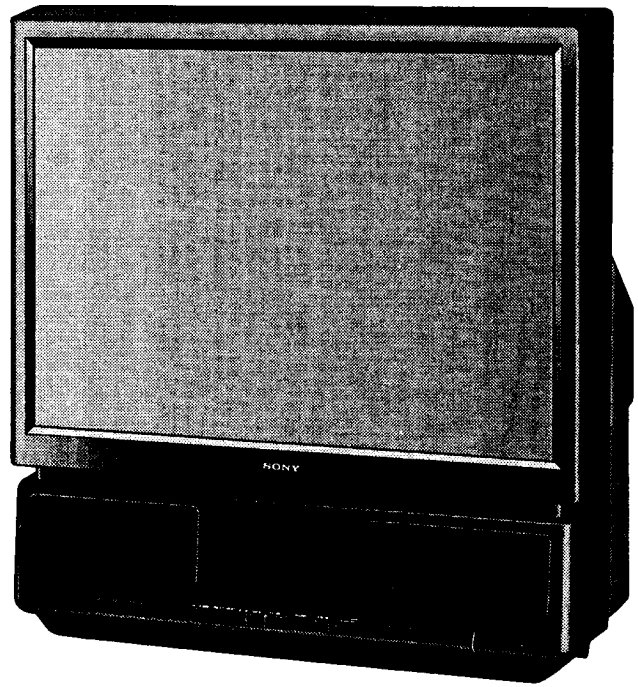
SONY®

Supplement Training Manual

Projection Television



Convergence

Course: TVP-07 Supplement

TVP-07 Supplement
CONVERGENCE:
KP-41T35, KP-46C36, KP-48S35, KP-53S35, KP-61S35, KP-48V45, KP-53V45 & KP-61V45

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A Division of Sony Electronics Inc.

Course presented by_____

Date_____

Student Name _____

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Overview

This course manual describes the alignment procedures necessary to converge projection TVs that use the Sony RA chassis. These TVs have wide deflection angles requiring projection lenses and deflection yokes that create non linearity and curvature distortion. Therefore, additional convergence controls are added to correct these distortions.

Projection TVs normally need convergence when either a CRT, a convergence board or the EEPROM is replaced or when the unit has been misaligned.

Layout

This alignment procedure is laid out systematically, in an order designed to show a technique that speeds repairs and gives you consistent results. Even if the TV does not require a complete alignment, this format should be followed. Steps that are not needed by a particular unit may be skipped.

It is designed to show you how the convergence adjustments inside a family effect each other and how the "balance the distortions" method can help to converge Sony projection televisions.

The manual begins with a problem diagnosis section that allows diagnosis of convergence related symptoms and describes the corrective action to take. The following sections are in this manual:

- Problem Diagnosis
- Formulating a Repair Procedure
- Required Equipment
- Screen Control Adjustments
- Deflection Yoke Alignment
- Focus
- Convergence

Problem Diagnosis

The following defect symptoms and causes are covered in this manual. They are divided into four symptom groups: 1) screen control alignment; 2) deflection yoke alignment; 3) focus alignment; 4) Full convergence board alignment.

Symptom: (Screen control problems)

- The picture does not come ON at all.
- The picture comes ON then goes OFF.
- The picture takes an unusually long time to appear after turn on.
- Retrace lines are visible on the screen.

These symptoms can be caused by circuit malfunctions or by misadjusted screen controls. Refer to the Screen Control Adjustment section for an explanation of the alignment procedure.

Symptom: (Focus problems)

- One or more of the colors are out of focus or the sides of the screen have a colored haze

  This symptom can be caused by an aging CRT or misaligned 2 or 4 pole magnets on the CRT necks. Refer to the CRT Focus section for an alignment description.

Symptom: (Global convergence problems)

- All colors have either size, linearity or geometric distortion.
- Geometric, size or linearity distortion on one or more colors that cannot be corrected due to the controls "maxing out"

  These symptoms can be caused by either replacing the board that contains the EEPROM without first transferring the EEPROM from the defective to the new board, by misaligning the convergence registers or replacing all three CRT's simultaneously and not aligning each CRT as it is replaced. Refer to the Convergence section of this manual for the alignment procedure.

Symptom: (One or two colors is misaligned. Although green should be used as a reference it may have a problem.)

- One or two colors are unconverged, with one color remaining aligned.

  This symptom can be caused by failing components or when a CRT is replaced. Refer to the Convergence Section.

Formulating a Repair Procedure

Before beginning repairs, the technician must formulate a repair procedure that will not complicate the alignment. Important items to consider are:

- An unconverged color should be aligned to match a converged color (to green - if possible). This requires that during repairs, at least one color should remain "as is".
- In the event all three CRT's need replacement, they should not be replaced together. Instead, a tube should be replaced, preferably green, and aligned to the other two CRT's; then the next CRT is replaced and aligned; and finally the last CRT.
- A Global register has an effect on all three colors. If a non global register "maxes" out before its respective function can be aligned, its Global counterpart (if available) should be adjusted to bring the "maxed" register back into range. When a global register value is changed, all three colors will have to be re-aligned to compensate for the shift. It is unlikely to need global adjustments unless the EEPROM has been replaced or the unit has been tampered with.

The exact alignment procedures to follow depend on type of repair that was done to the TV. The alignment "scenario" for the following repairs are described here:

One or two CRT's were replaced. This type of repair requires the following adjustments:

1. Screen
2. Yoke rotation
3. Focus
4. Touchup of the convergence for the replaced CRT's. Use the non replaced CRT(s) as a reference for correcting the replaced CRT's

The board containing the EEPROM was replaced. This repair does not require any alignment (unless other problems exist with the unit):

1. Replace the EEPROM IC on the new board with the original EEPROM. The picture quality should revert to its "before it broke" condition.
2. Use the NVM Jig to read the old data before the board is replaced. After the new board is replaced write the old data from the NVM Jig into the new board.

EEPROM was replaced with a new one or EEPROM registers were tampered with and misadjusted.

1. Set all registers to standard data values (see Service Manual)
2. Global VP Adjustments(See Service Manual)
3. Green Geometry
4. Converge Red and Blue to Green

All three CRT's were replaced without 'in between" alignment

1. Screen (all CRT's)
2. Focus (all CRT's)
3. Yoke rotation (all CRT's)
4. Green Geometry
5. Touch-up Red and Blue to Green

Required Equipment

The following items are needed to align the unit:

