.



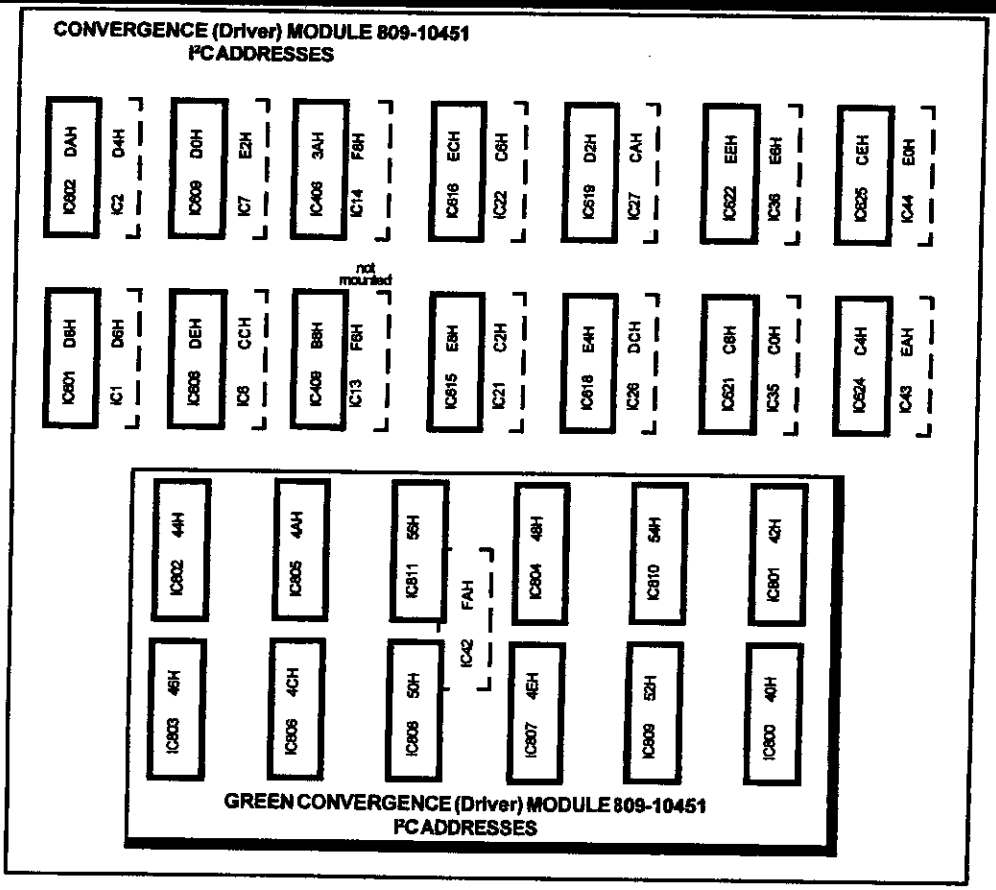
<< *Fig. 93* >>

Convergence zones

1	2	3	4	5
6	7	8	9	10
11	12		13	14
15	16	17	18	19
20	21	22	23	24

<< *Fig. 94* >>

Convergence module (Driver) - Green convergence sub module



<< *Fig. 95* >>

CONVERGENCE / ERROR CODES

Green Convergence Main Module

HEX address	IC	CORRECTION	ZONE
D6H	IC1	R Horizontal/Vertical	12
		B Horizontal/Vertical	12
D8H	IC601	R Horizontal/Vertical	13
		B Horizontal/Vertical	13
D4H	IC2	R Horizontal/Vertical	11
		B Horizontal/Vertical	11
DAH	IC602	R Horizontal/Vertical	14
		B Horizontal/Vertical	14
C4H	IC624	R Horizontal/Vertical	3
		B Horizontal/Vertical	3
EAH	IC43	R Horizontal/Vertical	22
		B Horizontal/Vertical	22
CEH	IC625	R Horizontal/Vertical	8
		B Horizontal/Vertical	8
E0H	IC44	R Horizontal/Vertical	17
		B Horizontal/Vertical	17
D0H	IC609	R Horizontal/Vertical	9
		B Horizontal/Vertical	9
E2H	IC7	R Horizontal/Vertical	18
		B Horizontal/Vertical	18
CCH	IC6	R Horizontal/Vertical	7
		B Horizontal/Vertical	7
DEH	IC608	R Horizontal/Vertical	1
		B Horizontal/Vertical	1
C0H	IC35	R Horizontal/Vertical	1
		B Horizontal/Vertical	1
E6H	IC36	R Horizontal/Vertical	20
		B Horizontal/Vertical	20
C8H	IC621	R Horizontal/Vertical	5
		B Horizontal/Vertical	5
EEH	IC622	R Horizontal/Vertical	24
		B Horizontal/Vertical	24
C6H	IC22	R Horizontal/Vertical	4
		B Horizontal/Vertical	4

HEX address	IC	CORRECTION	ZONE
ECH	IC616	R Horizontal/Vertical	23
		B Horizontal/Vertical	23
C2H	IC21	R Horizontal/Vertical	2
		B Horizontal/Vertical	2
E8H	IC615	R Horizontal/Vertical	21
		B Horizontal/Vertical	21
DCH	IC26	R Horizontal/Vertical	15
		B Horizontal/Vertical	15
E4H	IC618	R Horizontal/Vertical	19
		B Horizontal/Vertical	19
CAH	IC27	R Horizontal/Vertical	6
		B Horizontal/Vertical	6
D2H	IC619	R Horizontal/Vertical	10
		B Horizontal/Vertical	10
F6H	IC13	R/G/B Left BOW (Hor)	Left side
		R/G/B Left SKEW (Hor)	Left side
F8H	IC14	R/G/B Bottom BOW (Vert)	N/S corr.
		R/G/B Top BOW (Vert)	N/S corr.
		R/G/B Bottom Keystone (Vert)	N/S corr.
		R/G/B Top Keystone (Vert)	N/S corr.
FAH	IC42	G Vertical Midline SKEW (H)	Midlines
		R/G/B Vertical Midline BOW (H)	Midlines
		R/G/B Vertical Midline SKEW (V)	Midlines
		R/G/B Vertical Midline BOW (V)	Midlines
3AH	IC406	R/G/B E/W Seagull	E/W
		R/G/B N/S Seagull	N/S
B8H	IC409	R/B Precorrections	Sides
		R/B Precorrections	Head Corner
50H	IC808	G Horizontal/Vertical	23
		G Horizontal/Vertical	4
52H	IC809	G Horizontal/Vertical	24
		G Horizontal/Vertical	5
54H	IC810	G Horizontal/Vertical	1
		G Horizontal/Vertical	20
56H	IC811	G Horizontal/Vertical	21
		G Horizontal/Vertical	2

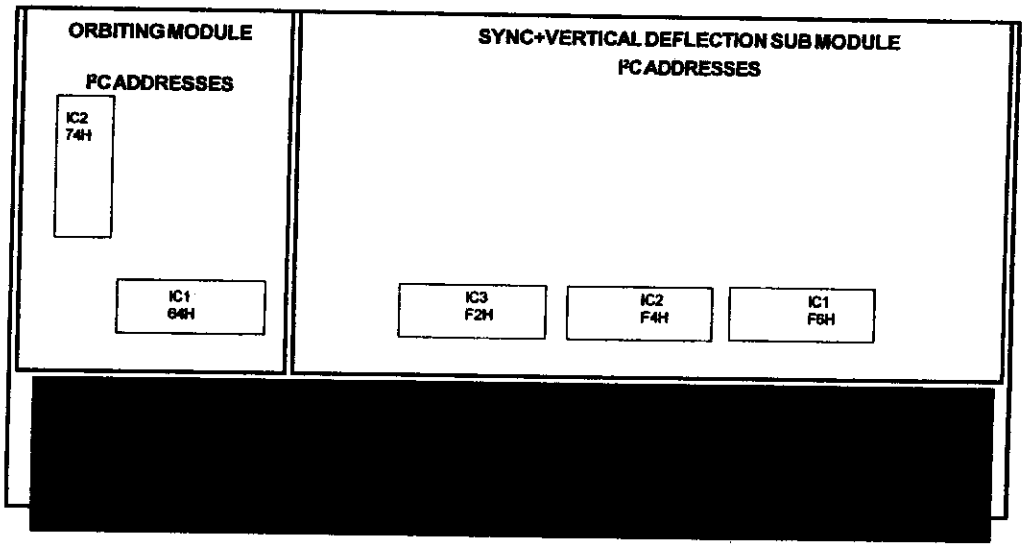
CONVERGENCE / ERROR CODES

Sync + Vertical Deflection Module

HEX address	IC	CORRECTION
F2H	IC3	bottom blanking vertical shift red vertical shift green vertical shift blue
F4H	IC2	vertical amplitude vertical linearity horizontal phase
F6H	IC1	top blanking side keystone side bow left blanking right blanking

ORBITING

HEX address	IC	CORRECTION
74H	IC2	max deviation zero deviation slow orbiting fast orbiting
HEX address	IC	CORRECTION
64H	IC1	shift orbit phase orbit



<< Fig. 96 >>

Magneticl Focus + Hoz Shift

HEX address	IC	CORRECTION
F0H	IC52	horizontall shift red horizontal shift green horizontal shift blue
FCH	IC303	focus Red center focus Green center focus Blue center H Amp (not used)

HEX address	IC	CORRECTION
FEH	IC311	focus bottom R focus top R focus left R focus right R
66H	IC312	focus bottom G focus top G focus left G focus right G
68H	IC313	focus bottom B focus top B focus left B focus right B

CONVERGENCE / ERROR CODES

QUAD DECODER

HEX address	IC	CORRECTION
40H	IC17	sharpness sharpness On

INPUT RGB+SWITCHING

HEX address	IC	CORRECTION
42H	IC601	Clamp Width 1 Clamp Width 2 Clamp Mode 1 Clamp Mode 2 (not 1200 mode) Enable CHROMA filters Scan Doubler On Width ident.
3EH	IC604	RGB Matrix Saturation Hue (V03) not used

HEX address	IC	CORRECTION
70H	IC602	Red on/off Green on/off Blue on/off Sync fast/slow
	IC601	SDA On/Off (P5-P7) Input Switch

RGB Driver

HEX address	IC	CORRECTION
5AH	IC1	Bright. Red Bright. Green Bright. Blue Brightness
5CH	IC2	Cut off Red Cut off Green Cut off Blue IBCL Value
3C	IC109	Right Blanking Left Blanking Blue Breakpoint (4) not used
58H	IC3	Red gain Blue gain Red cut off Blue cut off

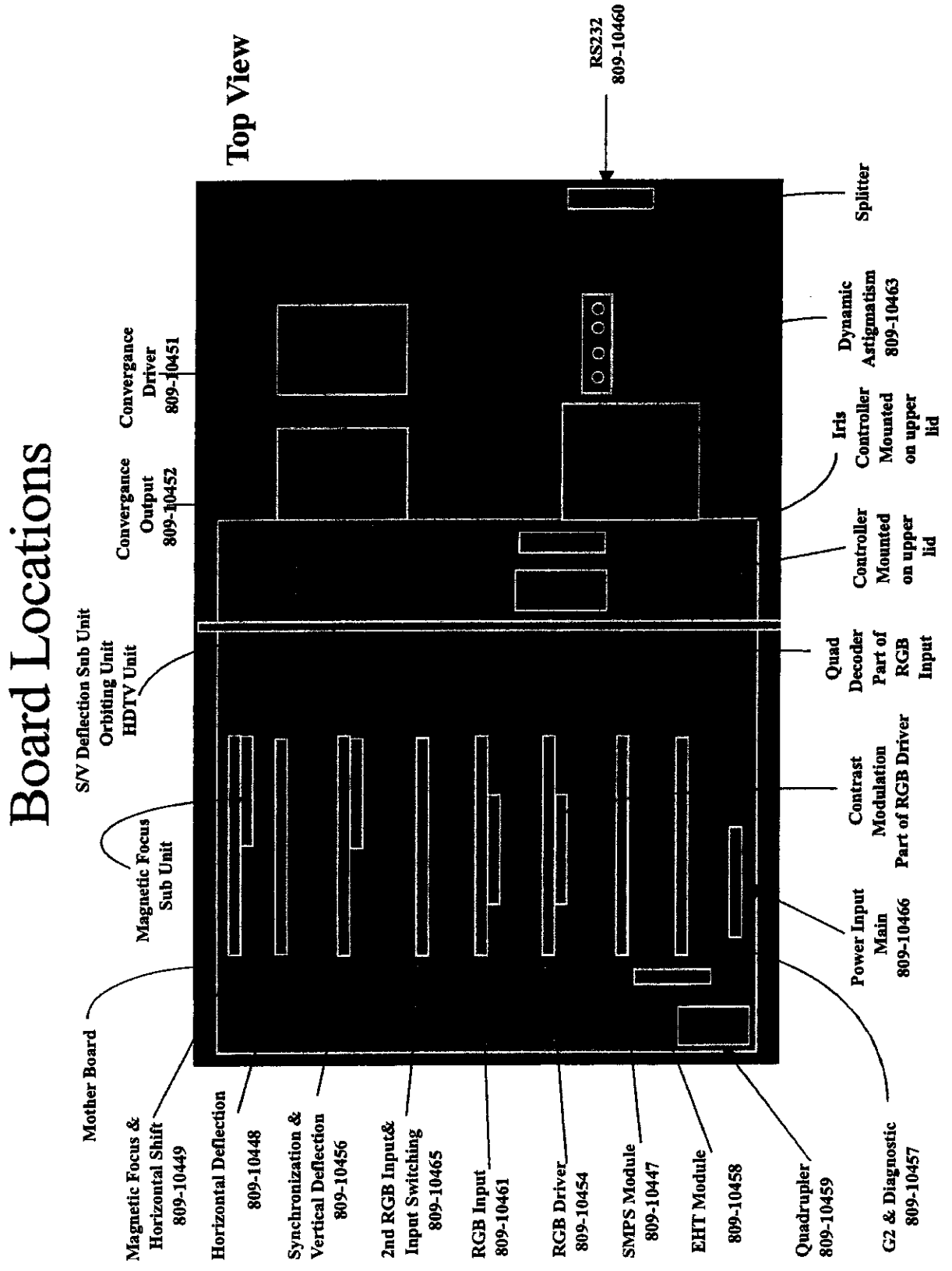
HEX address	IC	CORRECTION
42H	IC100	Midlights Red 1 Midlights Red 2 Midlights Red 3 Midlights Red 4 Midlights Blue 1 Midlights Blue 2 Midlights Blue 3 Midlights Blue 4
44H	IC101	Peaking 1 Peaking 2 Peaking 3 (P3) not used Blue correction 1 Blue correction 2 Blue correction 3

CONVERGENCE / ERROR CODES

I²C Error Messages in Ascending Order of Address Number

HEXaddress	IC	MODULE
40H	IC800	Convergence G
42H	IC801	Convergence G
44H	IC802	Convergence G
46H	IC803	Convergence G
48H	IC804	Convergence G
4AH	IC805	Convergence G
4CH	IC806	Convergence G
4EH	IC807	Convergence G
50H	IC808	Convergence G
52H	IC809	Convergence G
54H	IC810	Convergence G
56H	IC811	Convergence G
40H	IC17	QUAD Decoder
66H	IC312	Mag. Foc+Hor Shift
68H	IC313	Mag. Foc+Hor Shift
F0H	IC52	Mag. Foc+Hor Shift
FCH	IC303	Mag. Foc+Hor Shift
FEH	IC311	Mag. Foc+Hor Shift
42H	IC601	IN RGB+Switching
70H	IC602	IN RGB+Switching
3EH	IC604	IN RGB+Switching
64H	IC1	Orbiting
74H	IC2	Orbiting
C0H	IC35	Convergence
C2H	IC21	Convergence
C4H	IC624	Convergence
C6H	IC22	Convergence
C8H	IC621	Convergence
CAH	IC27	Convergence
CCH	IC6	Convergence

HEXaddress	IC	MODULE
CEH	IC625	Convergence
D0H	IC609	Convergence
D2H	IC619	Convergence
D4H	IC2	Convergence
D6H	IC1	Convergence
D8H	IC601	Convergence
DAH	IC602	Convergence
DCH	IC26	Convergence
DEH	IC608	Convergence
E0H	IC44	Convergence
E2H	IC7	Convergence
E4H	IC618	Convergence
E6H	IC36	Convergence
E8H	IC615	Convergence
EAH	IC43	Convergence
ECH	IC616	Convergence
EEH	IC622	Convergence
F6H	IC13	Convergence
F8H	IC14	Convergence
FAH	IC42	Convergence
3AH	IC406	Convergence
B8H	IC409	Convergence
F2H	IC3	Sync+Vert defl
F4H	IC2	Sync+Vert defl
F6H	IC1	Sync+Vert defl
42H	IC100	RGB DrIVER
44H	IC101	RGB DrIVER
58H	IC3	RGB DrIVER
3CH	IC109	RGB DrIVER
5AH	IC1	RGB DrIVER
5CH	IC2	RGB DrIVER


Board Locations
Top View
RS232
809-10460
Splitter
Dynamic
Astigmatism
809-10463
Iris
Controller
Mounted
on upper
lid
Controller
Mounted
on upper
lid
Quad
Decoder
Part of
RGB
Input
Contrast
Modulation
Part of RGB Driver
Power Input
Main
809-10466
Convergance
Driver
809-10451
Convergance
Output
809-10452
S/V Deflection Sub Unit
Orbiting Unit
HDTV Unit
Magnetic Focus
Sub Unit
Mother Board
Magnetic Focus &
Horizontal Shift
809-10449
Horizontal Deflection
809-10448
Synchronization &
Vertical Deflection
809-10456
2nd RGB Input&
Input Switching
809-10465
RGB Input
809-10461
RGB Driver
809-10454
SMPS Module
809-10447
EHT Module
809-10458
Quadrupler
809-10459
G2 & Diagnostic
809-10457

<< *Fig. 78* >>

Main Input (809-10466)

The Power (Main) Input provides protection against interference when operated in a commercial environment and contains the setup jumper for switching between 120Vac or 230Vac operation.

Power (Main) Filter

The power filter consists of the coil L1 with four windings, and the capacitor C3. It is a filter, blocking all high and low frequency noise towards the outlet. NTC-resistors NTC1, NTC2 and NTC3 limit the start up current. The fuses F1 and F2 prevent damage to the power Input board and the Switched Mode Power Supply in the event of short circuit or wrong 230/120Vac setting.

230 VAC Operation

When we look how the diode bridge D100 of the Switch Mode Power Supply is connected to the power input board (Figure 1), we can see how the 230Vac operation works. Diode bridge D100 operates as a bridge rectifier, and we get an output DC-voltage of approximately +300 Volts. Capacitor C103 forms a capacitive load on the Switch Mode Power Supply, to reduce the AC-ripple on the +300 DC-voltage. Resistor R103 is used to discharge this capacitor quickly when the projector is switched off.

120 VAC Operation

When we look again how the diode bridge of the Switch Mode Power Supply is connected to the Main Input/Output board during 120Vac operation, we can draw the following schematic, figure 2.

To make it more comprehensive, we redraw this figure (Figure 3.), deleting NTC1, NTC2, and NTC3 that only play a roll during start up, and by deleting R3 and R4 that are only important while switching off.

Now we see that the diode bridge operates as a voltage multiplier. During the negative half period of the power (mains) voltage, capacitors C11-C12 are charged through bridge rectifier. During the positive half of the power (mains) voltage, capacitors C9-C10 are charged, through bridge rectifier, on a voltage which is the input voltage together with the load on the capacitors C11/C12.
In this way a DC-voltage of again approximately +300 Volts is built across the capacitor C.

Mains (Power) Adaptation Procedure

1. Switch off the projector and unplug the power plug from the wall outlet.
2. Open the Top and the Module rack cover (refer to § Access to chassis for servicing)
3. Loosen the lock screw of the power-input module and pull out this module.
4. Pull out the "POWER SELECTOR PLUG" and reinsert it as illustrated below depending of the wall outlet in the room.
5. Replace the fuses.
6. Reinsert the power-input module and secure it with the lock screw.
7. Reconnect the power cord with the wall outlet and switch on the projector.

CIRCUIT DESCRIPTIONS

SWITCHED MODE POWER SUPPLY (809-10447)

Generation of the Line Frequency Independent Voltages

The mains voltage is rectified by the bridge D100 and the +300 volts is now the supply voltage for the power switches Q100 and Q101 on the main board. The connector J2 brings this voltage to the subunit where it is used for the production of the standby voltages (-) and (+) SB. We assume that the thyristor TH1 is conducting (Has received power on signal, its gate is not clamped at ground level.)

The positive half-wave of the main voltage (START) charges C102 and C104 via D104. The gate of the thyristor is set at 11 volts with the zener Z100 through R101 from the +300volts. As soon as the capacitor voltage of C102 and C104 reaches approximately 12 volts, the IC can start up by driving the base of the power switch. The diode D104 stops conducting as its anode is at about (11 + 0.6) volts. The thyristor gets blocked as well, because its cathode equals the gate voltage. In the meantime IC100 and IC102 have started to operate and the voltage at pin 9 receives its supply voltage now from the winding 24/18-22 of the T2 transformer via D106 and D109 and . This voltage is filtered and stabilized with C131. It is then input to IC130 where it is regulated to 15Vdc and input into pin9 on both IC100 and IC102.

Once the IC's start operation, the push-pull outputs on pins 7 and 8, provide drive pulses to the base of Q100 and Q101 and during the off time of the pulses the accumulated energy in the primary winding is transferred to the secondary capacitors via the rectifying diodes (flyback principle).

The feedback winding 20-22 provides two pieces of information for the control IC:
Firstly, the waveform is sent to pin 2 where the **zero passages** are detected, this is used to drive the switching transistor on at the correct time. The base drive is delayed until the energy in the transformer has been completely transferred to the secondary side. By this measure, the current through the switching transistor is reduced to a minimum.

Secondly, the negative amplitude is rectified by D111 and compared with the reference 4 volts that is available at pin 1. The error voltage is now sent to pin 3 and serves as a control voltage to adjust the duty cycle and frequency of the switcher. The windings P18-P22 also serve as an aid at starting up. This winding provides energy the moment the P22-P24 winding does not. The rectified voltage (D131) passes into pin 9 up to the moment that pin reaches 12 volts.

The current through the power switch is at all times checked and if too high (in the event of a short on the secondary side) the comparator 393 (IC101) output drops the error voltage in order to adapt the duty cycle of the switcher.

Note that a "special" winding is provided, delivering **+17M,** or, a voltage related to the **Mains** ground and not the chassis ground. This voltage is utilized on the EHT board, because the drive circuit for the power switcher is **Mains ground and <u>not</u> Chassis ground**. (See description EHT board).

Generation of the +HTHD Voltage (Scan Voltage)

This voltage is linked with the horizontal deflection board as it has to be adapted to the scanning frequency. A feedback voltage (FBHD) is sent back to the subunit for that this reason. This feedback voltage, which can be monitored at contact J4(pin 8) (FBHD) of the subunit, is sent to the base of the error amplifier Q6.

The potentiometer P2 allows an adjustment of this feedback, or in other words, the horizontal width can be aligned with P2.

The emitter of Q6 is set at a reference zener voltage, adjustable with the voltage at the regulating pin of Z8. This voltage is the result of the output of the DC-amplifier- buffer IC3, combined with the +HTHD voltage. By this measure, we reduce the range of the horizontal width at high scanning frequencies. Indeed, at standard video frequency we need much more range to overscan.

The collector current of the regulating transistor Q6 flows into the opto-coupler IC5. The phototransistor of this isolating device (pin5-FB2) is now regulating the DC voltage at pin 3 of IC100 via connector J6 (pin 1) to stabilize the +HTHD voltage for one typical line frequency and amplitude setting. The transistor Q7 is a 5mA current generator and D10 a **green** LED to give visual confirmation that the +HTHD voltage is present.

Overvoltage Protection

Pin 2 of the IC4 is set at 5.6 volts with Z10 and, the other input, pin 3 is the scan voltage which is derived from the voltage divider network of R38, R50, R39 and R51. As soon this input exceeds the zener voltage, the output switches high and saturates transistor Q9. The saturated transistor Q9 pulls pin 2 of IC5 to ground level. The transistor of IC5 has its max current conduction when pin 5 is pulled to ground level via R44. This ground level, applied to IC100, drops the +HTHD voltage to a low level. The original overvoltage protection is now is causing an under-voltage protection.

Under-Voltage Protection

The stabilized zener voltage with Z8 is used as reference voltage for the comparator IC4, pin 6. The other input at pin 5 is the +HTHD voltage. If pin 5 drops below the reference voltage, the output switches low, and the transistor Q8 saturates, pulling pin 2 of IC5 low.

Protection Against Too Low +17 Volts

If, for some reason, the +17 volts (and all the other voltages as well) are, even temporarily, too low, it is then advised to shut down the +HTHD voltage (coming from the other SMPS). The pin 6 of IC3 is pre-adjusted at the factory to 14 volts with P1 (refer to the adjustment procedure). This happens when the comparator in IC3 detects a problem and its output at pin 7 causes Q8 to go into saturation.

Standby / ON-OFF Switching

An oscillator is built up around Q1/Q2 and the transformer T1. Q1 gets its base current via R3. The collector current of the latter flows in the winding P1/P3 and induces a voltage in the winding P5/P4. The current is supplied to the base of Q1 to drive it into the on state. As soon the emitter voltage of Q1 can drive the Q2 and saturate it, this transistor clamps the base of Q1 at ground level and cuts off Q1. Immediately the cycle starts all over again.

Two opposite polarity SB voltages (+/- 9 volts) are available at the secondary side.

CIRCUIT DESCRIPTIONS

a) Standby Mode (OFF)

The voltage at contact 4 of the J4 connector ('OFF') is in this case 'high' and this means for the opto-coupler IC1 that the phototransistor is not conducting. The transistor Q3 is thus saturated as R6 can provide the required base-emitter current. The collector 'ON/OFF primary' of Q3 is 'low'. Furthermore, via connector J1 (pin 2), the pin 5 of IC102 is below its "active level" via the diode D105, disabling the drive output. As a conclusion, only the +/-9SB standby voltages are available.

b) Operational Mode (ON)

The I/O block of the controller board (collector of a transistor) pulls now contact 4 of J4 at a low level 'ON' to light the LED in the opto-coupler IC1. Now, the phototransistor of IC1 is saturated and brings the base of Q3 at nearly ground level. This puts this transistor into an OFF state this allows the voltage to be applied to Z100. The zener Z100 on the motherboard can now provide +11 volts at the gate of the thyristor TH1 allowing C102 to charge.

DC Fan Control

The speed of the fans is regulated by means of a sensor resistor, NTC1, mounted close to the heatsink of the SMPS board. IC2 is an integrated circuit used in regulating the speed of the fans by adapting the duty cycle of the output drive for the power transistor Q4. L1 and C7 provide filtering for the output voltage. The feedback is applied to pin 5, which is protected against arcing with D4/D5. IC2 is a switching regulator. An oscillator trimmed with C6 is applied together with a dc voltage to an RS-flip-flop via an AND gate. That DC voltage now is the result of a comparator output receiving an internal reference voltage of 1.25 volts and the feedback voltage at pin 5 (comp). Consequently, the duty cycle depends on the DC voltage that is built up as follows :

- it is determined by the output voltage via R13 / R14 / R11 in order to stabilize the latter for a well-determined value of the NTC1 resistor.
- it is equally influenced by any change of the NTC1 resistor itself, sensing the heatsink of the SMPS board.

The minimum voltage is set by Z5 at approximately 7.5 volts and the maximum speed by Z4 + Z4 at 15 volts. The maximum current output is limited by R10, and a RC feedback straight from the output to pin 5 provides a more regular speed at any time.

Power Supply for the EHT Generator

The EHT generator is supplied directly from the rectified main voltage. The +300M volts is leaving the board at the contacts 31/32 of the J8A connector for the EHT board (see description of that board). By above measure, we eliminate the influence of the EHT load on the performance of the power supply, and the maximum peak current of the EHT generator is increased.

"G2 + DIAGNOSTIC" (809-10457)

SMPS for +/- CONV and + FOC Voltages

This power supply uses the same type voltage regulator (IC179) as the main SMPS. We will refer to the SMPS description of this regulator for more details. We will limit our discussion here to the differences in operation and the control loop to generate the correct amplitudes of the supply voltages.

Because of the high scanning range of the projector, from 15khz to 105khz, the needed amplitude for the convergence corrections is much higher for the higher frequencies (let's say around 100khz) than for the standard frequency. By permanently supplying a high power supply to the power end stages in the convergence, the dissipation in heat for the lower frequencies is quite high. A better solution is to 'track' the power supply with the line frequency. This means the power supply for the power convergence stages increases with the line frequency. The available information on the line frequency is the +HTHD voltage. This voltage increases in a linear way and is used for tracking. The voltage regulator (IC179) totally relies on the +17 MAINS delivered by the main SMPS and the +300V. If for some reason the + 17 MAINS is not available, the SMPS cannot start up. The +17 MAINS is stabilized to +15 volts with IC217 and supplies the pins 9 and 5. The transformer and rectifier circuit provides the +FOCUS, +/- CONV and the +CONV' for the feedback control loop discussed hereafter.

Control Loop / Feedback / Adaptation

The supply voltage of the convergence and focus power stages has to change when the horizontal frequency of the projector changes. A portion of the +HTHD voltage is applied to the base of Q208 to change the emitter voltage of Q203. The +CONV' voltage is biasing the base of the Q203 amplifier. The amplitude of the feedback is depending on the status of the output of the level detector IC216, pin 1. Pin 2 of the IC216 is set at 5.6 volt with Z197. Via an insulating opto-coupler, the collector current of Q203 is transferred to pin 3 of the voltage regulator IC179.

The +CONV' voltage is also applied to another detector in IC216, pin 5. The same reference voltage of 5.6 volts is found at pin 6. When an overvoltage situation occurs, the output at pin7 of IC216 pushes Q227 into saturation and shorts the collector of Q203 to ground level. The SMPS switches into a safe loop, whereas the output voltage is dramatically dropped.