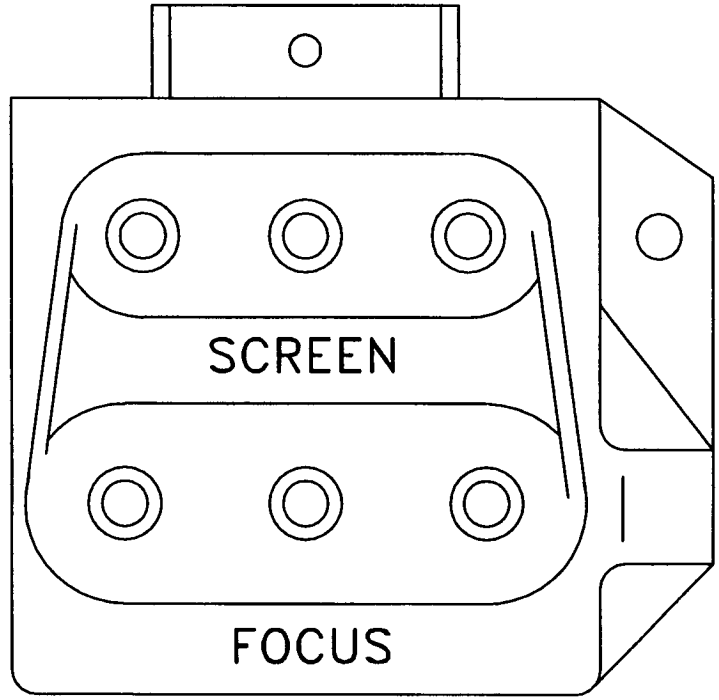
- Remote Commander
- Registration Control Jig (part number T-998-572-31). This allows you to make convergence adjustments faster and easier than with the Remote Commander.
- A video generator that produces crosshatch, center cross and dot patterns. It is very important that you know your generator. These generators are made by a variety of manufacturers and offer many different types of crosshatch patterns. The number of boxes as well as the shape of the box may be different. During this discussion the generator used is a Leader LCG-396. It uses square boxes and has 14.25 vertical boxes by 19 horizontal boxes.
- A ruler (36 inch flexible plastic ruler is ideal) can be used for "on screen measurements". It is helpful in checking for uniform box size and linearity throughout the entire picture.
- You will need a piece of plain white paper to check for optical focus from the back of the set.
- Something will also be needed to block light from two of the lenses. Sometimes this is necessary when adjustments are only needed for one or two colors. An old lens cover is perfect for this.
- Also a Sony 8mm test tape (WR5 5NSP) can be helpful. It simplifies size and linearity adjustments. The tape contains a circular monoscope pattern that assists the visual determination of size and linearity. The part number for the tape is 8-967-995-42. However it does require that a 8mm camera or playback deck be added to your equipment.

NOTES

Screen Control Adjustments

The screen controls are the first items to be adjusted. In this model screen levels are important and have limited tolerances: high screen levels will cause retrace lines to appear on the screen; low screen levels will blank the screen. The screen levels are adjusted differently than on other TVs. In this chassis, the Ik circuit (not shown) senses beam current. If the beam current falls below a fixed level, the Ik circuit will blank all three tubes, resulting in no picture. On the other hand, excessive beam current will cause retrace lines to appear in the picture The adjustment "headroom" between the low beam levels and the high beam levels are limited It is therefore important to adjust the screen controls properly This adjustment is simple and effective.

1) Prepare the unit as follows
   a) Remove the front panel assembly to gain access to the screen controls
   b) Warm up the CRT's by driving them with a white raster for 20 minutes.
   c) From the VIDEO menu, set the PROGRAM PALETTE to STANDARD mode
2) After warm up, place the unit in the Video 1 mode. Do not apply any signal to this input.
3) Slowly increase one of the screen controls until retrace lines appear, then decrease it until the screen is dark. Do not turn the control lower than necessary.
4) Repeat step 3 for the other two screen controls.



SCREEN/FOCUS/BLOCK

TVP7J39 614 9 2 97

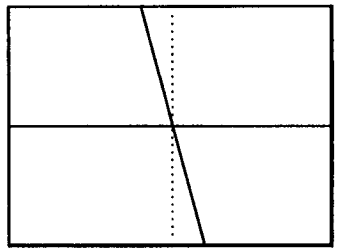
Deflection Yoke Alignment

This alignment is done whenever a yoke is moved. It positions the yoke so that SKEW controls will be able to compensate for any picture tilt that the yoke causes.

1. Confirm that the deflection yoke is all the way forward on the CRT neck. Loosen the yoke clamp screw slightly to allow the yoke to rotate.
2. Drive the TV with a center cross pattern. Rotate the yoke so that:

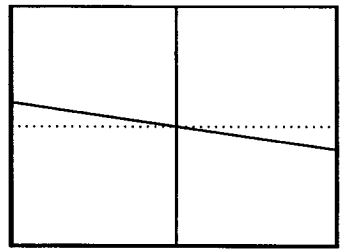
   the horizontal line is in parallel with the top and bottom of the screen and the vertical line is parallel with the sides of the screen.

   In most cases this cannot be done, as the horizontal and vertical lines cannot be made perfectly perpendicular with each other - one line or the other will be skewed (tilted). In such cases rotate the yoke to equalize the horizontal and vertical skew error. (See the picture on the facing page.) Secure the yoke with the clamp screw.
3. With the horizontal and vertical SKEW registers, "level" the horizontal and vertical lines (make them parallel to the screen edges). This can be done later when convergence alignment is done.
4. If proper alignment can't be done using the SKEW controls then do the following. With the Remote Commander, set the data in the horizontal and vertical "SKEW" registers of the subject yoke to zero. Re center the yoke as described in steps 1 - 3.



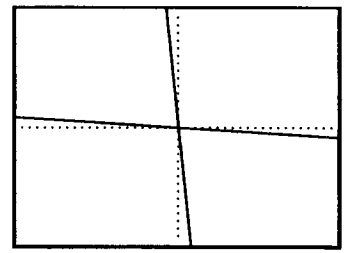
A

INCORRECT
(EXCESSIVE VERT. TILT)



B

INCORRECT
(EXCESSIVE HOR. TILT)



C

CORRECT
(DIFFFERENCE OF A & B)
YOKE ADJUSTED TO
EVENLY DISTRIBUTE THE
H &V TILT (SKEW) ERRORS

DEFLECTION YOKE ALIGNMENT

TVP7J36 610 8 28 97

Focus

To produce a sharp image, each CRT must be focused optically - with the lens, magnetically - with the neck rings and electrically - with the focus controls. Focus can go out of adjustment either as a result of CRT aging or component replacement. Optical focus is normally not necessary unless the CRT has aged considerably, the lens has been misaligned, or the CRT replaced. Use the following procedure:

Optical (lens) focus.

This consists of focusing the CRT projection lens to a sharp picture on the screen.

1. Input a dot pattern with the picture level set at 100%. Do not leave on the screen for more than five minutes at a time.
2. Loosen the CRT lens locking nut and rotate the lens for optimum focus (not shown in the diagram). In this model, the locking nut is accessible only from the rear of the TV. Therefore, the rear panel and the lens baffle inside the TV must be removed and the picture viewed from the rear looking up towards the back of the screen. It is helpful at this point to tape a plain white piece of paper to the front of the screen so that it is easier to see the dots from the rear.
3. Block the light from the two colors that you are not adjusting or use the Remote Commander and adjust the centering controls to separate the colors so that the desired color stands apart.
4. Turn the lens assembly until the dot focus in the middle of the screen is optimized. It is necessary to go back and forth between optical and electrical focus to be sure of the optimum optical focal point. Tighten the locking nut when complete.

Magnetic Focus.

This adjustment magnetically focuses the electron beam in the neck of the CRT. Note: Incorrect magnetic focus can cause color haze at the screen sides. Changing the magnetic focus will slightly change the horizontal and vertical centering, requiring a minor readjustment of these controls

2 pole Magnet Adjustment

1. Turn the electrical focus control counter clockwise until a bright spot (somewhat star shaped) appears inside the defocused dots. Do not turn the electrical focus control past the point where these bright spots disappear. It can be helpful to disable the Velocity Modulation to help see the spot. This can be done by unplugging CN302 on the A board.
2. With the two lower magnetic neck rings(closest to the tubes connector), center the bright spot within the dot. This is done by changing the distance between the tabs on the outside of each of the two pole magnets.
3. Return the electrical focus control to its original position.

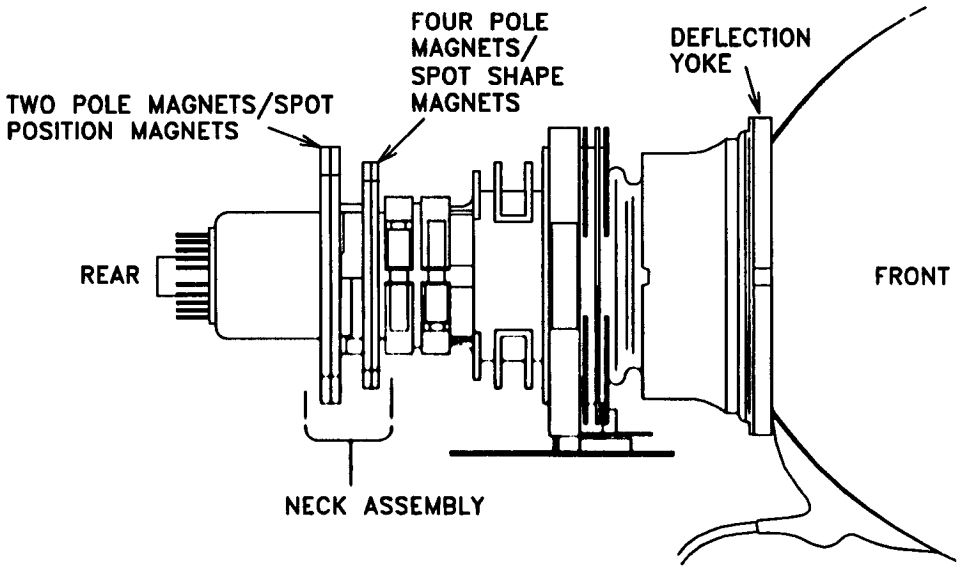
4-pole Magnet Adjustment

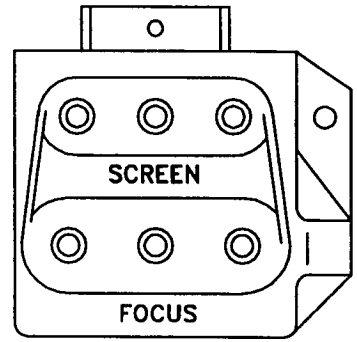
1. Defocus the CRT by turning the electrical focus control clockwise (past the point of maximum focus) until the dot patterns appears as enlarged circles. Do not defocus the CRT to the point that the circles begin to fade out.
2. Adjust the two upper magnetic rings on the CRT(closest to the face of the tube) to the following specifications, depending on the CRT:
3. Red and green CRT's. Adjust the rings for round shaped spots in the middle of the screen.
4. Blue CRT. Adjust the rings for a round shaped at the left edge of the CRT. (The middle area may become oblong).

Electrical Focus.

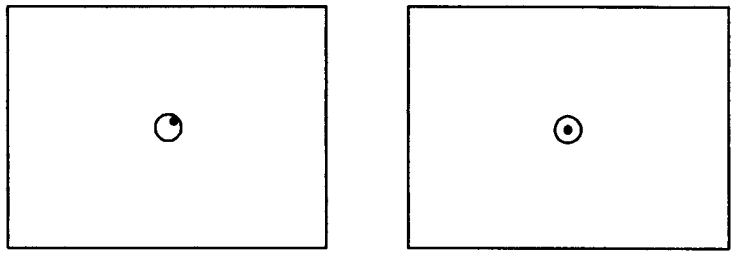
This adjusts voltage level of the CRT focus element.

1. Adjust all three focus controls for uniform focus from edge to center of the screen. (The front panel must be removed to access the focus controls).
2. Switch the generator to a crosshatch pattern.
3. Turn the blue focus control slightly counter-clockwise. This provides a more uniform screen brightness level. The larger the screen size the more defocusing may be required.

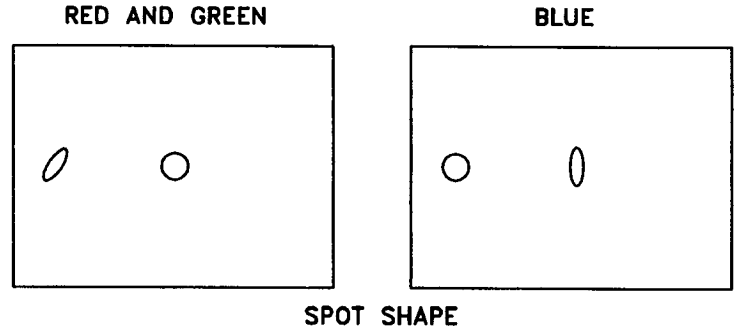




SCREEN/FOCUS/BLOCK



Two Pole Magnet Adjustment



Four Pole Magnet Adjustment

Formulating A Convergence Strategy

Overview

Before we attempt to change any of the convergence registers it is important to first check out a few things so that a strategy can be conceived that will not only keep you from wasting time but also save you the trouble of adjusting things that are not necessary. This can be done with a basic three step process:

- Listen to the customer.
- What do you observe.
- Formulate and execute a plan.

Listen to the Customer

One of the most important things that you can do as a service technician is to listen to the customer. Find out what there complaints are exactly. Even if the problems appear to be obvious to you make sure you ask them if they have any other complaints. This will possibly save you the problem of a costly recall to fix a problem that the customer could have identified for you the first time.

Another problem that can be encountered when you are inside the customers home is that they may expect more out of the television set than it is able to deliver. They may have complaints about geometry that always have to do with one particular channel which may be the result of a broadcast graphics problem. With so many broadcast mediums today and so many local cable channels there may be some computer generated video graphics that even the highest quality televisions cannot reproduce. There is no substitution for good communication with the customer. In the long run it will save you many problems.

What do you observe?

The first step in your observation is to take the information you got from the customer and decide if they are correct or realistic. Also make sure that you have allowed the set to warm up for 20 minutes before determining problems. Since you are the professional you may also spot obvious problems that the customer might not. Taking time to take a good look at the picture will save you time in the long run. It may also be a good idea to write down the problems you see. For example, you may see a problem in the upper right corner and the lower left corner along with some size and linearity problems. Now when you go to formulate an alignment strategy you can decide if the problems are related or separate. This will keep you from wasting time trying unnecessary adjustments. Remember when formulating a convergence strategy to use the theories discussed in the families of adjustments section.

Formulate and Execute a Plan

Always be sure that there is not an actual electrical problem causing your symptom. Usually these problems appear to be drastic in nature and are often intermittent. The most common problem in the past has been poor soldering contacts on the sub-deflection amplifiers. Always be sure you do not have an electrical failure before taking other steps.

In order to form a strategy we must first come up with a repeatable method that we can always follow that will lead us to a converged picture when done. Although it is impossible to give you repeatable generic answers to every convergence problem it is possible to use a method that combined with the knowledge of what the adjustments do will lead you to a fairly quick solution.

Balance Distortion

The first thing that you must do is to get yourself in a mindset where you are thinking of the picture as a whole. There are no adjustments in this system that only effect one particular part of the screen. You often run into a problem where fixing one problem causes another. Therefore, we have to use a series of adjustments which will result in equal (balanced) distortion on both sides of the picture. Then follow up with a single adjustment that simultaneously corrects the distortion on both sides. This is the basis for what we call the "balance distortion" method. In the following sections of adjustment families, you will find separate explanations on how this method applies. When coming up with strategies we must always keep in mind how the adjustments inside a family effect each other.