Monitoring the +230V

A very stable Vref voltage is formed with Z2 / Z1 and buffered with an OPAMP. Z2 provides a 33 volts which is then divided with R14/R1 to exactly 10 volt and buffered to provide sufficient current. If the +230V were absent, the Vref would disappear and the monitoring circuit cannot work. The +9V takes over in such case and installs a reference voltage via Z1. This Vref of voltage is used for the level detectors monitoring the supply voltages of the video power stages.(+230V) The absence of one or both of these voltages can damage the picture tubes. Scan Fail is becomes active (Q1 is saturated) as soon one of the voltages drops below safe level.

CIRCUIT DESCRIPTIONS

G2 Voltages

The G2 voltages must be very stable to avoid thermal drift, and, they must be adjustable between 400V and 1020 volt. The voltage coming from the Quadrupler is already very stable since it is coming from a stabilized source, the EHT. The series output resistor in along with P2, P3, P4 and R17, R250, R251 form a voltage divider. If we stabilize the voltage at the M2 test point (listed as "Adjust for 1020V with P1") we have also a stable G2 voltage on the sliders. The test point for the1020 volts is sensed with the voltage divider formed by R15 / R13/ P1. Since the Vref is 10 volt, the output of the OPAMP will change until pin 13 is at the same voltage level of 10 volt.

Any voltage difference due to a change of the 1020 volt is adjusted by Q2, which will feed a current from the node to the (negative) output of the OPAMP. The Q2 is needed because the 1020 volt is a too high voltage for the OPAMP. A high voltage transistor such like the BU508A is therefore required.

LED's for Diagnosis

The presence of the various voltages is all displayed with green LED's. The variable voltages like the +HTHD and +CONV' drive an LED through a transistor to obtain a constant light output of the LED. The scan fail diode D16 is red and shows a problem in the horizontal or vertical deflection.

EHT MODULE (809-10458)

The EHT drive pulses for the EHT power supply are generated on this board. The primary circuit for the EHT power supply receives its 300VDC supply from the Main Power Input. In the event of a failure, either because the EHT is too high, too much current in the EHT circuit or a horizontal or vertical scan failure condition exists, the EHT voltage is shut down. We will discuss the generation of the EHT pulses, its regulation and the different protection circuits.

DC Controlled Multi-Vibrator

The EHT multi-vibrator is set up around two Schmidt Trigger NAND gates in IC2. The frequency of this oscillator is typically around 80 kHz. Two time constants are involved in this circuit : C7 / P3 + R11 and in the feedback loop C8 / R10 + transistor Q2.

The first time constant is preset and determines the OFF time of the power switch Q7. The OFF time is tuned to 10 µS using P3. The second time constant is variable, it is dependent on the current flow through Q2. By a change of the bias voltage on the base of transistor Q2, this time constant can be regulated. Q1 receives at its base the FBHV voltage (feedback voltage from the divider). This is the EHT voltage divided by a factor 1000 on the splitter. The emitter of Q1 is set at a reference of +33 volts by zener IC4. The duty cycle or the on/off time of the power switcher Q7 is consequently regulated by the voltage difference detected by Q1.

The squared waveform at pin 3 of the NAND gate is, via a fast switching and inverting FET Q3, sent to the opto-coupler IC1. This opto-coupler is necessary because the remainder of the circuit is supplied with the +17M' and the +300M which are not isolated from the Mains. The +17M voltage is obtained from a special winding on the SMPS and the +300M is the rectified main voltage (GNDM is mains or hot ground).

Caution: Any servicing on a board that uses both a Mains Ground and a Chassis ground should involve the use of an Isolation Transformer, especially when using an oscilloscope, or other equipment connected to the main AC source. Do not connect the Main and Chassis Ground together at any time.

As this board is supplied with the +300M as soon the Mains switch is pushed, it is not recommended to remove this board any more even when the projector is in a standby position. This can damage the contacts of the board.

The output of the opto-coupler IC1 drives a FET Q6, which in turn drives the push-pull stage Q4/Q5. The pulses are capacitively coupled with C11 to the gate of Q7. The 20 volts zener Z3 has two purposes. The negative level of the pulses are clamped at -0.6 volt, and in addition the gate-source voltage is limited to 20 volt DC, in order to protect the switcher Q7. The drain (DHV) of the power switcher is connected with the primary winding of the EHT transformer. Transformer and Quadrupler are in the same unit. The +300M enters the board and is passing a filter L1/C29 and a fuse before it supplies the Transformer / Quadrupler unit.

Protections

a) EHT Hold down:

The EHT of the projector must be switched off in the event of a failure in the regulating circuit or an absence of the feedback voltage. Moreover, when the current in one or more tubes is excessively high (leaking of a tube), the projector must be switched off via the EHT Hold Down rather than via the main switch. As the spot suppression does not work, the CRTs could be damaged when switched off via the main switch.

1. EHT Hold Down due to Fault in the Regulating Circuit (FBHV too high)

The slider voltage of P2 ("hold down adjust" potentiometer) is sent to the base of Q8 and its emitter is set at a threshold of 5.6 volt by Z4. As soon the EHT rises beyond 36.5kV, transistor Q8 starts conducting, turning on Q9. The Schmidt-trigger pins 8 - 9 of IC2 go high and the corresponding output pin 6 goes low. D6 pulls pin 6 of IC2 low in order to stop the EHT multi-vibrator, halting the EHT. The low at 12-13 means that the output of IC2 , pin 11, goes high (inverting) in order to forward bias LED D8 indicating the EHT HOLD DOWN condition. The feedback resistor R30 maintains the hold down condition (lock-down), until the projector is powered off to reset the circuit.

2. EHT Hold Down due to a Feedback Loop Fault Condition

The EHT hold down protection must also operate when there is an "open loop", or no EHT feedback voltage +FBHV from the splitter. If that were the condition, there would be no way to monitor the EHT, and it could go higher than the 36.5kV, since there is no FBHV voltage available. Another reason is that the maximum voltage on the MOSFET switcher is limited to 960V as well. The detection for "open loop" is built around the EHT "flyback" pulses taken from the drain of Q7. These pulses are rectified with D42 and the resulting pulsating DC is filtered by C30, divided down with R70/R35+R38 and applied to the base

of Q10. A threshold level of 4.7 volt is installed at the emitter with Z8. From 5.6 volt base voltage onwards Q10 starts conducting, turning fully on Q18. In the LED of the opto-coupler there is small current flow from the +300M through R9. When Q18 is forward biased, this current increases heavily and the output of pin 5 drops. Via the forward biased Z5, the emitter of Q8 is lowered and Q9 is turned on introducing the EHT HOLD DOWN .

Note that the same opto-coupler and transistor Q15 are used to remove the influence of the hum on the +300M supply via the feedback voltage. The +300M is, via a filter C24+R51/R9, supplying current to the opto-coupler (pin 1 of IC5). The voltage containing this mains hum is taken from the collector of Q15 and capacitively added to the FBHV input.

3. EHT Hold Down in the Event of an Excessive Amount of CRT Beam Currents

Finally, in the event of an excessive amount of CRT beam current, the negative HVL voltage can charge up C39 to the -0.6V threshold and Q9 conducts to introduce the EHT HOLD DOWN condition. The delay is determined by the time constant, which is established by R102 & C39 and the amplitude of the HVL voltage. Note that a beam current proportional voltage (BCL) is also sent to the RGB-Decoder drive board to reduce the contrast and brightness from some level onwards.

As a summary, the EHT Hold Down is active for :

- too high EHT, information coming from the feedback line FBHV
- too high EHT in "open loop" via Q10/Q18 and the opto-coupler IC3.
- too high beam current lasting for some time (short in a CRT).

b) Switching off the EHT when a Horizontal or Vertical Scan Failure Occurs

In the event of a horizontal and/or vertical scan failure, the SF line is dropped to around zero volts. Q16 is turned off which allows Q6 on the subunit to turn on. D3 then becomes forward biased and pulls pin 6 of the multi-vibrator to ground level, stopping the EHT. When the scan fail line goes high again prior to switching off the projector, C45 has to charge up first. This prevents oscillations and further delays the action of the slow start circuit (Q11-Q13).

c) Over-Current Protection of the Q7 Switcher

The resistor R21 in the source measures the drain-source current of Q7. This voltage developed across the sensing resistor is applied to the base of Q14 via a divider R40/R15. The purpose of the circuit is to temporarily stop the EHT when the beam current goes beyond a maximum to avoid damage of the phosphor coating of the CRTs. However, the pin 4 output of the opto-coupler may only affect the EHT multi-vibrator 's duty cycle at the moment there is a positive drive pulse on the common bases of the push-pull stage. Therefore, when the drain voltage of Q6 is high, D5 is reverse biased and Q14 can work. When, however, the common bases are low, Q14 is inhibited as the current through R69 is flowing away through D5 and Q6 to ground.

Slow Start up of the EHT

When the projector is switched on, the EHT voltage must gradually be built up to prevent mechanical damage of the gun. The reference voltage grows slowly because of the delay circuit around Q11.
The main delay at start up is obtained by the circuit on the subunit. As soon the feedback voltage would like to rise beyond the reference voltage, Q6, gets forward biased, drives Q7 on and the latter drives Q10 into saturation. Thereby, D222 goes into conduction and the multi-vibrator is stopped. The feedback voltage drops and Q6 turns off. This phenomenon is repeated all the time at start up. Consequently, the EHT rises to its maximum in steps. When the unit is switched off, C40 is quickly discharged via D9, taking the EHT reference voltage for the zener IC4 quickly down, and therefore the EHT itself goes down. The discharging of C40 turns Q11 on quickly because its base is pulled in a negative direction.

Delay of the Power Switch Drive

FET Q30 is used to keep a drive pulse from driving Q7, until the EHT pulse on the Drain of Q7 has fully dropped to its minimum. The EHT pulse is coupled to the gate of Q30 and keeps the drain of Q6 at a low level as long it is saturated. This prevents driving the power switch Q7 befor the drain has dropped to a minimum.

HORIZONTAL DEFLECTION (809-10448)

Preparation of the Drive Pulses

The horizontal deflection circuit uses two MOSFETS in series in order to be capable of handling more than 1000 volt pulses. Therefore, two drive pulses on different ground reference levels are required.
The "bottom" MOSFETS are driven by a pulse train referenced to ground or chassis ground, the "top" MOSFETS by drive pulses referenced to the midpoint of the two series connected MOSFETs, the **HDM** point.
The power supply for generating the "top drive pulses" is taken from the +17 volt via diode D38 to block the pulses, as HDM, the reference ground for the top drive pulses, carries line pulses. The horizontal drive pulses, prepared on the *"UNSYNC+VERT DEFL"* board, are sent to the amplifier Q13. By using a transformer T2, a "floating" drive pulse referred to HDM for the top mosfets can easily be obtained. When the flyback pulse is present during retrace, D38 becomes reversed biased and act like an open circuit to the 17VDC line. At that time, the drive circuit receives its voltage supply from the charge stored in C48. The "high" drive pulses reach the gate-source of the top Mosfets, and the "low" drive pulses drive the bottom Mosfet switches.

Modulation of the Scan Voltage East-West Correction

The +HTHD voltage from the SMPS board is modulated in Q3 by the East-West correction signal prepared on the "Sync + Vert Defl" board. Z2 protects the transistor and SR2 limits the charging current of this coupling capacitor through the zener. Transistor Q2 is used to discharge the boosting capacitor C31 at the start of a vertical scan. A vertical flyback pulse, derived from VDH B (Vertical Deflection High Blue) is sent to the gate. This minimizes keystone problems at the top due to a remaining charge on C31 after the vertical retrace. It causes the charge on C31 to always start from the same amplitude after each vertical retrace, regardless of the voltage that was built up at the end of the vertical scan.

CIRCUIT DESCRIPTIONS

Horizontal Linearity Tracking Control

The problem we meet with such a big frequency range, is the frequency dependent characteristic of the linearity coil. At a higher scanning frequency, the impedance of the linearity coil would increase. To overcome this, a second coil T1 is magnetically coupled to the standard linearity coil. The mosfet Q1 delivers the current in this modulating coil. The needed current for tracking is supplied via the biasing circuit of the gate of Q1 (LIN HIGH) as follows. The drive pulses trigger a one-shot in IC1 at the positive going transient input.

The output pulses are then applied to the gate of a Mosfet Q8 and from the drain split into two circuits :

- the simple integrator R20 / C3, the obtained voltage across the capacitor is consequently a voltage proportional with the line frequency labeled *"LIN REF"*.
- the push-pull Q5 / Q6 and the top/top detector just to obtain a negative voltage to supply among others the OPAMP IC2.

The DC level of this LIN REF voltage is not correct to drive the Mosfet Q1 and a level shift is realized with the OPAMP 1-2-3 of IC2. This OPAMP receives at the inverting input a voltage that is proportional with the line frequency, the amplitude adjustment does not affect this LIN REF voltage. The other non-inverting input receives a voltage that is proportional with the scan voltage. This voltage is proportional with the line frequency and with the amplitude adjustment. The influence of the amplitude adjustment must be minimized and this done as follows. For one typical frequency, we obtain one typical LIN REF voltage. The HTHD voltage however depends also on the horizontal amplitude. Any change in the emitter voltage of Q4 is compensated via the feedback Q7 - base Q4.

Protection Circuits

a) Over-Current Protection

If the sum of the currents of the three scan coils exceeds a predetermined level, the drive is inhibited as follows :

The wire J2-J3 in series with the three scan-coils , acts as a low value resistor and is connected across the base-emitter of Q16. When a 0.6 volt or greater voltage is dropped across the wire, Q16 starts to conduct and triggers the monoflop Q10/Q14.As long Q10 is blocked, the drive transistor Q13 remains "on", inhibiting the drive. BY reapplying the drive pulse to the base of Q10 via D9 (a kind of feedback), a faster reaction on the over-current can be obtained.

b) Overvoltage Protection

The sum of flyback pulses on each of the series connected Mosfets are checked by a rectifier network consisting of diodes D30, D31 and D32 and common de-coupling capacitors. The pulses at the node of the two Mosfets (HDM) are rectified with D24 . This voltage must be half of the total flyback voltage in order to protect the mosfets against overvoltage. This is realized with the circuit SR8/C46/ D24/SR5/ R56/C32. The rectified voltage is dropped with R52 / P2 / R51 and sent to two level detectors. The threshold level is set by a zener at 6.2 volt with Z5. At the moment pin 6 of IC2 exceeds the threshold, the horizontal amplitude is reduced with Q11. This will avoid the action of the "Hold Down Deflection" protection circuit.

If for any reason, the 1950V level is reached the HOLD DOWN DEFLECTION circuit is activated.