Order of Adjusting

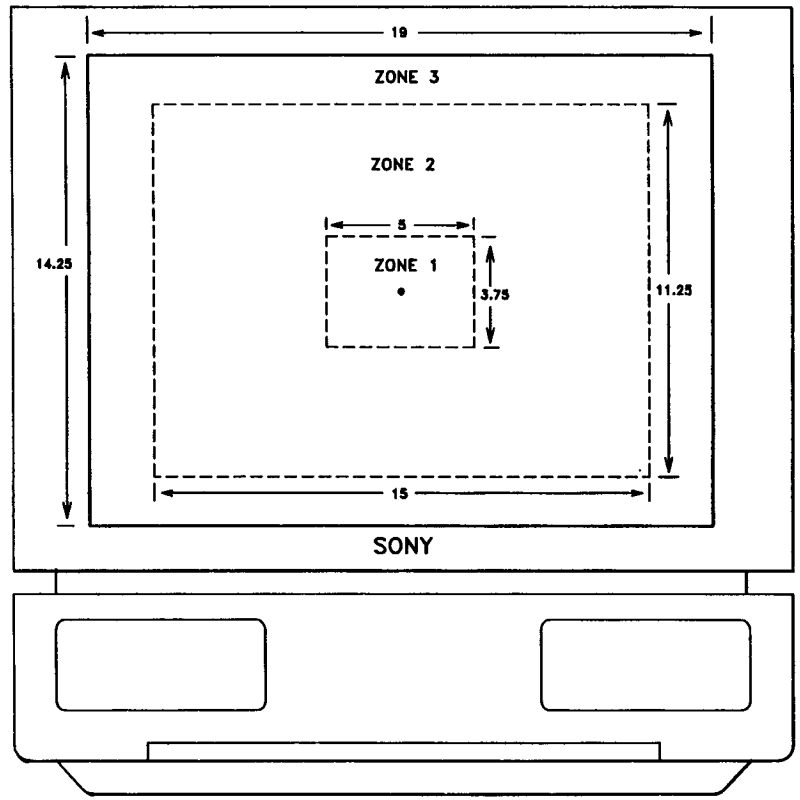
In addition to the "balance distortion" method we also have a basic order for doing these adjustments. The order you read below is not the only one that works. However, we have found it to be a highly effective way of tackling convergence problems. Before proceeding there are certain things that must be checked.

- A system reset should be done to prevent effect from customer adjustments. A reset is done by pressing the "**8**" and "**enter**" buttons while in the Service Mode.
- You must be sure that the screen, focus and yoke rotation adjustments are correct. See previous sections of the book to see how to check this.
- You must have proper geometry for 1 color. This color is preferably the green color but if for some reason green cannot be used you may use another color. The important thing is that one color be correct. If none of the colors are OK you can either suspect an electronic problem or the sets memory has been lost. See the instructions for full geometry later in this book.
- Proper geometry can be checked by blocking the light from the other 2 colors and examining the remaining color. All of the lines in the picture must be straight. You can verify this with a ruler by placing it next to the line and checking for straightness.
- Tilt can be checked by measuring the distance from the bottom edge of the beznet to various points on the center vertical and horizontal lines. All distances should be the same to the vertical and horizontal lines.
- Size and linearity can be checked by measuring a box height and width in the center and comparing it to box height and width in the corners as well as in the middle of either side.
- Once you are sure that one color has proper geometry you can continue with the following method. This should be done one color at a time. Do not try to converge two colors at once since it can become confusing.

1. **Centering** - The first thing that must be done is to center the color you are converging to one of the other colors. Centering is done first because it will effect all of the other adjustments.
2. **Straighten the Center Lines** - You want to make the lines in the center zones as straight as they can be. There are only a few adjustments that effect this they are bow and 4bow for horizontal and bow and wing for vertical.
3. **Center Tilt** - Adjust the tilt in the center of the picture. You can use the skew control to do this. Repeat steps 1 and 2 if necessary.
4. **Rough Straightening** - Do a rough straightening of the rest of the lines. It may not be possible to tell if the lines are 100% straight at this point but a finer adjustment can be done later. The lines can be straightened using the bow/pin and 4th families.
5. **Outer Tilt** - Adjust the tilt on the outside regions of the screen. This is done using the Sub skew and Keystone adjustments to straighten the edges of the screen. There is also a middle keystone if the problem is on the vertical plane.
6. **Size and Linearity** - Using the adjustments in the size/linearity family adjust the size and linearity of the boxes. Keep in mind the "balance distortion" method while adjusting
7. **Outside Edges** - At this point the only problems left should be on the outside edges. These lines should be straightened using the bow/pin family and the 4th family.
8. **Verification** - At this time you should go back and verify the whole picture. You may find that some of the lines cannot be made perfectly straight or have some very "strange abnormality". Due to tolerances of the deflection yokes, both main and sub, some relatively minor problems may be difficult to resolve. However, these problems can often be minimized by adjusting the size and linearity controls. Remember these are very minor problems compared to the typical convergence problems and are not a cause for you to begin changing parts or give up on adjustment.

Other Considerations

- Sometimes when you see a problem that is very obvious and drastic. You may want to start with that problem before starting with the method described before.
- When adjustments are near the end of there range they tend to have an effect on other adjustments. For example, if the horizontal size control is brought to the end of its range it will effect the straightness of the vertical lines near there edges.
- The picture should always be perfect in the center of the screen. Tolerance of about ½ of a line width is acceptable between red and green in Zone 3. The same applies between blue and green. However, because of the flare that is inherent with the blue color it is very difficult to distinguish this distance.
- After completion of screen (G2) and focus adjustments, reduce the PICTURE level to 25% of max. This should be done before proceeding into convergence to prevent phospher burns due to prolonged use of the crosshatch pattern.



CONVERGENCE ZONES

NOTES

Convergence Families

Overview

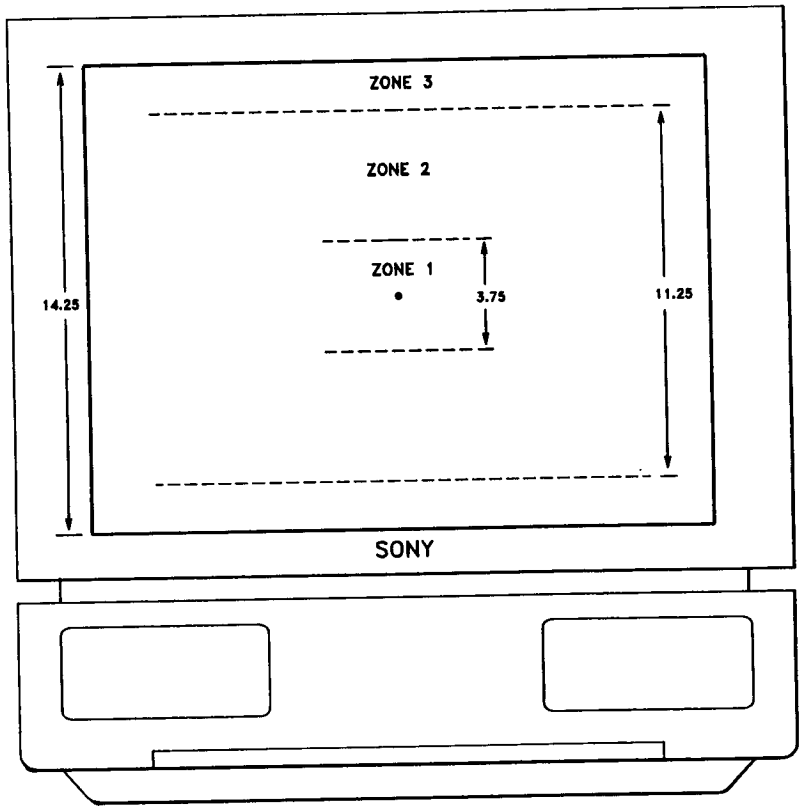
In order to better understand what each convergence adjustment does we must first divide the screen up into three different zones in both the horizontal and vertical planes. We will call these simply, Zone 1, Zone 2 and Zone 3. Below we see pictured the three zones for the horizontal and vertical screens. If you input a crosshatch pattern using the Leader LCG-396 you can mark the zones by how many horizontal or vertical boxes they take up. The zones are divided as follows. For horizontal, if we start in the center we can see that the 5 vertical boxes in the center make up Zone 1. Zone 2 consist of the area between 5 and 15 centered vertical boxes and Zone 3 is comprised of the rest of the screen. For vertical, 3.75 centered horizontal boxes mark the area that makes up Zone 1. Zone 2 is made up of the area outside of Zone 1 until the end of 11.25 centered horizontal boxes. Finally Zone 3 is comprised of the rest of the screen.