1) The drive is inhibited through the DEFL OFF.
2) The input pin 6 remains "high" as transistor Q12 is blocked and D18 conducts via R28 to keep pin 6 of IC1 high. This requires that the set be powered off to reset this circuit.
3) The red LED D10 (HOLD DOWN DEFLECTION) is illuminated in order to show that "scan hold down" has occurred.
4) As the deflection is stopped, there is also a horizontal scan failure and the associated circuit will drop the EHT voltage and blank the three CRT's to prevent damage to the CRT phosphorus.

c) Too Low Drive Protection (+17V Monitoring)

It is imperative that the Mosfets are fully switched on, so that the internal resistance will be as low as possible. Due to the large deflection current, even a small amount of excess resistance, will cause the Mosfets to generate too much heat. This Mosfet drive pulse amplitude depends in part on the **+17 volt** supply and the voltage supplied from the +17VDC line . The drive signals are developed from the 17VDC and to prevent damage, due to insufficient drive, if this voltage becomes too low, IC1 pin 3 goes low and inhibits the drive signal via the 'DEFL OFF'. The DEFL OFF is connected with the reset of the monoflop in IC1. The function of the latter will be explained hereafter.

d) Input Protection

The H DR from the UN SYNC + VERT DEFL has as task to start and stop the conduction of the Mosfets. If however the Mosfets are in conduction and there is a "stop" that does not arrive, there is a risk of damaging the power switchers. In such case, a stop pulse will be automatically generated by the monoflop in IC1, output 7. This output remains low as low the input is re-triggered at pin 5. When such a trigger pulse is absent, the output switches high after a time determined by the time constant R25 / C5 + current delivered by Q9. This current is tracked with the line frequency by using the scan voltage as emitter supply.

e) Horizontal Scan Failure

Horizontal pulses are fed into the transistors Q17, Q21 and Q19. As long as there are horizontal pulses on the base of these transistors, they are conducting for each horizontal period and C33, C44 and C37 hold the collectors "low". The smoothed collector voltages keep the gating diodes D28, D29 and D26 blocked. If either one of the pulses or all pulses are missing, Q15 transistor gets in conduction and turns its collector at low level. The SF line will be pulled low and the scan fail condition will be met.

Feedback to the SMPS (to Stabilize the Horizontal Width)

The scan voltage +HTHD has to track the line frequency in order to regulate the horizontal width of the picture. The amplitude of the flyback pulses at the connection of the top and bottom Mosfets (=HDM) is a direct result of the horizontal width and can be taken as a reference. These pulses are coupled and isolated by transformer T3, rectified by D34 and the **FBHD** voltage is sent to the SMPS, to regulate the HTHD. This voltage is proportional to the width of the raster on the CRT faceplate.

CIRCUIT DESCRIPTIONS

Picture Tube Burn-In Protection

When the module with the horizontal width coils is not connected, the deflection circuit is limited to the Horizontal shift circuitry, causing burning-in of the picture tubes (SF can not be detected).
This situation is protected with the OPAMP IC6. The inverting input (pin 5) receives the LIN_REF voltage (a voltage proportional with the line frequency) and the non-inverting input the HDL_Ref voltage (+HTHD voltage modulated by the E-W correction signal). When the module is not connected, the HDL_REF voltage becomes higher than the LIN_REF and consequently the "scan hold down" circuit is activated, indicated by the illumination of the red LED D10.

Adjustment Procedure 'Vertical Defletion +Sync Module'

The following adjustments are provided on the **main module**:

a. Vertical HOLD P1.
b. Vertical SHIFT adjustment for RED - P621 and BLUE - P620 image
c. Vertical amplitude correction for RED - P626 and BLUE - P627 image

The following adjustments are provided on the **sub module**:

a. Vertical parabola symmetry P1
b. Vertical parabola amplitude P2

Adjustments On The Main Module

a. Vertical Hold P1 Alignment

- Short-circuit the anode of the diode D7 to ground.
- Adjust P1 for a slowly rolling up of the picture (ceiling mounted projector).
- Remove the short circuit from the anode of D7.

Note; To adjust the Vertical Hold, switch the projector on the connected source with the highest Vertical frequency.

b. Main Vertical SHIFT Adjustment for RED and BLUE Image

Note: The alignments are factory set coarse alignments of vertical shift, to compensate for the shift caused by the stigmators on the CRT necks. These potentiometers also are used to minimize the range of the digital potentiometers for the vertical shift, allowing for a more accurate center convergence.

Preparation

Adjust the vertical raster centering controls for Red and Blue to the midpoint position. The numeric indicator under the respective bar scale indicates 50.

Alignment

Use the vertical shift controls P621 for RED and P620 for BLUE to shift vertically the Red and Blue image until the horizontal centerline coincides with this of the Green image.

c. Vertical Amplitude Correction for RED and BLUE Image

Adjust potentiometer P626 for the Red image and P627 for the Blue image to obtain the same vertical amplitude as the Green image.

Adjustments on the Sub Module

Vertical parabola symmetry P1 and amplitude P2

Adjustment **Symmetry** of the vertical parabola **P1**

- Projector has to operate on a signal with standard frequency.
- Connect the oscilloscope to pin 10 of connector J4 on the sub module.
- Adjust P1 for a symmetrical curve of the parabola signal.

Adjustment **Amplitude** of the vertical parabola **P2**

- Projector has to operate on a signal with standard frequency.
- Connect the oscilloscope to pin 10 of connector J4 on the sub module.
- Adjust P2 for an amplitude of the parabola signal of 4.5 Vpp

SYNC + VERT DEFLECTION (809-10456)

I. Vertical Oscillator

The principle of the simulator oscillator is to determine the appropriated charging current of the real oscillator, proportional to the vertical frequency, by generating a stable simulated vertical sawtooth.

We find two current sources Q38,and Q37 driven by the output of the Miller integrator output pin 7 of IC16. The minimum or initial charge current is determined by R168. The capacitor C13 is charged up and discharged when Q19 is driven on with the V Sync pulse. The sawtooth is buffered and integrated (= average) and the obtained voltage is compared with the level set by P1 (ADJUSTMENT VERTICAL HOLD). The charging current is adapted via R161 / D50 until both voltages at the input are identical. When the feedback is stable, the two current sources send current to two circuits :

- Sawtooth simulator as explained above for vertical autolock.
- Second sawtooth oscillator for the V_ST signal.

With P1 we can adjust the average output voltage of the integrator. The potentiometer must be adjusted in order to obtain vertical lock, the frequency is irrelevant. The sawtooth is buffered and feeds one potentiometer in IC2. The VO0 output is buffered with Q27/28 and AC coupled to the power amplifiers.
The linearity control is built around the differential amplifier IC8, which receives at the non-inverting input the V_PAR' signal and at the other the adjusted V_PAR'. The output, pin 14, is added to the V_ST signal in order to compress or decompress the ramp at the top or bottom. The linearity is controlled by a potentiometer in IC2.

CIRCUIT DESCRIPTIONS

Vertical Oscillator Synchronization

By Means of the Composite Sync

The composite video **(VID)**, composite sync **(CS)** or Horizontal Sync **(HS)** is, at any time, applied to pin 2 of IC14, a typical sync separator. The output pin 1 serves the digital PLL IC6 for all modes. If D606 is in conduction (depends on the DC level of the input signal) the video composite also passes on to Q2, for serving for IC1. In this case D601 is blocked and the output pin 1 of IC14 is not used.
IC1 is used as sync separator for composite video since its input is noise - integrating. In that case the transistor Q596 is saturated and D601 is blocked. If the sync input is HS or CS, then, IC14 is used as the sync separator since it has no integrator at the input. The composite sync output HS / CS, pin 1, is routed to IC1 via the buffer Q2 (Q596 is not saturated then).

The output pin 9 of IC1 provides the composite sync pulses which are now sent to the base of Q7 through the Vertical Sync separator circuit, built around the OP AMP IC9 with output pin 7. If we assume that the switcher Q6 is conducting (see later), the negative pulses on the collector of Q7 can trigger the vertical oscillator. The oscillator can also be triggered by means of the vertical pulses **V Sync**, which come straight from a BNC input (via the differential input, at the base of Q4. Note that an optional HDTV interface with tri-level sync may be connected to the J7 connector.

By means of the Vertical Sync Pulses , if Applied Separately

These vertical pulses enter the board at pin 13 of the connector J4A and are capacitor coupled to the base of Q4. The amplified negative pulses on the collector trigger the oscillator now via D10 / D7. To prevent triggering via Q7, the FET Q6 is now blocked in the following manor. Each time a VS pulse arrives on the base of Q4, capacitor C23 is charged via D9 / Q4. Consequently, the gate of Q6 is low and Q6 is blocked, to disconnect the emitter of Q7.

Barco IC : 4 x Digital Controlled Potentiometer

The voltage or waveform, applied between **VRPx** and **VRNx**, the two extremities of a potentiometer, is adjustable in 128 steps through the remote control (I2C bus). The output, or, the 'slider' voltage is available at **VOx**. The corresponding pins are **VRP1**, **VRN1** and **VO1**. We find 4 of such potentiometers **in one chip**, and there are three of these chips on the subunit : IC1, IC2 and IC3 , which we will discuss in the explanations hereafter. The output waveform or voltage is controlled by the **SCL** (Serial Clock) and **SDA** (Serial Data) lines, which are connected to the microprocessor of the controller board. The address info, arriving via the data SDA line, is identified by a hardware connection of the address pins of the chip (the address pins are connected differently for each chip). Obviously, as there are 4 potentiometers, the address of the chip is followed by a '*slave- address*' to drive the requested potentiometer in the chip itself.

Vertical Linearity Control

The V PAR (Vertical Parabola) signal at the emitter of Q2 is divided by R23 / R100 and applied to the potentiometer "1" of IC2 (pin 19). The adjusted parabola at output VO1 , pin 25, is now sent to the non-inverting input of IC8 whereas the full amplitude of the parabola is applied to the inverting input of the OPAMP (voltage difference amplifier). The output is then added to the V ST (Vertical Sawtooth) at pin 17 of the same IC2.

Generation of ABL Pulses

Two pulses are generated with the two monoflops in IC15. The first monoflop is triggered with V_ST and the second one with the inverted output pulse of the first one.

- ABL DEFL PULSE : this pulse causes an overshoot in the vertical deflection at the end of the vertical retrace time in order to make invisible the spot, as, during this time the blanking is disabled.
- ABL PULSE : this pulse determines the exact time of implementation of the black current and the measurement of this implemented current.

Vertical Output Stages - Vertical shift - Vertical Amplitude Vertical Amplitude - ABL Deflection Overshoot:

The vertical sawtooth V_Stat, the buffered output from pin 14, leaves the main board and passes over to the subunit to be applied to IC2 (VRN0 and VRP0). The output is VO0 (pin 24) and is coming back to the board at J4 (pin 4) of the edge connector. It is now buffered twice with Q27 and Q28. The switcher Q29 at the base of Q28 is driven with the ABL DEFL PULSE in order to cause an overshoot in the vertical deflection during the time the ABL circuit is active. It is now capacitively coupled to the inverting inputs of the power amplifiers IC11 / IC12 / IC13 together with a DC-voltage (Vertical Shift voltage). P626 and P627 can adjust the amplitudes for the red and blue, this will allow a matching with the green and minimize the need for convergence corrections.

Vertical Shifts

These DC voltages are adjusted in IC3 located on the subunit (outputs 25, 26, 27). The big tolerances on the deflection units and the astigmators require a coarse alignment of the shift for red and blue in order to improve the resolution of the digital potentiometers. This pre-alignment or coarse alignment is done by the multiturn potentiometers P620 and P621. The voltages applied to the extremities of these potentiometers are reversed when changing the vertical scan inversion switch (done when switching from ceiling to table or vice versa). A " **VS I** " info is therefore sent to the switching transistors Q611 / Q612. This "VS I " is either at ground level or not at ground (= 'open'). It is a signal coming from the contact of the vertical scan inversion switch on the frame. One of the two transistors is in conduction, depending on the voltage at Q611's base. When the green raster is moving on the screen, the red and blue rasters move also allowing a quick adjustment of the three colors.

Vertical Output Stages

The amplified sawtooth output currents flow in the respective scan coils and find their way back to ground through the feedback resistors R44 / R97 / R79. The amplitude of the waveforms across these resistors is proportional with the vertical amplitude and can obviously be utilized as feedback to stabilize the vertical amplitude. The TDA8172 has an internal boost up circuit, which allows a short vertical retrace time, by boosting the supply voltage during the retrace time. At the end of the scan time, the voltage across the capacitors C35, C55 and C52 is switched in series with the supply voltage of +8 volts by means of a transistor in the chip. As a result, the voltage during flyback is approximately 8 + (8+17) = **33 volts.** This boosting up means a possible **rapid change** of the current in the coils in order to realize a short flyback time.

CIRCUIT DESCRIPTIONS

Vertical Scan Failure Detection

The sawtooth waveforms across the feedback resistors of 2E2 are capacitively coupled to the base of a transistor. The conduction time of these transistors is proportional with the amplitude of the sawtooth. In normal scanning conditions, the average DC voltage on the three collectors is too low to forward bias Q14. As soon as any amplitude is too low or absent, Q14 is saturated and the SF line is dropped to ground level. On the other hand, the diode D16 and the saturated Q14 **cause a permanent conduction of the Q15** transistor (via D16). The **V BL** (Vertical Blanking) output is obviously permanently high and this means also a total blanking or **cutoff of the three CRT's.**

Vertical Blanking During Retrace

Vertical flyback pulses are picked up at pin 6 of the blue output stage and are applied through C63, D41 and R306 at the base of Q20. D41 prevents the BL pulses to penetrate into the vertical output stages. On the same base arrive the pulses **BL** for the top and bottom blanking. These pulses are adjusted on the subunit (see further top / bottom blanking). Q20 drives Q15 and the **V BL** pulses leave at A,C(26) of the J4B edge connector to the decoder, where they are mixed up with the horizontal blanking pulses. A differentiated vertical sawtooth is added to the base of Q15 in order to blank from the start of the flyback. Indeed, the flyback pulse from the output stage is slightly delayed.

II. EAST - WEST Correction Generation of a frequency independent vertical sawtooth

This generator is built up around Q4 / Q11 / Q10 / IC7. The vertical sawtooth **"V ST"** is buffered and then differentiated to get pulses driving on and off the switching FET Q10. When this FET is on, the output is shorted to the input. This input is approximately ground level since the other input of the OPAMP, pin 10, is connected to ground. The time that Q10 is not in conduction, C18 is charged up from the output voltage at pin 8 via D6 / R46 towards the negative voltage at pin 14 of IC7. The charging current depends obviously upon this negative voltage and the latter is the averaged sawtooth obtained by integration. By doing this, constant sawtooth amplitude of 1.9Vpp is seen at pin 8. The sawtooth starts from 0 volts due to the clamping transistor Q10.

Trapezoidal Distortion Correction (on the subunit)

The saw-toothed waveform at pin 8 of IC7, is applied to the inverting pin 2 of IC7 in order to obtain two opposite phase saw-toothed waveforms. These two signals are now entered into a digital potentiometer in IC1 (pins 16 / 17 or VRN0 and VRP0). The corresponding output is VO0 and via R45 the adjusted sawtooth (in amplitude and phase) reaches the adder- amplifier TL084, pin 5.