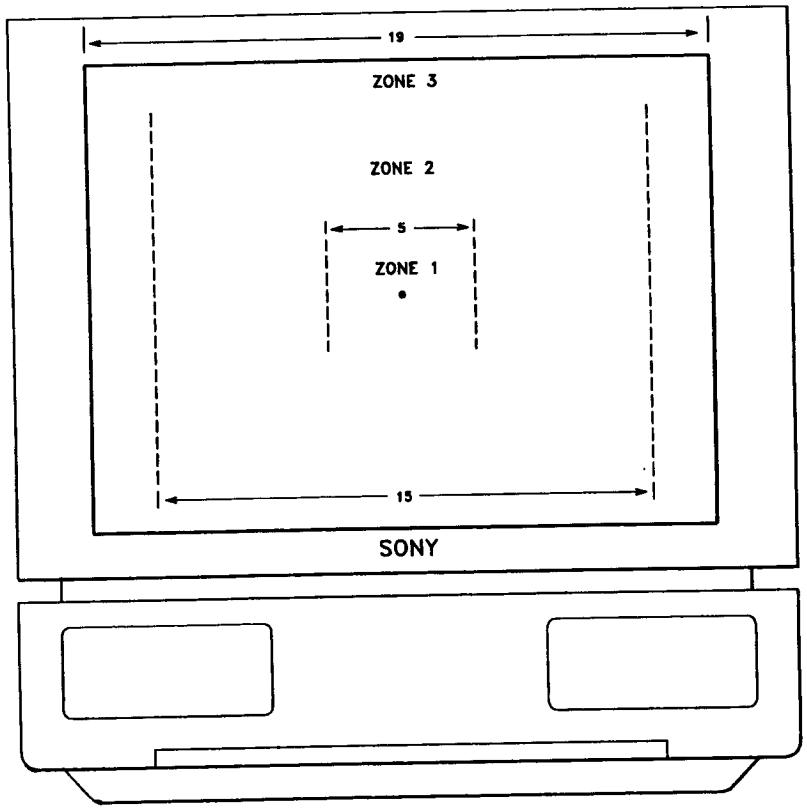
Separating the screen in to zones will give you a better understanding of what each adjustment does. It is particularly important because some adjustments effect only one zone or change the geometry at different rates in different zones.

The next thing in understanding the convergence adjustments is that they can be broken up into families of adjustments. That is certain groups of adjustments work together to fix certain problems. In the Sony convergence system there are 4 Families of adjustment. They are:

- The Size/Linearity family
- The Skew/Keystone family
- The Bow/Pincushion family
- The 4th family

Each of these 4 families can be further broken down into separate vertical and horizontal sections. Keep in mind that some adjustments available in the vertical section are not available in the horizontal and vice-versa. The following section will describe to you what each adjustment does and how they effect the zones.





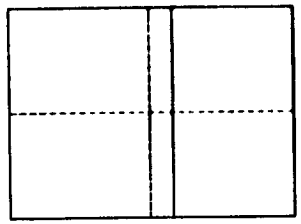
CONVERGENCE ZONES

The Size/Linearity Family

Horizontal

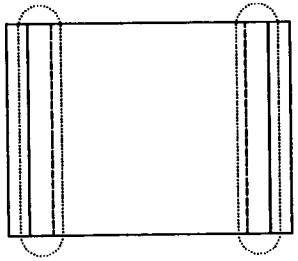
Centering - CENT

Changing the centering control causes all of the horizontal lines in all three zones to move away from the center at the same rate. It is the first adjustment that should be made when aligning convergence. Keep in mind that the customer does have a user control for changing centering. Reset the unit to center all customer controls.



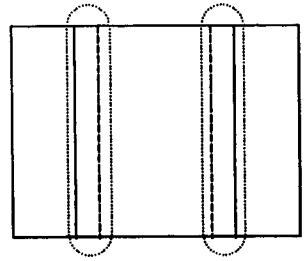
Size - SIZE

The effect of the horizontal size control is to change the box width from the center outwards. Though this adjustment will effect all three zones the effect is greater as you go away from the center. There is a more rapid change in box width in Zone 3 than in Zone 2. Its effect on Zone 1 is very small.



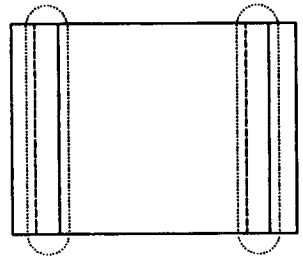
Middle Size - MSIZ

The effect of middle size is similar to that of size however there are some very important differences. Overall the effect of the middle size control is more drastic than that of size. The effect on Zones 2 and 3 is especially important. When you adjust middle size the rate of change is greater in Zone 2 than it is in Zone 3, so much so that the boxes in Zone 2 will eventually become wider than those in Zone 3. There is also more of a change on the outside of Zone 1. In short middle size is a course adjustment compared to size and has more of an effect on the middle of each side of the screen than on the edges.



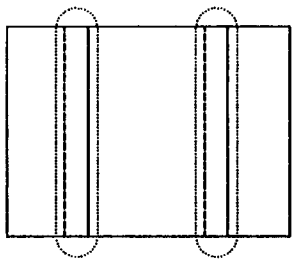
Linearity - LIN

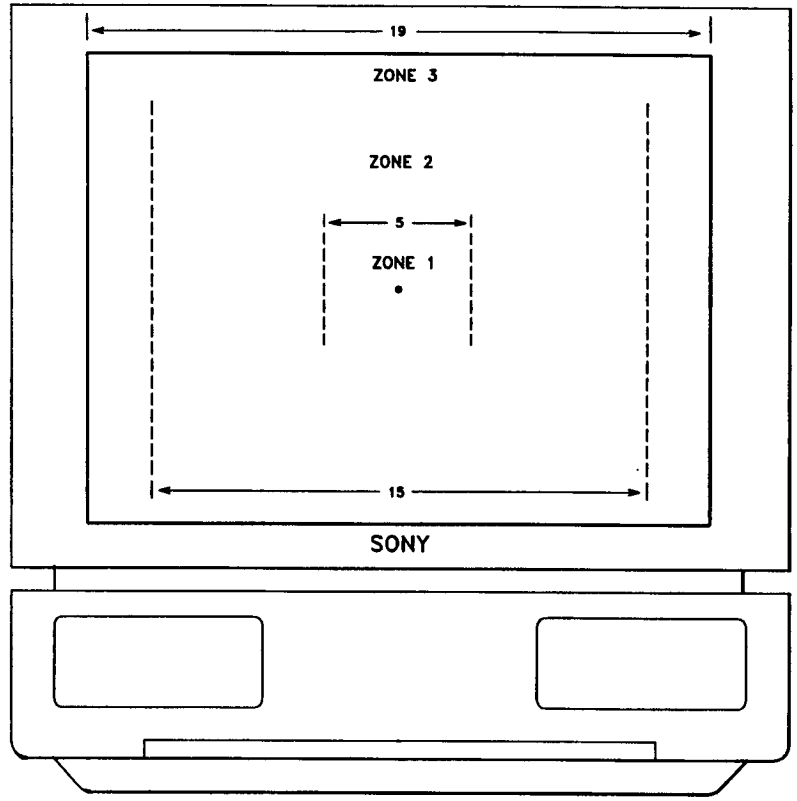
The linearity control changes the linearity or the width of the boxes on the left side of center as compared to the right. While changing the linearity control, if the box width on the right side were getting smaller the box width on the left side would be getting larger. This effect is seen mostly in Zone 3 but is also evident in the outside portion of Zone 2. The closer you get to the edge of the screen the greater the effect. The linearity control has no effect on Zone 1.