Parabolic or Pincushion Distortion Correction

To generate the parabolic waveform, a multiplier is used. IC336 is a wideband monolithic four-quadrant multiplier. The output is a linear product of the two input voltages. In this case the two input signals are the same (a sawtooth voltage). One of the sawtooths is applied between pins 4 and 8 , whereas the second (same sawtooth) one is applied between pins 9 and 12. But, since the pins 4 - 12 and 9 - 8 are connected together, the output is a nice parabolic shaped waveform (= product of two linear ramps). The open

collector outputs are pulled up to the + supply line and sent to an OPAMP in IC8. The parabolic signal is then capacitively coupled to an inverter - OPAMP . The two opposite phased signals are then sent to a digital potentiometer in IC1 for the pincushion correction. The output VO2 is now mixed up with the previously discussed sawtooth output and passing the line frequency depending amplifier described hereafter. The parabolic waveform is also amplified by Q3 and led out by the buffer Q2 to the focus board.

Frequency Depending Correction

The gain of the OP AMP in IC7 is variable and depends on the divider R31 / Q1. The FET Q1 is biased by the output of another OP AMP (integrator-comparator) in IC7 (pin 1). The DC level of the non-inverting input, pin 3, is set by R30 / R24. This DC voltage now is amplified by a factor determined by the ratio R31 / Q1. The east - west waveform obviously 'undergoes' the same gain. The output now (sum of DC and east-west waveforms) is sent to a 'comparator' in IC7. But the east - west waveform is filtered out by the R55 / C28 network. This resulting amplified dc voltage is compared to a portion (R28 / R22) of the HTHD' voltage which is applied to the non-inverting input. The output of the comparator is sent now to the gate of Q1 via a filter network. This filter network also depends on the state of Q306. The VSI line can switch on and off Q306 in order to add or disconnect R309 / C304. There is thus a correction depending upon the ceiling table position. **NOTE: The J6 contacts must be shorted for an off-axis projection. For IN - AXIS projection it is recommended to remove the strap to guarantee an optimum geometry.**

This gate voltage changes or adapts the gain of the named amplifier as long as the voltages at the comparator inputs are not the same. An increase of the line frequency means also an increase of the +HTHD' voltage, thus an increase of pin 5 voltage, so, a change of the Q1 / R31 ratio or of the gain. By this looped circuit we obtain an automatic tracking of the east-west correction with the line frequency without any alignment.

Power Amplifier

The sum of the corrections is now sent back to the motherboard to be amplified by IC10 before reaching the 'horizontal deflection' board to modulate the scan voltage HTHD for the horizontal deflection circuits.

III. Phase Control - Skew and Bow (Introduction)

The midline bow and skew dynamic corrections are added to the DC phase control of the picture. These corrections change in a dynamic manner the horizontal phase of the picture during the vertical scan. The position of the HS pulse at pin 4 of IC1 is determined by the position of the pulse sent to pin 2 (Flyback Pulse Simulation). The second PLL of IC1 adjusts then the horizontal drive output pin 4 " back in the time" in accordance with the position of the simulated pulse. The original pulse may now be delayed in the time to determine the start of the scanning with respect to the reference video (= phase control). This delay happens in two steps by means of two monoflops. The first one realizes the phase control itself. The second one the skew and bow corrections. The width of the final pulse **"H PULS"** is significant for the total delay and the falling edge of this pulse triggers a third monoflop IC5 on the main board which also sets the width of the real horizontal drive pulse. The same pulse H PULS' is also sent to the microprocessor board to lock the text and generate the pixel-clock.

CIRCUIT DESCRIPTIONS

Phase Control (IC12)

The HS pulse at pin 4 triggers the monoflop IC12 on the positive going edge. The absolute value of the phase control may be lower for the high scanning line frequencies than for the low scanning frequencies. This is automatically realized by a loop system: The pulse train at pin 5 's output is integrated with R78 / C43. The obtained DC voltage across C43 is proportional with the width of the pulses (= adjusted phase) and the line frequency. The required phase shift is applied to the base of Q7 via R84 coming from IC2. The voltage difference between the two collectors of Q7 is now the base-emitter voltage of Q6. This transistor is the current source for pin 7 (Rx / Cx) and automatically adapts the length of the output pulse to the line frequency. The current generator regulates the width of the output pulse as long as the voltages at the bases of Q7 are not the same (balanced).

Skew and Bow Corrections

The sawtooth (skew), adjusted at 50%, and parabolic (bow) waveforms are added with R44 and R42, and sent to an inverting OP AMP in IC8. The monoflop in IC12 is triggered on the positive going edge of the pulse of pin 12. The width of the output pulse is modulated by the waveform applied via D16. Here again, the range is tracked with the line frequency by applying the HTHD' voltage through R77 / R75. The output pulse of pin 4 is now inverted with Q8 and the **"H PULS"** is sent to the last monoflop (IC5) in the row located on the main board. Note: the convergence board performs Skew and Bow.

IV. Horizontal Oscillator - Horizontal Autolock

Horizontal Autolock

The sync separator IC14 serves Q1 with composite sync. The amplified sync is then split to the PLL (IC6) and transistor Q17 of the coincidence detector. The line oscillator in IC1 is locked to its exact frequency by a PLL in the chip. Unfortunately, the latter has a very limited lock range of approx. 1.2 kHz only and cannot lock the range from 15 to 92 kHz. An extra PLL is utilized, the **4046** (IC6), for the **coarse alignment**. The fine-tuning is performed by the PLL in IC1 itself. This PLL - IC consists of two-phase comparators, and a VCO. For this application the second phase comparator only is used, the VCO is not used either. The **'signal input'** (pin 14) is the line oscillator of IC1 (squared horizontal drive output of IC1) and the **'comparator input '** (pin 3) is the composite sync having been inverted by Q1. The corresponding output is pin 13, a three-state output, and, initially biased at 6 volts with R89 / R92. If the output is 'high impedant or open' (in the locked state) the voltage is **set at 6 volts** with R92/89. This voltage is buffered by a voltage follower in IC7 and then reaching pin 5 of another OPAMP, acting as a voltage comparator, in IC7. The other input, pin 6 of IC7 is set at approximately 7.7 volts with R94 / R90. Consequently, the **COIN NEG (pin 7) is low in the locked position.**

Line Oscillator Lower than the Horizontal Sync

If we assume that the local oscillator frequency is lower than the horizontal sync pulses, then , the voltage on C8 decreases (pull down state). This voltage is now buffered and sent to pin 5 of IC7. But, because of the zener Z3, this voltage cannot decrease and stays at approximately 6 volts. The other pin 6 is initially at 7.7 volts (divider R90/R94). This voltage now decreases because the transistor Q17 discharges the capacitor C97 as follows: The squared horizontal drive of pin 4 switches on and off Q18. When the frequency of the local line oscillator is different from the horizontal sync (as we assumed), some pulses arrive on the base

of Q17 at the moment Q18 is not saturated. These horizontal sync pulses turn on Q17 and C97 is discharged. The voltage at pin 6 drops and becomes lower than the other input ,pin 5. The output **COIN NEG (pin 7) switches 'high' in the unlocked state.** The gate of the mosfet Q9 is now positive and Q9 conducts to connect the output pin 8 of the PLL (IC7) to the inverting input pin 2 of the next 'proportional - integrating' OP AMP. The decreasing voltage output of the PLL is inverted by IC7 and transistor Q21 draws more current out of pin 14 of IC1 in order to increase the frequency of the line oscillator. As the line oscillator frequency is increasing, the PLL output increases also. This continues up to the moment there is coincidence between the horizontal drive and the horizontal. sync at the base of Q17. Once coincidence is reached, the voltage at pin 6 is again 7.7 volts and the state of the Mosfet Q9 changes again to a stable and blocked position. All this means, we have reached now the capture range of the PLL in IC1.

From now onwards the PLL in IC1 takes over as follows: As long there is no coincidence, Q33 is blocked and the PLL output pin 17 is disconnected from the VCO input pin 14. Q33 is closed the moment there is coincidence. The line frequency is fine tuned by the PLL output pin 17 of IC1 , as long this PLL output has not reached the 6 volts installed at pin 3 of IC7. Therefore, the pin 17 output is sent to the same pin 2 of the integrating OP AMP. In the locked state of the PLL of IC1 this output is indeed 6 volts. Any change in frequency is now compensated or corrected by the PLL of IC1, and consequently the 4046 is switched off. Above circuit does not require any alignment as it is completely self-aligning, and guarantees a correct locking to the center of the lock range of the PLL system in IC1.

Line Oscillator Higher than the Horizontal Sync

A similar explanation is valuable here, although, in this case the PLL's output is increasing now. The zener diode Z3 does not limit the voltage because the voltage across it is not 6 volts. Pin 5 'follows' the PLL output. As there is no coincidence as well, the other input of the comparator goes down resulting in a 'high' output for pin 7. Q9 is turned on and the PLL output can correct the line oscillator frequency.

V. Adjustable Top/Bottom Blanking

On the subunit, blanking pulses are generated for an adjustable blanking of the top and the bottom of the picture by the user. To achieve a high accuracy, the sawtooth is passed into a so-called **'dead band response amplifier'** built up around an OP AMP in IC8. The sawtooth is entered at pin 9 of IC8. The output is inverted and the ramp is steepened at the start and the end. Two clipping levels are installed by clamping circuits in order to obtain a complete feedback between these levels (= center of the screen). As soon the first clipping level is reached, the output is invariable. and obviously no change any more in the output is noticed. The transformed waveform is now sent to two level detectors in IC9. The voltage clipping levels of the other inputs of the comparators are regulated by the potentiometers in IC2 and IC3.

VI. Simulation of the Flyback Pulse for the PLL of IC1.

By means of the monoflops in IC4 a 'simulated' line (flyback) pulse is generated. The first monoflop introduces a small delay for the pulse and the second one determines the width. The introduced delay is used to 'mislead' the PLL and consequently to allow a 'negative' phase alignment. Indeed, this phase comparator (PLL) determines the phase of the squared output at pin 4. It normally has to compensate for the delays in the power switching of the deflection circuits. If we can mislead this PLL by giving a 'wrong' info, the horizontal output at pin 4 is anticipating the reference (video). This allows now a range for the phase going from a 'negative' phase shift to a positive one.

CIRCUIT DESCRIPTIONS

VII. Blanking - Coincidence

In the event of a non- coincidence, the transistor Q16 gets in complete saturation since the **COIN NEG** signal is at a high level. This results in :

- Led D20 comes on to show the non-coincidence situation.
- If the strap J5 is in position, the transistor Q15 is in saturation and causes a blanking of the three CRT's.

2ND RGB INPUT (809-10465)

Red, Green and Blue Inputs

Three identical differential amplifiers are switched to "active" with the ON voltage. This ON voltage is obtained from the +PORT 3 voltage arriving at contact 28 and the transistors Q50 and Q53. Note that the 75 Ohm termination is not switchable. The **Red** signal is taken from the collector of Q2 and fed to the current driver Q4. The collector resistor of the latter is on the RGB SW + Input board. G OUT and B OUT are produced in a similar way. The green signal is also sent to Q60 and used for synchronization if "Sync on Green" has been detected. The blue output at Q23 is also supplying Q15. When the Blue in Green switch S2 is in a closed position, Q16 is blocked and Q15 adds some amount of blue into the green channel via D25 . If however S2 is open Q16 is saturated and Q15 does not get enough base voltage and is consequently blocked. Note : The "Blue in Green" of the first analog input is switchable via the remote control, thus via software control. Here, the blue in green is switched with S2 and is not affected by the software.

Vertical Sync Input - Automatic Polarity

If separate vertical sync pulses are available and applied to Q41 / Q43 input, they arrive on the Q39 amplifier / inverter. The inverted pulses are now inverted or not inverted depending on the voltage level of pin 12. Assume the pulses at the drain are positive then, Q46 is regularly switched on by these pulses and the average voltage at the collector or at pin 12 is low. In this case the output at pin 11 follows the input at pin 13 , which means that the pulses are positive at pin 11.

If the pulses are of a negative polarity at the drain, Q39 never goes into conduction and the level at pin 12 is "high" through R127. The input pulses are inverted by the exclusive OR gate. The polarity of the pulses at pin 11 are therfore always positive reguardless of the input polarity. These pulses are proceeding to the base of Q47 via D54 and to the multiplexer / demultiplexer IC1, pin 11. The +RGBS voltage provides the necessary biasing for Q47. The IC1 is a triple two-channel multiplexer, having three separate digital control inputs. One of these control inputs is pin 11. If VS pulses are applied to the input, then the HS/CS output must be the HS input. The selection between HS or CS happens in the second multiplexer. On other words, as soon VS pulses are applied, the HS pulses must also be selected. The presence of the VS pulses determine the correct voltage at pin 9 in order to select the pin 3 input (Shaped Horizontal Sync).

Horizontal Sync/Composite Sync

The HS / CS signal, taken from the collector of Q32 , is passing a similar automatic polarity circuit as the VS pulses. When no pulses at all are applied to this circuit, the monoflop IC3 is never re-triggered and the output remains all the time "low". This output is filtered and is the control voltage of the multiplexer. The "0" output is then connected to pin 15 which is at ground level. This all means that Q58 is saturated and the

+RGsB voltage becomes available for further switching. The LED D50 comes on to indicate the RGsB mode. When the monoflop is constantly triggered with pulses the output is switched "high" and then the "1" output of the multiplexer is connected to the grounded input (pin 15). This now provides the +RGBS voltage instead. When no VS pulses are available, the "0" input pin 5 of the multiplexer is chosen. The "1/13 DUTY-CYCLE Control System " circuit cannot be used in this case due to the presence of the VS pulses in the composite sync.

1/13 Duty-Cycle Control System

When separate HS pulses are used for synchronization, the width of the pulses is all the time adjusted to 1/13th of the line period. Positive horizontal pulses are applied to the leading edge input pin 12. The output pulses are integrated by R177/C87 and applied to the non-inverting input pin 3 of the (Miller-integrating) OPAMP IC4. The other input is installed at a voltage set by R180/R178 (6 volts). This integrated voltage is proportional with the width of the pulses and inversely proportional with the line period. The output of the Miller-integrator (=OPAMP) determines the current flowing in Q63. This all means that the width of the sync pulse depends on the line period, and the feedback the systems provides a setting to 1/13th of the line period. These SHAPED HORIZONTAL SYNC pulses proceed now to the multiplexer and if VS is available, these pulses are selected and Q48 brings them to the output.

2ND RGB Input (809-10465)

Adjustment procedure

The following adjustments are provided on the **main module**:

Horizontal SHIFT adjustment for RED - P2 and BLUE - P1 image

Adjustments

Horizontal SHIFT adjustment for RED and BLUE image

Note: the mentioned adjustments are Horizontal shift 'course' adjustments for the Red and Blue picture tube.

Preparation

Adjust the Horizontal raster centering controls for Red and Blue to the center position by means of the Remote Control Unit. The numeric indicator under the respective bar scale indicates 50.

(Refer to the Owner's manual of the projector - Guided or Random adjustment mode).

Alignment

Use the Horizontal shift controls P2 for RED and P1 for BLUE to shift horizontally the Red and Blue image until the center coincides with the center of the Green image.

CIRCUIT DESCRIPTIONS

R-G-B DRIVER (809-10454)

The black level of the Red, Green and Blue signals have been clamped at zero volt and the amplitude adjusted to 0.7V on the Input board. The signal is now ready to undergone the Brightness and Contrast controls before reaching the video power amplifiers. The optional contrast modulation can also be added to the contrast voltages if implemented. Furthermore, as a color temperature adjustment is also possible, the gain and black levels are controllable per color and tracked is some way to maintain the color temperature over the full range. The red, green and blue colors are passing through identical circuits, but, as a gamma correction is implemented, the red and blue channels are a bit different from the green (master) channel. We'll discuss first the green channel and limit the discussion of the red and blue to the differences with the green.

Green Video Channel

Contrast / Green Gain / Contrast Modulation

The video signal is terminated at 50 Ohm with R300 (coax cable is 50 Ohm), clamped at 0V and has an amplitude of 0.7V on the input board. IC301 is an analog multiplier and its output $W = (X1-X2) \times (Y1-Y2) + Z$. The video signal at pin Y1 is thus multiplied with the voltage at pin X1, since X2 and Y2 are both at zero level. The Z input is connected to ground level, consequently, the black level at the output is also 0V. The *GAIN_GREEN* voltage changes from 0.05V —> 1.2V. This voltage is the result of the general contrast, the individual gain adjustment of the green channel and the contrast modulation board. IC304 (HF A100) amplifies this signal 5.7 times.

Brightness / Black Level Offset Controls

The positive bias voltage obtained by R319/R317 installs a negative black level output in order to use the full output swing if this amplifier. This black level is then again pulled up with R324 and the current generator Q300. C317 means a bypass for the video frequencies. Via Q301 and R329 the green video is applied to the base of Q302. The latter is, together with Q303/Q304, a non-inverting amplifier with a low impedance drive output. This is necessary to match the 75 Ohm cable impedance to the connection with the video output amplifier. The required biasing current is obtained with R337, which determines together with R340 the gain of this amplifier. The output signal *G_OUT* and the current from the *DC_GREEN* voltage (= black level offset voltage) is compared with the reference of +2V in IC305(2,3,6) during the *CP* pulse time window. If, for example, the output voltage is too high, the output of the comparator increases and the current generator Q300 draws less current through R324. The voltage drop across this resistor decreases and compensates the too high DC output level.

Peaking Adjustment

By adding an overshoot and undershoot to the video transitions, the picture looks sharper. If these over/ undershoots are adjustable in amplitude and width, we can adjust an overshoot matching the bandwidth and the scanning frequency of the signal. If for example the *PEAKING_1* line is high, there is a current flowing in R330/D303/R331 towards the emitter of Q302. The RLC circuit L33/C319/R331 is then in parallel across the emitter resistor. A critically damped sinus peak is seen at the output. *PEAKING_1* gives the smallest peak and must be selected for the highest scanning frequencies. Three selections are possible related to the scanning frequencies : low / mid and high range. If no peaking is wanted, R336 means a

compensation, in order not to change the gain of this stage.

Spot Killer

During operation, the gate of Q301 is at +12V and the latter is fully conducting (5 Ohm resistance). At switching off the projector, the *SPOT_KILL* line is dropped very quickly to 0V and Q301 is immediately blocked. This avoids any undesired voltage peaks that could cause a spot on the CRT.

Red Video Channel

The in- and output circuits are identical to the green channel. In between the contrast adjustment and the x 5.7 amplifier, a gamma correction network is incorporated. This gamma correction is based on the red CRT characteristic, which is different from the green one. The relation light output / drive voltage for the red CRT is more linear for the red CRT phosphor than for the green phosphor. With IC202/IC203 a nonlinear correction in the mid-gray zones is now possible. The (original) video signal is applied to the X1 (pin 8) input of the multiplier IC203 Pin 7 (X2) is fixed at 0.7V with R212/R214. The same video signal is, on the other hand, sent through a step attenuator. By switching on one of the switchers of IC202 the video signal is divided with R204, R206, R208, R210 and the common R213. With the *MIDLIGHTS_1, 2, 3, 4* lines one can select between 15 possible steps. The attenuated signal is then applied to the Y2 input whereas the Y1 is at 0V. The output W, pin 5, is (X1-X2) x (Y1-Y2). Assume the input is a linear ramp from 0 -100% or from 0 - 0.7V. The output of the multiplier is then a positive parabola with a maximum at 50% of the amp and zero at 0 and 100% of the ramp, the amplitude of this parabola is determined by the step attenuator. This parabola is sent to the inverting input of IC204 via R217 and subtracted from the original ramp. As a result, we obtain a new nonlinear ramp where the 50% zone has decreased amplitude and the 0 and 100% zones are not affected. With this step attenuator, the light output / drive voltage of the red CRT tube can be adjusted to match the green one.

Blue Video Channel

Gamma Correction

The light output / drive voltage of the blue CRT is less linear than the green one. We can obtain a matching when the polarity of the parabola is inverted compared to the red one. This is got by swapping the Y1 and Y2 inputs of the multiplier IC403. If we assume we have linear ramp input, the parabola of the output W of IC403 is negative. The final result at output pin 6 of IC404 is a nonlinear ramp with increased amplitude in the gray zones.

Blue Correction Circuit

The blue phosphor saturates from some drive voltage onwards. This saturation point depends on the CRT phosphor, the spot size, frequency of scanning, temperature, etc... To resolve this problem, the blue signal undergoes an increased gain from some level onwards (the breakpoint level) . This level can be adjusted by software and is the *BLUE_BRKPNT* voltage. As soon the emitter voltage of Q402 exceeds the *BLUE_BRKPNT* level with 0.3V diode voltage drop), the diode D412 gets forward biased and R456 is added to the emitter load. The slope of the correction is further adjusted by means of the *BLUE_CORR 1,2,3* voltages. This will add to the emitter load one of the feedback resistor(s) R454, R455, R456 or a combination of these.

CIRCUIT DESCRIPTIONS

DC Stabilization, Additional Clamping

Without further measures, the DC level of the emitter voltage would not be very stable. It is very much temperature dependent and it varies with the bias current through the stage. An additional clamping is required. This clamper compares the output voltage with the emitter voltage during the *CP* timing window. The output voltage drives Q407 which is part of the biasing resistor (drain connected to -12V). Q408 provides a lower impedance for the source of Q407, as the current flow through R437 and Q407 depends also on the video signal.

Blanking

The composite blanking pulses are the result of the sum of different individual blanking information added together in the NAND IC104 after modeling to the correct TTL amplitude. If there is no blanking necessary, the output pin 8 of the NAND is low level and this forward biases Q107 and Q109. The current flowing through the latter installs around +11V at the *BL* output. In case of blanking, the TTL high level output of IC104 forward biases Q108 now and through Q110 the BL output is at around -16V.
D114 - D117 avoid saturation of the transistors and hence improve the switching. The following is the blanking information that is used as an input to the NAND gate IC104:

- *LP* (line pulses): are dropped in amplitude with R116/R117/R140 limited with D102/D103, inverted by IC103 (5,6) and input to pin 1. Note: The same negative line pulses are inverted again with IC103(1,2) and then referred to as *HFB* to be used in the optional Contrast modulation board.
- *VBL* (Vertical Blanking): these pulses are also dropped to TTL level, inverted and applied to pin 2.
- *SPOT_KILL* (pin 5): The line SPOT_KILL is +12V during operation and drops to zero level at switching off the projector to blank the picture.
- *SCAN FAIL* (pin 6): This line is high when there is no scan fail and drops to zero when scan fail has been detected. Note: The scan fail condition also drops the SPOT_KILL line to an active low level and hence switches off the video output stages of the UN DRIVE board.
- Supply voltage controls (pin 3,4): The +/- 12V and +/-5V supply voltages are checked with the window detector IC105. If one voltage fails or is not within the desired window, the output switches low and the same pins 3, 4 are pulled low level. Note that this will mean a scan fail condition and the SPOT_KILL line will be active as well.
- *LEFT/RIGHT* blanking: The blanking pulses for the beginning of the scan (left blanking) are generated by IC108 (output 4) by triggering the monoflop on the positive transition of the *LP* pulses. The output pulse train of pin 13 is integrated with R138/C108 and compared with the *LEFT_BLANKING* voltage. The output of the Miller integrator drives the current source Q104, which determines the pulse width of the blanking pulses.

The pulses for the end of the scan are generated by the other monoflop in IC108. Here, the monoflop is triggered by the negative transition and the positive pulses at pin 5 output are used. Consequently, the low level of these pulses is the blanking time. It is obvious that, in this case, the negative pulses at pin 12 are integrated and the obtained voltage is used to adapt the pulse width in conjunction with the *RIGHT_BLANKING* voltage. The integration of the pulses (average voltage) means a tracking of the range with the line frequency. The absolute value of the required blanking is much smaller for the higher scanning than for the lower scanning signals. Another tracking is also got by a correction current via D122 and D124 by switching on Q111 with *HFB* pulses.

I²C Interfacing

IC100 : the *MIDLIGHTS_RED* and *_BLUE* switching on/off voltages.
IC101 : 3 outputs are the *PEAKING* adjustments.
If no peaking is needed, the three outputs are at approx. -11V and hence Q112 and Q113 are both conducting. The output *NO_PEAKING* is then at about +12V. As soon one output of a comparator switches to a positive high, due to the resistive dividers R171/R172/R173, the emitter of Q112 jumps at -3.5V and the latter gets blocked. The *NO_PEAKING* line is then at about -5V and D123 is forward biased to keep the impedance of the *NO_PEAKING* line low and avoid distortions in the RGB DRIVE stages. IC100 uses the same address of IC601 on the INPUT board. The data line *SDA* of either one of these I²C interfaces can be disconnected via a switching Mosfet. To select this IC100, output port P7 of IC101 must be low level, blocking Q103 and via R113, Q102 is forward biased.

IC109 : two outputs are used for the Left/Right blanking and VO3 is the Blue breakpoint output. The DC range is corrected with IC102 (8, 9, and 10).

Spot Suppression

There are two actions at switching off the projector :

- via the **G1 grid**: The G1 grid voltage is at approximately 0V via D101. During normal operation and on condition the +17V is correct (sufficiently high) Q100 is saturated and Q101 is off as its base is lower than 0.6V. The collector of Q101 is then at 150V or the voltage drop across Z101. C100 is consequently charged up to 150V. At switching off, the +17V drops very quickly to zero and the +210V rather decays slowly. The moment Q100 shuts off and Q101 gets forward biased, the collector of the latter drops to zero and the - of the capacitor C100 drops also instantly with the same amplitude to -150V. The G1's are dropped to -150V and the CRT's are blanked.
- via the **cathodes** (drive voltage): The *SPOT_KILL* line is in normal operation at +12V via R106. When the projector is switched off, the line is dropped to 0V via D100. This zero level cuts the output via the mosfets Q201, Q301, Q401.

Contrast, Brightness and Gain Adjustments

Contrast / Gain

The general (common) contrast and the individual gain controls are first combined with the (optional) contrast modulation waveforms and the combined wavform used in a multiplier (a variable gain amplifier) to adjust the amplitudes. The contrast voltage is generated by IC3 *VO0* output, and ranges from +1V (minimum) to +3V (maximum). The multiplier requires just the opposite, hence, the contrast voltage is inverted by IC5 (8,9,10). R54 and D8 avoid this contrast voltage from exceeding the +3V as this would mean that the multiplier inverts the polarity of the video signal. This contrast voltage is now three times multiplied with the gain control of each color. This is released by using the contrast voltage as the *VRP3, VRP2* and *VRP1* supply for the potentiometers *1, 2* and *3* of the Bella IC3 and the other end of the potentiometers *(VRN*)* is connected to the +3V, or the minimum contrast. The outputs *VO1,2,3* are thus the result of the general contrast and the individual gain controls. The output range of the Bella's in not what is needed by the multipliers. Therefor the OPAMP's / inverters in IC4 adapt the range to 0.05V <—> 1.19V which is the needed range of the multipliers.

CIRCUIT DESCRIPTIONS

BCL / IBCL / Drive modes

The contrast voltage can be reduced by the *BCL* and *IBCL* information. The negative *BCL* voltage from the EHT board drives Q2 on from the -0.6V level onwards and this will turn on Q1. The *Int*ernal *CONTRAST* voltage or the *BCL_LINK* voltage cannot further increase in this case. The *IBCL* voltages are slightly smoothed and compared to an adjustable voltage *(IBCL_VALUE)* from the potentiometer *"0"* of IC2. This value depends on the Eco / Normal / Boost mode drive, set by software. As soon an *IBCL_** voltage reaches the *IBCL_VALUE* the corresponding comparator drops the contrast through one or more of the conducting diodes D4, D5, D6.

ABL Trigger Generator

The ABL circuits of the RGB video amplifier are triggered by a pulse of 20 µS long and an amplitude of 12V. This pulse is added to the *IBCL* lines as these lines are not carrying any valid information during this time. The *ABL* pulse is here ac coupled to the lines through C19, C20 and C21. As the ABL trigger pulse is generated on the *UNSYNC+ VERT DEFL* board and superposed on the *VBL* (has an amplitude from 17V - 34V), the *VBL* is dropped by 20V with Z3 and Q3 will conduct during this *VBL* pulse time. The differentiator C18/R70 drives Q4 into conduction for 20µS and via R73/C19, C20, C21 they are AC coupled into the IBCL lines.

Brightness / Black Level

The brightness control is about identical to the contrast. The general brightness is combined with the individual *BLACK_LEVEL_** and the resulting *OUTPUT_DC_** voltage is an offset of the reference black level of +2V. At 50% brightness setting, the black level of the output signal of the *RGB DRIVE* board must be clamped at +2V. This condition is translated into a 2V output for the potentiometers *VO1, VO2, VO3* of IC1 **and** IC2. Only then, there is no current flow in R7, R8, R9, R10, R11 and R12. The +2V *OUTPUT_DC* is now the same as the reference voltage of the inverters/summiteers (=comparators) IC205, IC305, IC405.

Circuit Implementation

As *VRN0* = +3V and *VRP0* = +1V the brightness voltage at *VO0* of IC1 changes from +3V (min. brightness) to +1V(max. brightness). This brightness voltage is applied again to the *VRP1,2,3* of three potentiometers in IC1. The other end *VRN1,2,3* of these potentiometers is the reference voltage **+2V**. These three potentiometers in IC1 obtain the same settings of the gain controls in IC3. If now the brightness voltage is +2V (50%) the outputs *VO1,2,3* of IC1 are ALWAYS at +2V, irrelevant the gain setting. Any change of the brightness and gain settings change the output voltage(s). With above **"gain scaled brightness voltages"** the black level is tracked with the gain adjustment in order not to deteriorate the color temperature with contrast. We can however add to these "gain scaled brightness voltages" an extra offset via R10, R11, R12 to adjust the low lights.

RGB OUTPUT (809-10450)

Adjustment procedure

- Supply an external signal to the projector (e.g. a color bar signal)
- Connect the first measuring probe to the video input signal, testpoint TP1 'VIDEO_IN'.
- Adjust the projector brightness control until the DC blacklevel of the video input signal reaches 2V.
- Adjust the contrast control until the video input signal information reaches an amplitude of 2.35V.

Adjustments

Adjustment of the +200V (Regulated Power Supply)

- Connect a voltmeter to the measurement Eye contact MP8.
- Adjust the potentiometer P3 for +200V on MP8.