Middle Linearity - MLIN

The effect of the middle linearity control is similar to linearity except for some very important differences. The overall effect of middle linearity is more drastic than linearity. Like the difference between size and middle size the difference between linearity and middle linearity is greatest in Zones 2 and 3. The changes in linearity on both sides of the picture change more rapidly in Zone 2 than in Zone 3. There is also a slight effect on the box llinearity in Zone 1.





HORIZONTAL CONVERGENCE ZONES

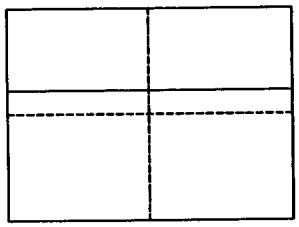
TVP7J30 804 8 26 97

The Size/Linearity Family

Vertical

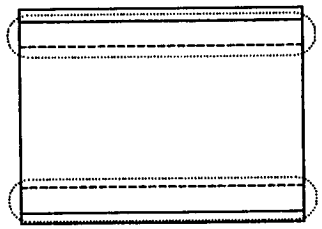
Centering - CENT

Changing the centering control causes all of the vertical lines in all three zones to move away from the center at the same rate. It is the first adjustment that should be made when aligning convergence. Keep in mind that the customer does have a user control for changing centering. Reset the unit to center all customer controls.



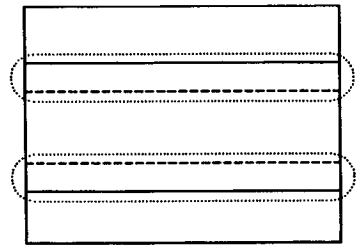
Size - SIZE

The effect of the vertical size control is to change the box height from the center outwards. Though this adjustment will effect all three zones the effect is greatest as you go away from the center. There is a more rapid change in box height in Zone 3 than in Zone 2. Its effect on Zone 1 is very small.



Middle Size - MSIZ

The effect of middle size is similar to that of size however there are some very important differences. Overall the effect of the middle size control is more drastic than that of size. The effect on Zones 2 and 3 is especially important. When you adjust middle size the rate of change is greater in Zone 2 than it is in Zone 3, so much so that the boxes in Zone 2 will eventually become taller than those in Zone 3. There is also more of a change on the outside of Zone 1. In short middle size is a course adjustment compared to size and has more of an effect on the middle top and bottom of the screen.

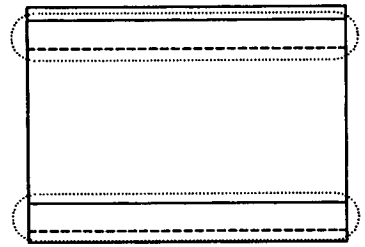


M SIZE

Linearity - LIN

The linearity control changes the linearity or the height of the boxes on the bottom side of center as compared to the top. While changing the linearity control, if the box height on the top were getting smaller the box height on the bottom would be getting larger. This effect is seen mostly in Zone 3 but is also evident in the outside portion of Zone 2. The closer you get to the edge of the screen the greater the effect. The linearity control has no effect on Zone 1.

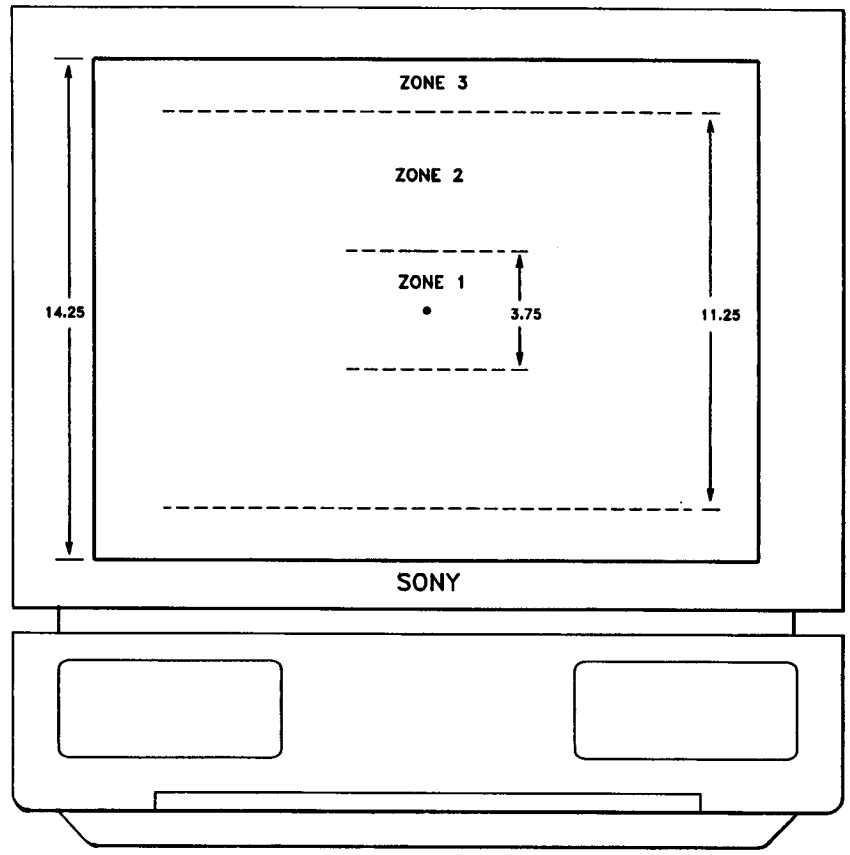
There is no vertical Middle linearity adjustment.



LIN

Balance distortion

When adjusting the size and linearity controls either horizontally or vertically you must remember their relationships. Remember that the middle controls will effect the middle of Zone 2 more than Zone 3 but they do have an effect on Zone 3. Therefore it becomes important to adjust the middle first. Linearity should be adjusted by creating the same size problem on both sides of the screen. It is best if you can adjust linearity for the same error between the reference color and the color being adjusted. Then, fix the error using size.



VERTICAL CONVERGENCE ZONES

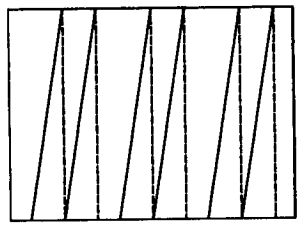
TVP7J28 8 25 9:

The Skew/Keystone Family

Horizontal

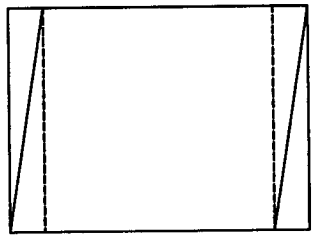
Skew - SKEW

The skew control tilts all of the horizontal lines on their vertical center at the same angle. It effects all three zones equally.