Adjustment of the Signal Gain for each Output Amplifier

- Connect the oscilloscope probe to the measurement Eye contact MP9 'VIDEO OUT'
- Adjust the potentiometer P1 for an amplitude of the output signal of 100Vpp

Adjustment of the ABL_LED

IMPORTANT: No oscilloscope probe connected to the Eye contact of the respective picture tube.

- Adjust the potentiometer P30 until the LED D30 'ABL_LED' just stops lighting up.

FOCUS - SHIFT (809-10449)

Electromagnetic Focus Principle

In this form of focusing, a strong magnetic field produced by an electromagnet or a permanent magnet mounted behind the yoke on the neck of the CRT forces divergent electrons to take a helical (coil-like) path to reach the CRT faceplate. The helical path is usually only one turn long. With the proper magnetic field strength oppositely divergent electrons will move forward along coil-like paths that rotate in opposite directions and meet at the phosphor screen, thereby bringing the electrons together again to form a small spot.

At Line Frequency

A sawtooth generator is built around Q300 / 301. C302 charges up via the variable (line tracked) current generator Q300, and discharges via Q301 when a horizontal pulse is sent to its base. This pulse starts slightly before the end of the horizontal scan in order to obtain sufficient energy at the start of the horizontal scanning. The trigger pulse is generated in two steps by the two monoflops of IC401. By an integration of the pulse train at the output pin 13, an automatic tracking of the trigger moment with the line frequency is obtained. C302 then charges, and its rate of charge is determined by the condition of the current generator Q300. Q300 is supplied with the +FOCus voltage from the SMPS, which is in some way proportional to the line frequency. A vertical parabola is added to this charging current via C422. Because of this, a tracking of the amplitude sawtooth signal with the line and vertical frequencies is developed.

The sawtooth signal is now applied to :

- A multiplier IC301 in order to generate a symmetrical parabolic waveform, regardless of the line frequency.
- A level detector in IC307 pins 3, 2 and 1 to produce a left-right squarewave which is buffered by Q307 and feeds the switchers-clampers Q309 and Q310 with a correct DC level (note that Q307 is supplied with + / - 12 volts).
- The inverting input of another level detector of IC307, pin 6, to produce a left-right squarewave (DRIVER) opposite in phase to the one on pin 1 of IC307. This squarewave is used on the main board to boost up the supply voltage of the line power amplifiers during the second half of the horizontal scan (see further).

The parabolic signal from the multiplier, IC301 is buffered with Q302, clamped and buffered. The signal then goes to the non-inverting inputs of two voltage-followers in IC309.
Obviously, the clamper Q310 shorts to ground the parabolic waveform, during the first half of the horizontal scan, and Q309 shorts the signal during the second half of scan.

The buffered signals are now adjusted in amplitude with IC311, IC312 and IC313 for the three colours. The outputs are summed and sent to the power amplifiers on a suitable level.

At Vertical Frequency

The vertical sawtooth **"VDL"** is DC coupled to a buffer IC308 pin 3 and then applied to :

- The multiplier IC302 to generate a vertical parabola. The parabola is inverted with Q304, clamped, buffered, and feeds two buffers in IC309.
- A level detector IC308 input, pin 5, to produce a top-bottom squarewave. The output is buffered and feeds the clampers Q311 / Q312 with a correct DC level for grounding the input at either the top or bottom half of the raster.

The two remaining potentiometers of IC311, IC312, IC313 are used to adjust the top / bottom waveforms which are again summed and leave the subunit to be amplified by the power amplifiers on the main board.

Static or Average Focus (Center Focus)

Three voltages **R STATIC , G STATIC and B STATIC**, adjustable between + / - 1.5 volts with potentiometers in IC303 are added to the feedback of the vertical focus power amplifiers.

Power Amplifiers :

Corner - H

The left / right adjusted waveforms, summed on the subunit IC309 output, are now amplified to generate the required magnetic field for focusing of the beam during the horizontal scan. Because of the high scanning range, a good slew rate of these amplifiers is necessary. This is especially critical during the second part of the horizontal scan. This can be realized by boosting up the supply voltage during this time. This boosting up of the +FOC voltage is got with the circuit around Q190 - 193. The squarewave drives the push-pull stage

Q190 / Q191, which on its turn drives the MOSFETs Q192 - Q193 . The +FOC voltage is boosted up during the second part of the horizontal scan and is now referred to as **+V[DYN]**. Three identical amplifier stages with feedback to the inverting input of the OPAMPs in IC100, deliver the required current to the horizontal focus coils.

Corner - V / Static

Since the vertical scanning frequencies are much lower than the horizontal frequencies, a TDA2030 may be used. For stability reasons, a similar feedback voltage is applied on the inverting input, together with a DC-voltage (=static, for the centre).

Horizontal Shift

The + / - SHIFT voltages are not returned to chassis ground, but to the **HDL** (Horizontal Deflection Low, which is basically HTHD). Therefore, the adjusted shift voltages may not be referenced to chassis ground, but to the same HDL. The digital potentiometer IC (IC52) has to be supplied with the + / - SHIFT voltages from the SMPS. The I2C-bus lines **SDA** and **SCL** must drive the above-mentioned chip via an isolation circuit, using an opto-coupler. The opto-coupler IC50 is used to isolate the SDA and SCL lines, referenced to a cold (chassis) ground, from the shift circuits in IC52. The SCL pulses are sent to pin 1 of IC52 via an opto-coupler in IC50, whereas the SDA data line is connected with pin 2 through the other opto-coupler in IC50.

At the moment an "Acknowledgment" bit is returned to the Controller, another opto-coupler IC51 takes over. To avoid a return to IC52 via the first opto-coupler, MOSFETs are automatically switched on and off. The **HSI** (Horizontal Scan Identification) information from one of the horizontal scan switches on the "Scan Switching" module, allows an inversion of the supply voltages for the multiturn potentiometers P1 and P2. These potentiometers are the factory set coarse alignments of the shift, to be adjusted prior to the digital control. The SHIFT voltages control an average DC current through the horizontal yoke windings in order to horizontally shift the rasters.

CONVERGENCE DRIVER (809-10451)

The Surface Mounted Devices (SMD) technology applied in the driver module makes servicing of the module not easy and requires the correct tools. The description of the schematics will then also be limited to the essential functions.

Two trigger pulses are generated to trigger the sawtooth generator and the dynamic boosting up of the power supply of the end stages. The sawtooth waveforms are clamped to ground level during one part of the scanning (left/right or top/bottom) and adjusted in amplitude for a linear correction on the scan for red and blue colour (except when the "convergence on green " option is mounted). Multipliers produce parabolic waveforms which undergo the same kind of flow for the non linear corrections. A combination of the clamped signals, and a modulation on either a sawtooth or parabola is needed for the corner convergence. All the waveforms for one colour are summed with an OPAMP and amplified by a DC amplifier in the OUTPUT module.

CIRCUIT DESCRIPTIONS

Trigger Pulse Generation Pulse 1 and 2

The HDR_CONV is speeded up and inverted with Q603. The negative pulse at the collector triggers at its negative going transient the monoflops IC9 and IC19.

Pulse 1 : (trigger of the sawtooth generator).
The width of the positive output pulse at pin 13 of IC9 is adjusted with P1. The pulse train at the output pin 13 is integrated with R34/C620 and applied to one input (+) of the OPAMP IC15. It is obvious that the voltage across C620 is proportional with the width of the pulse and the line frequency. The output of this OPAMP determines the current of the current source Q9. This current adjusts the width of the pulse at the output pin 7 of IC19. The time constant of this one shot is designed to be a little less than the time period. That time constant needs to be tracked with the line frequency and this is realized as follows. The opposite polarity output pin 7 is integrated by R677 / C663 and applied to the inverting input of the same OPAMP. The pulse at pin 7 *(Pulse 1)* starts consequently just before the end of the scanning and is used to trigger the horizontal sawtooth generator.

Pulse 2 : (dynamic boosting up power supply).
The pulse output at pin 13 triggers on the positive going transient the second monoflop in IC9. The width of the output pulse at pin 5 is adjusted with P2. Through the buffer Q5 the pulse is available for boosting up the supply voltage of the power end stages. Note that this pulse 2 is also added via D38 to pulse 1.

Horizontal Axis Convergence :

Horizontal Sawtooth Generator

C602 is charged up by the current source Q2. In order to stabilize the amplitude, irrelevant the line frequency, the charging current is tracked with the line frequency as follows. The sawtooth is buffered and an average value of the amplitude is obtained by integration with IC3 / C7 . The resulting output voltage adjusts the charging current of the current source Q2. The amplitude is set by the voltage at the other input of the OPAMP, thus by R2 / R602. The sawtooth is inhibited by the clamper Q22 when the current consumption of the power end amplifiers is too big (see Power Output stages). OPAMP IC3 (5-6-7) amplifies the sawtooth in order to supply IC4, IC16 and the multiplier IC20.

Preparation of the Waveforms

The voltage comparator IC16 (5-6-7) transforms the sawtooth into a squared Horizontal 'Switch Pulse' of 24 V_{pp} (+/- 12V). This switch signal is used to clamp either the sawtooth or the parabola during the first or second half of the horizontal scanning. Note that the clipping level is variable with the voltage that drives the current source of the sawtooth generator. The multiplier IC20 (AD633) generates a horizontal parabola **HP+**. The next OPAMP shifts the DC level by clamping the middle of the parabola to a voltage adjusted by P5 (approx. 0 volts) in order to compensate the tolerances of the multiplier. The convergence at horizontal frequency with the ramp and parabola waveforms in the zones 11 - 14 are adjusted in IC1-IC2-IC601-IC602. The waveforms are each time clamped with a clamping transistor served by the horizontal switch pulse. Two opposite phased waveform are each time applied to the potentiometers in the Bella's (digital potentiometer or D/A convertors).

Vertical Axis Convergence

The vertical sawtooth generator is generated in a similar way as the horizontal sawtooth generator, discussed above. The much lower frequencies here allow the use of the MUXDMUX IC46 (4053) in stead of the clampers. The "Vertical Switch Pulse" is passed through the RS flip-flop IC39 which is clocked with the pulse 1 in order to make the transition coincide with the trigger or the start of the horizontal sawtooth. This avoids a jitter for interlaced signals.

North-South / East-West and Midline Corrections

For these corrections we need horizontal waveforms with an amplitude depending on the vertical position or vertical scanning. The horizontal waveforms must be modulated on a vertical sawtooth or parabola. This modulation is performed by IC29 (MLT04). The four different waveforms are all applied to the "X" and "Y" inputs and the modulated waveforms are the "W1 - W4" pins. The corrections , called *GEOMETRY* corrections, are added to the *CORNER* and *AXIS* corrections in the "*Summing Amplifiers*".

East - West Corrections :

Two kind of corrections (referred to as "skew" and "bow") are required to correct the projection angle and aberrations of the optical system. The HSVS (Horizontal Sawtooth modulated on a Vertical Sawtooth) and HSVP are used for this purpose. The HSVS is first amplified with an OPAMP in IC30 and then clamped with Q11 and Q10 which are 'served' with the "R" and "S" switching signals. The *LS+* and *LS-* (Left Skew) and *RS+ / RS-* (Right Skew) are fed to two digital potentiometers in IC13 and the adjusted outputs are sent simultaneously to the three convergence coils.

HSVP is first inverted and amplified and then clamped during the first or second half of the scan. The RB+/ - and LB+/- are applied to the digital potentiometers in the same IC13 and the outputs also feed the three convergence coils.

North - South Corrections

Two type of waveforms are modulated on a vertical sawtooth VS, Horizontal Sawtooth (HS) and Horizontal Parabola (HP).The HSVS from IC29 (sheet 3) is capacitively coupled to the MUX DMUX IC46 (sheet 2) and in stead of clamping, the signal it is switched with the " vertical switch pulse " for a split of top and bottom. The TK (Top Keystone) and BK (Bottom Keystone) signals are adjusted in IC14. Since there is a correction per colour the different outputs of the digital potentiometers are gathered per colour and will be added to the other corrections in the "summing amplifiers".

Midline Corrections

For the vertical and horizontal midline skew and bow corrections, the non-modulated waveforms HP- / + , HS+ / - are adjusted in amplitude with IC42 and simultaneously applied to the vertical and horizontal convergence coils of the three crt's.

CIRCUIT DESCRIPTIONS

Corner Convergence

The four corners are further divided (split) into 4 zones. The generation of the convergence signals for the corners is similar for these four corners. The only difference is the clamping or switching period. A split top / bottom is realized with a MUXDMUX switcher and a left / right split with fast switching clamping transistors. We limit the explanation to one corner and one zone **(Zone 1)**. Zone 1 is the cross section of the extreme left vertical axis and the extreme top horizontal axis. We need to start with a Horizontal Parabola (=extreme left vertical axis) modulated on Vertical Parabola (= extreme top horizontal axis). This signal is called *HPVP'* in sheet 5. The clamping transistor Q16 clamps this signal during the second half of the horizontal scan and then the signal is called *Z1+Z20*. This signal is now split into top / bottom (Z1 and Z20) by the MUXDMUX IC12 (see sheet 4). Z1 and Z20 are now prepared for the digital potentiometer IC35 by the buffer - OPAMP IC37 to get *Z1+* and *Z1-* (same signal with opposite polarity). These signals are then adjusted in IC35 and used for red and blue. The outputs are added in the summing amplifier to the rest of the corrections. (*Geometry* and *Axis*).

Summing Amplifiers

All the corrections for the horizontal convergence coils are added per colour and amplified with an MC34081. These OPAMP's are supplied with + / - 12V and since the non-inverting input is at ground level, the average output of these OPAMPs is around zero volts. This is required by the output power amplifiers for a balanced load of the (complementary) output stage.

CONVERGENCE OUTPUT (809-10452)

The purpose of the power amplifiers is to bring the adjusted signals to a sufficient high level that the convergence coils can be fully driven. Important hereby is that the drift must be kept as low as possible and that the signals must be carried to the coils without using coupling capacitors. It is obvious that the coils react differently on signals at a high (line) frequency than on low frequency signals. Much more power is required for the high scanning than for the low scanning range. The power supply + / - CONV for these power amplifiers is a variable line frequency tracked voltage delivered by the "G2 + Diagnostic" board.

Six identical amplifiers feed the six convergence coils, two for each picture tube. We 'll discuss only the amplifier served with *"RHin" (Red Horizontal).* Note that "Horizontal " here relates to the moving direction (of lines of a crosshatch pattern) and not to the "horizontal" frequency. The " RHin " signal contains waveforms at line and vertical frequency. That' s also the reason why the amplifier stages are identical. The signal RH IN is passed onto the power amplifier IC1, pin 6. These power amplifiers are fully integrated hybrid amplifiers supplied with +CON' and -CON'. Each time the output current flows in 150 Ohm damping resistor across the convergence coils and a series feedback resistor of 4.7 Ohm. The voltage developed across this resistor is sent back to the inverting input of the amplifier for stability reasons.

Note: That the jumpers J12 and J13 can be removed in order to isolate the power stages of the convergence and thus to investigate whether an excess of load on the supply voltages of the whole convergence board is caused by one of these amplifiers (or caused by another power amplifier of this convergence module). The current of the +CON' and -CON' is permanently monitored with Q50 and Q51. The current taken from the + CON' develops a voltage across SR1 that is applied to the base of Q50. The current taken from the - CON' does the same for Q51. As soon Q51 is switched on , the Ilim turns on Q22 (See

sheet 1 of Horizontal Axis CONV) and the sawtooth generator is inhibited.