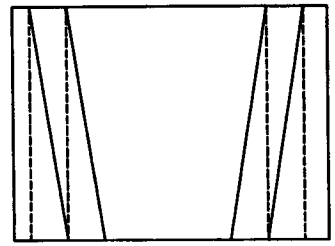
Sub Skew - SSKW

The sub skew control is similar to the skew control except that the only horizontal lines it effects are in Zone 3. If the control is moved all the way to either extreme the outside of Zone 2 may be slightly effected.



Keystone - Key

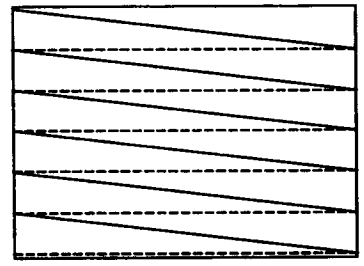
The keystone adjustment causes or takes out keystone distortion in the picture. This means horizontal lines on the right side would tilt towards the left while the lines on the left tilt towards the right. The tilting effect on either side is always in the opposite direction. This effect is greater in Zone 3 than in Zone 2. There is no change in Zone 1.



Vertical

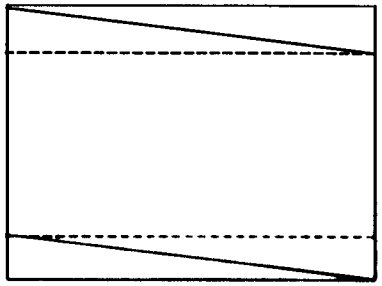
Skew - SKEW

The skew control tilts all of the vertical lines on their horizontal center at the same angle. It effects all three zones equally.



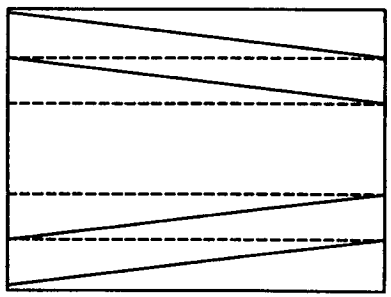
Sub Skew - SSKW

The sub skew control is similar to the skew control except that the only vertical lines it effects are in Zone 3. If the control is moved all the way to either extreme the outside of Zone 2 maybe slightly effected.



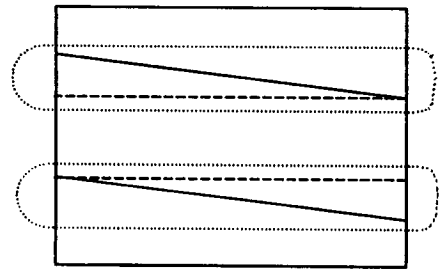
Keystone - KEY

The keystone adjustment causes or takes out keystone distortion in the picture. This means vertical lines on the top would tilt towards the bottom while the lines on the bottom tilt towards the top. The tilting effect on the top and bottom is always in the opposite direction. This effect is greater in Zone 3 than in Zone 2. There is no change in Zone 1.



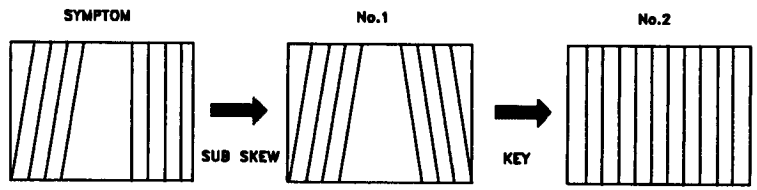
Middle Keystone - MKEY

The middle keystone adjustment is similar to the keystone adjustment with a few important differences. The first is that the amount of change between Zones 2 and 3 is roughly the same. There is also some effect on Zone 1. Also the rate of change is greater with a middle keystone adjustment than with a keystone adjustment.



Balance distortion

The first thing that you must understand is that there is no balance or opposite adjustment for the Skew control. Skew is adjusted by just paying attention to the lines in the very center of Zone 1. The Sub Skew control however can be used in a balance the distortion type case along with the key and middle key controls. If for instance a tilt is found only on one side of the screen you could use the sub skew control to create a tilt on both sides of the screen that can be corrected using the key control.

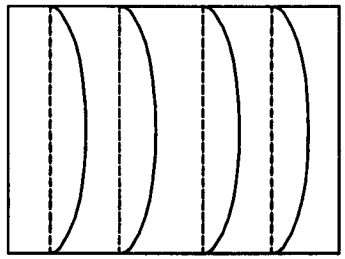


The Bow/Pincushion Family

Horizontal

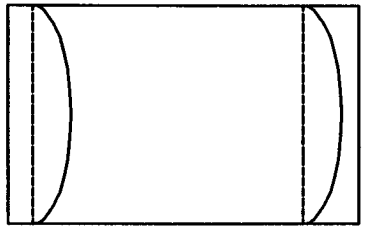
Bow - BOW

All three zones of the picture experience an equal bowing of the horizontal lines in the picture in same direction. The bottom and top of the line bend in the same direction while the middle stays straight.



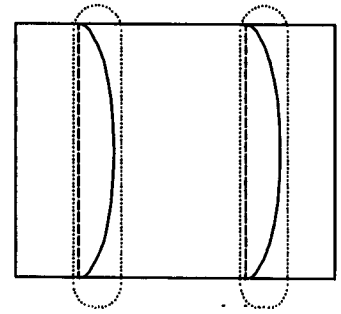
Sub Bow - SBOW

Sub bow causes a bowing of the picture similar to bow but only in Zone 3 and the very outside of Zone 2. The effect is greater the further away from the center of the picture.



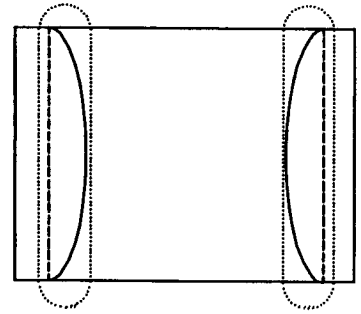
Middle Bow - MBOW

Middle bow causes a bowing of the horizontal lines in Zones 2 and 3. It has no effect on Zone 1. The bowing effect is greater towards the edges of the picture



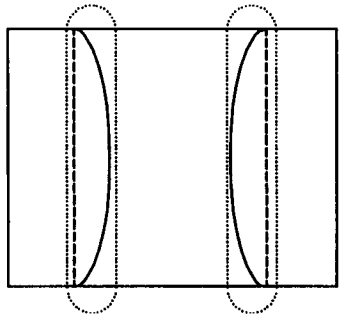
Pincushion - PIN

Pincushion causes a bowing of the horizontal lines that is opposite on either side of the center of the screen. If the right side is bowed to the left then the left side will be bowed to the right. The Pin adjustment only effects Zones 2 and 3. The effect is larger the closer you are to the edges of the screen.



Middle Pincushion - MPIN

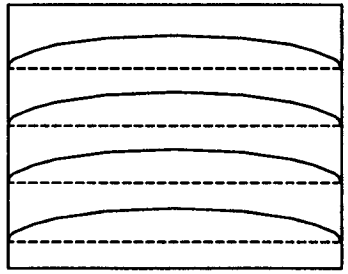
Middle pincushion is similar to pincushion except the rate of change is greatest at the end of Zone 2 and decreases in either direction from there. There is also a small effect in Zone 1.



Vertical

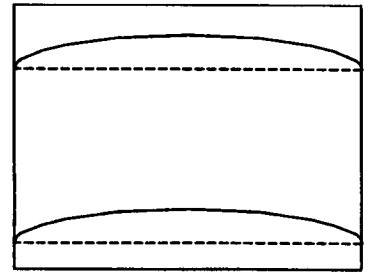
Bow - BOW

All three zones of the picture experience an equal bowing of the vertical lines in the picture in same direction. The right and left of the line bend in the same direction while the middle stays straight.



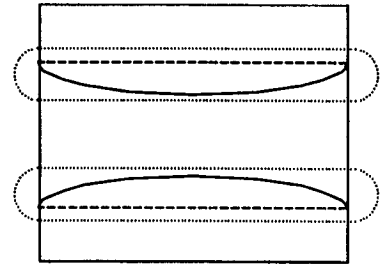
Sub Bow - SBOW

Sub bow causes a bowing of the picture similar to bow but only in Zone 3 and the very outside of Zone 2. The effect is greater the further away from the center of the picture.



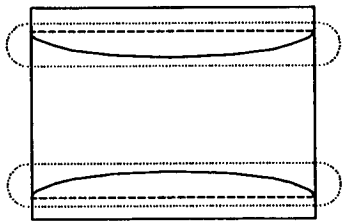
Middle Bow - MBOW

Middle bow causes a bowing of the vertical lines in Zones 2 and 3. It has no effect on Zone 1. The bowing effect is greater towards the edges of the picture



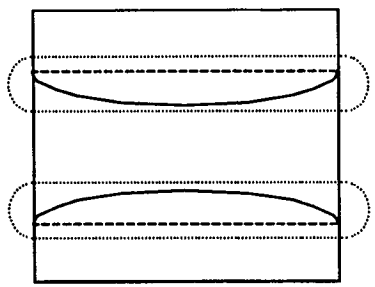
Pincushion - PIN

Pincushion causes a bowing of the vertical lines that is opposite on the top and bottom of the center of the screen. If the bottom is bowed up then the top will be bowed down. The Pin adjustment only effects Zones 2 and 3. The effect is larger the closer you are to the edges of the screen.



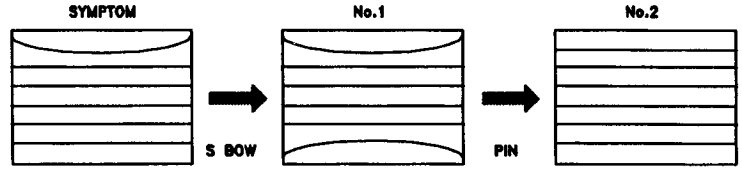
Middle Pincushion - MPIN

Middle pincushion is similar to pincushion except the rate of change is greatest at the end of Zone 2 and decreases in either direction from there. There is also a small effect in Zone 1.



Balance distortion

The bow control much like the skew control talked about earlier should be used alone by making the line in the center as straight as possible. Though bow does effect the rest of the picture it is the only control that effects the center. The rest of the bow/pin family can be used as opposites with, for example, sub bow being adjusted to create the same distortion on both sides of the picture and then correcting it with the pincushion control.

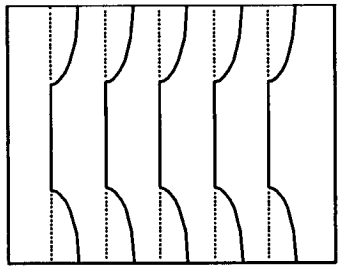


The 4th Family

Horizontal

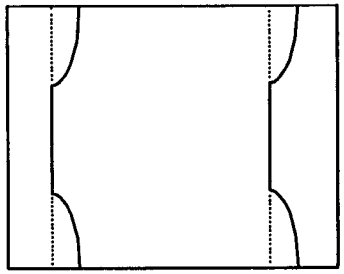
4th Bow - 4BOW

The 4 bow adjustment causes the top 1/3 and the bottom 1/3 of a horizontal line to bow in the same direction in all 3 zones on the screen. This type of effect is referred to as Cupid's bow.



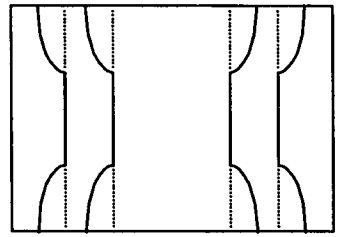
4th Sub Bow - 4SBO

The 4th sub bow adjustment causes the Cupid's bow to occur in Zone 3 and the outside edge of Zone 2. The effect is greater towards the edges of the screen.



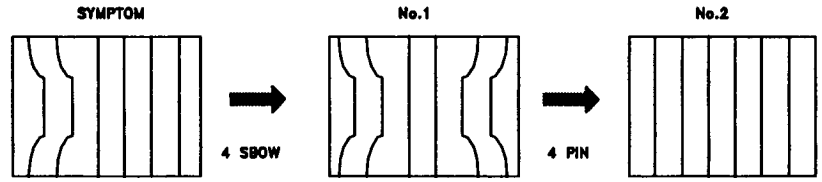
4th Pincushion - 4PIN

The 4th pin adjustment causes the cupid's bow to appear but going in opposite directions on either side of the screen. It is the same as the relationship between bow and pin. This effect occurs in Zones 2 and 3 with the greater rate of change toward the edges of the screen.



Balance distortion

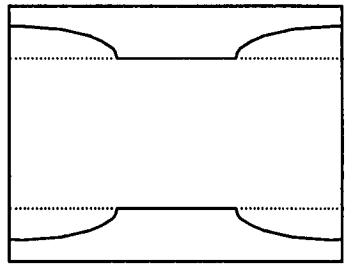
The 4bow adjustment should only be used by itself. It is the only adjustment in this family that effects the center of the picture. The 4 sub bow adjustment can be used with the 4 pincushion adjustment much the same way that sub bow and pincushion are used. Keep in mind that 4pin and 4 sub bow adjustment only effect a third of the picture on either side.



Vertical

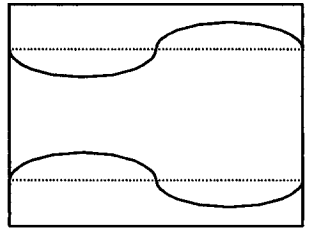
4th Pincushion - 4PIN

The 4th pin adjustment causes the cupid's bow to appear but going in opposite directions on either the top or bottom of the screen. It is the same as the relationship between bow and pin. This effect occurs in Zones 2 and 3 with the greater rate of change toward the edges of the screen.



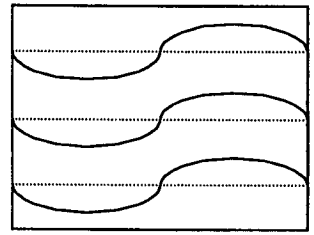
Wave - WAVE

The wave adjustment causes opposing S waves to be created at the top and bottom of the picture in Zones 2 and 3. The rate of change is greatest towards the edges of the picture in Zone 3.



Wing - WING

The wing adjustment is a new adjustment and <u>does not appear in RA-1 chassis</u>. It causes an S wave to be created equally in all three zones of the picture. This also means that this adjustment is not available on the Registration Adjustment Jig.



Balance distortion

The wing adjustment should only be used alone. It is the only adjustment that effects the center of the picture. It should be adjusted first if it is suspected of being off. The wave and 4pin adjustments can be used together. However they do not relate to each other in the same proportions as 4 pin and 4 sub bow.