DYNAMIC ASTIGMATISM (809-10463)

The waveforms for the dynamic astigmatism are parabolic and resemble the waveforms for the convergence corrections. It is then logic that the adjusted waveforms in the Bella's are delivered by, and coming from, the convergence driver board. These waveforms are carried to the module via the connectors J6 / J7 / J8. These connectors carry the split (clamped) parabolic waveforms at horizontal and vertical frequency and opposite polarity. Each correction consists of an orthogonal spot correction *(*X)* and a diagonal spot correction *(*Y)*. To facilitate the correction a separate centre or 'screen axis' and corner 'screen corners' is provided. In sheet 1 of the schematics you find the 12 Bella's for these corrections. As the waveforms have opposite polarity, the supply voltages for these Bella's is +3.2V and -1.8V taken from the convergence board. The " corner" and "axis" corrections are added per colour and then passed onto the power amplifiers. These power amplifiers are fully integrated hybrid amplifiers supplied with +/- DYN. The supply voltage for these amplifiers is **+30V** (+ DYN) and **- 17V** (- DYN). Each time the output current flows in 150 Ohm damping resistor across the stigmator coils and a series feedback resistor of 4.7 Ohm. The voltage developed across this resistor is sent back to the inverting input of the amplifier for stability reasons.

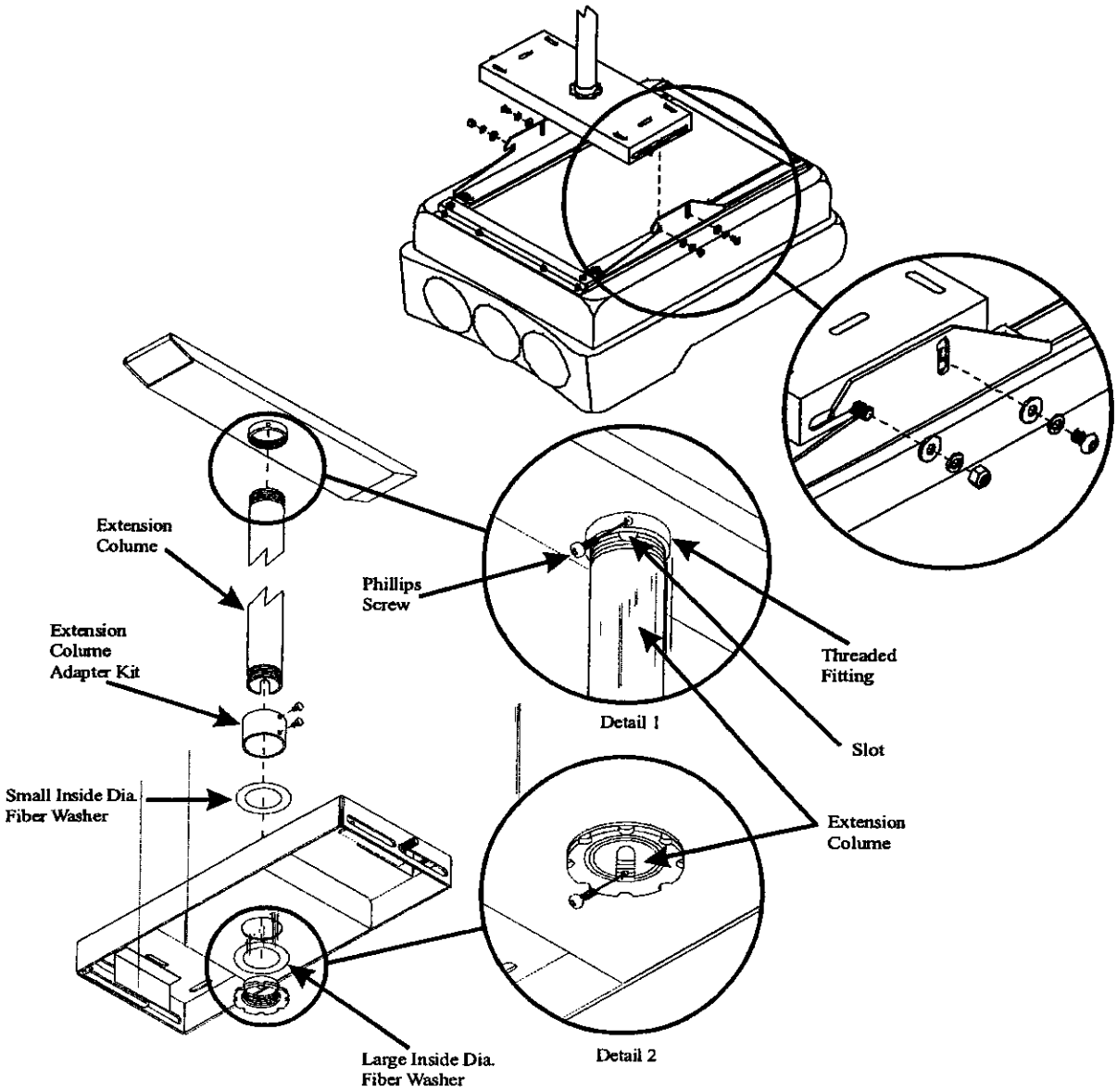
Note: That the jumpers J3 and J4 can be removed in order to isolate the power stages of the astigmatism and thus to investigate whether an excess of load on the supply voltages of the whole convergence board is

APPENDIX A

ZENITH Ceiling Mount Support

WARNING: Fine tune tilt and position of the projector. When adjustments are completed BE SURE TO TIGHTEN ALL FASTENERS SECURELY

CAUTION: Do not lift more weight than you can handle! Use additional man power or mechanical lifting equipment to safely lift and hang the Projector!



APPENDIX B: G2 ADJUSTMENT

G2 Adjustment

Once the on-screen menu "G2 ADJUSTMENT" is displayed, proceed as follows :

- Remove the top cover from the projector (see p.4-1) and open the front metal protection cover by turning out the 3 retaining screws on both sides.
- A green LED is mounted on each of CRT sockets (see Photo 2).
  When selecting the G2 adjustment menu, these green LEDs must be out. If not, follow the procedure below to adjust the G2 :

  - Open the second metal cover by turning out the retaining screws on both sides and pivot the cover to the front side of the projector (see Photo 1);
  - Adjust the G2 potentiometers (see Photo 3) very slowly with a plastic tweaker until the LED of the corresponding amplifier just stops illuminating. Repeat the adjustment for the other colors;
  - After the three G2 potentiometers have been correctly adjusted, close both metal covers and secure with the retaining screws.

After finishing the adjustments :

Press the <*ENTER*> key to continue with the *"SERVICE"* menu.

Press the <*EXIT*> key to return to the *"SERVICE"* menu.

Press the <*ADJUST*> key to return to Operational mode.

Fig. 66

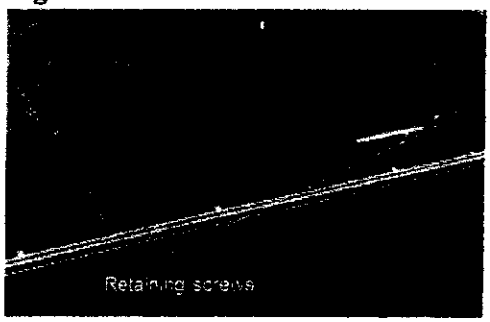


Fig. 67

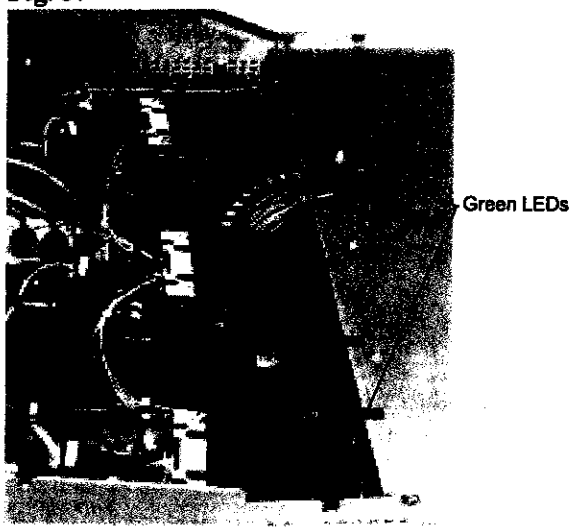


Fig. 68

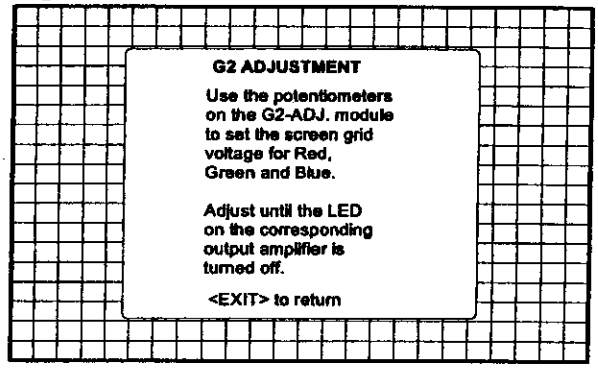
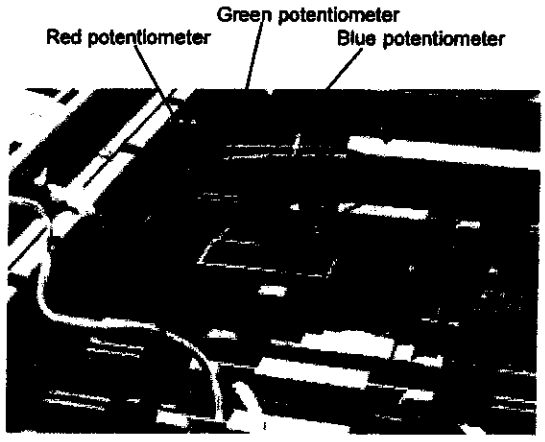


Fig. 69



GAMMA CORRECTIONS

GAMMA CORRECTIONS

When entering the gamma corrections, a warning will be displayed:

"RISK OF INCORRECT ADJUSTMENT OF THE PROJECTOR. THE GAMMA CORRECTIONS ARE FACTORY ADJUSTED USING AN ACTAS COLOR ANALYZER! THEREFORE, ONLY QUALIFIED INSTALLATION OR SERVICE PERSONNEL SHOULD PERFORM THESE ADJUSTMENTS!"

If you are qualified, press the <ENTER> key to continue.

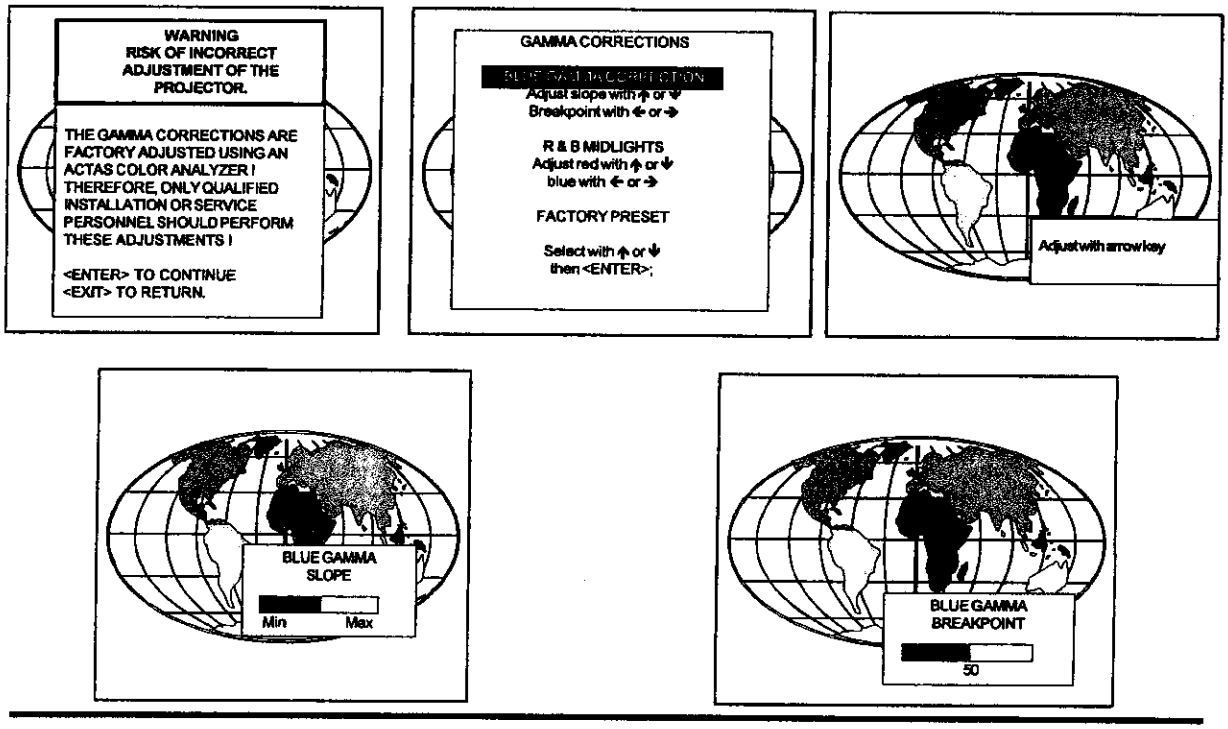
Gamma Corrections

Three items can be selected inside the "Gamma Corrections" me
midlights and the factory preset.

To carry out the Blue Gamma Correction :

- Push the control stick forward or backward to highlight the item BLUE GAMMA CORRECTION in the menu and then press the <ENTER> key. If the <EXIT> key is pressed, the projector will return to the Service menu.
- After the <ENTER> key is pressed, a text box with the message, "Adjust with arrow key", will be displayed on the screen.
- Push the control stick forward or backward to adjust the slope, a text box with a bar scale (Min to Max) will be displayed to visualize the magnitude of the correction.
- Push the control stick to the left or to the right to adjust the breakpoint, a text box with a numeric bar scale (0-99) will be displayed to visualize the magnitude of the correction.
- Press the <ENTER> key to return to the "Gamma Corrections" menu.

Fig. 70



GAMMA CORRECTIONS

To carry out the Red and Blue Midlights Correction :

- Push the control stick forward or backward to highlight the item R & B MIDLIGHTS in the menu and then press the <ENTER> key. If the <EXIT> key is pressed, the projector will return to the Service menu.
- After the <ENTER> key is pressed, a text box with the message "Adjust with arrow key", will be displayed on the screen.
- Push the control stick forward or backward to adjust the Red Midlights, a text box with a bar scale (0-16) will be displayed to visualize the magnitude of the correction.
- Push the control stick to the left or to the right to adjust the Blue Midlights, a text box with a bar scale (0-16) will be displayed to visualize the magnitude of the correction.
- Press the <ENTER> key to return to the "Gamma Corrections" menu.

To set the parameters back to the factory preset values :

- Push the control stick forward or backward to highlight the item FACTORY PRESET in the menu and then press the <ENTER> key.
- Press the <EXIT> key to return to the Service menu.