

USER GUIDE
for the
3DTV
SPACESTATION™
MODEL 3

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SpaceStation Model SS3 Overview

The 3DTV Corporation SpaceStation™ is a sophisticated and flexible scan converter for use in a wide variety of stereoscopic video applications.

Functions

- Demultiplexing interlaced field sequential stereo video into separate right and left views
- Multiplexing and demultiplexing stereo video using side by side or over/under compression and expansion
- Increasing the refresh rate of stereo video for flicker free viewing with LCD shutter glasses
- A full compliment of parallax and color controls *and more*

Specifications

Switch Selectable Inputs

- PAL composite video signals, two channels
- Svideo (Y/C) signals, two channels
- Analog RGB with composite sync, two channels

Simultaneous Outputs

- PAL composite video signals, two channels
- Analog RGB with composite sync, two channels
- VGA compatible RGB with separate h/v sync, two channels
- Svideo (Y/C) signals, two channels

Resolution: 576 lines, 512 pixels per line, 16,777,216 colors, unless otherwise noted.

Power: 110 or 220v AC, switch selectable.

Dimensions: approx. 4" x 12" x 15".

Weight: 9 lbs.

Warranty: Units are guaranteed for 90 days parts and labor.

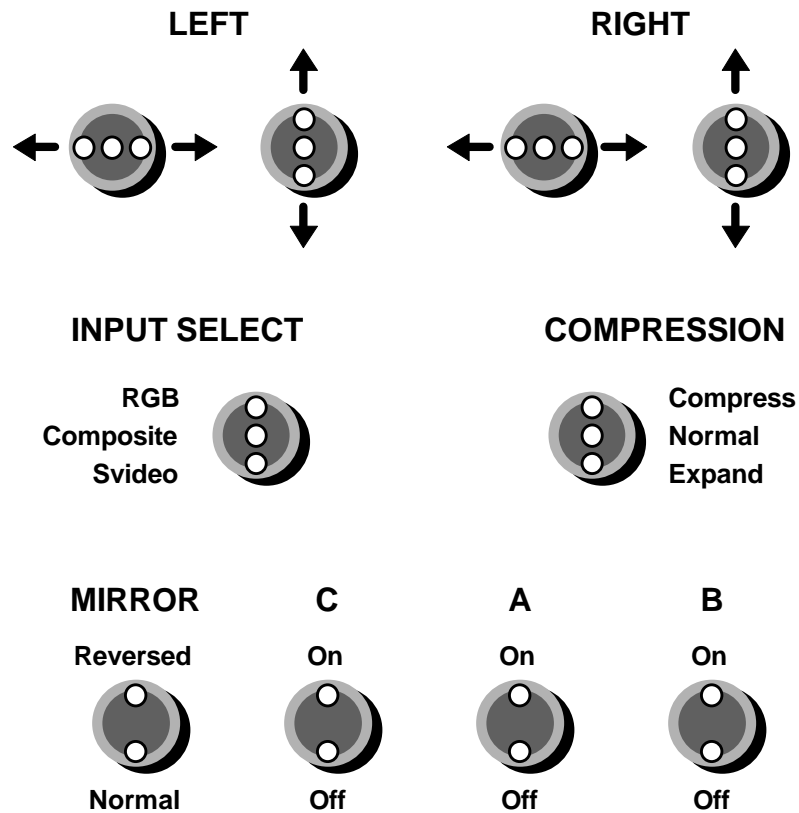
An NTSC standard SpaceStation, model SS4 is also available.

Revision: 4.05 1/20/96 ©1996 3DTV

A, B, and C switch summary

- A left/right or over/under mode of compression/expansion
- B delay: one, two or three fields
- C contrast and saturation control
- AB variable frequency PAL
- AC variable frequency VGA
- BC VGA output, delace and left/right compression/expansion
- ABC VGA output, delace and over/under compression/expansion

Note that the C switch is labeled “HI RES” on some remotes



Demultiplexing Stereo Video

General Setup

Stereo videotapes are multiplexed in several ways. Most commonly they are recorded in field sequential mode. Left eye views are usually recorded to even PAL or NTSC fields and right views to odd fields. Videotapes can also be recorded with one view compressed to the top or left half of the image and the other view compressed to the other half. To view these tapes in stereo with head mounted displays (HMDs) or with two video projectors and polarizing glasses the video signal must be split into separate right and left video signals, or *demultiplexed*. The setup for this procedure is the same for any of these tape formats.

1. Align the two projectors perfectly with a test pattern so that their images match in size, color and brightness. Place the polarizing filters at the correct angle on each projector.
2. Split the video out from the VCR using a distribution amplifier into the right and left inputs on the SpaceStation.
3. Run cables from the right and left outputs on the SpaceStation to the projector (or HMD) inputs (see page 19 for a description of cables available).
4. Attach the remote control to the SpaceStation parallel port and set switches to the correct video input type and output mode as described in detail in this section.
5. Plug in the SpaceStation power cord and switch on the power.
6. If the image is pseudoscopic (right eye gets left image) switch the output cables.
7. Adjust the vertical and horizontal parallax using the switches on the remote.
8. Flip the mirror switch on if doing rear projection.
9. YOU MUST USE A SPECIAL POLARIZATION PRESERVING SCREEN FOR 3D PROJECTION!!

Most, if not all, LCD projectors require the use of polarizers in a nonstandard vertical and horizontal orientation to avoid odd color artifacts (45 degrees to right and left is standard for polarized glasses). A 1/2 wave plate in front of each polarizer will rotate the angle back to standard. If tearing or jumping of the image is seen, it is probably due to poor signal quality, sometimes seen when the source is VHS tape being played on a consumer VCR. In such cases it is necessary to run the signal from the tape player through a time base corrector or to use professional VCR's and tape formats.

Field Sequential Stereo

In theaters, movies have long been projected at twenty-four frames per second. We don't notice any flicker because the screen is almost constantly illuminated; modern projectors show one frame almost immediately after the next, leaving the screen blank for a very short time. In a television set, each image is projected onto the screen just one small pixel at a time. The glow of the phosphors on the screen lasts long enough that we don't notice much flicker if the screen is refreshed 50 times per second. PAL (European) standard television signals are *interlaced*. Each 576 line frame is divided into even and odd lines, making two *fields* of 288 lines which are broadcast and displayed fifty fields per second. This reduces flicker to an acceptable level while staying within the bandwidth limits of inexpensive broadcast technology.

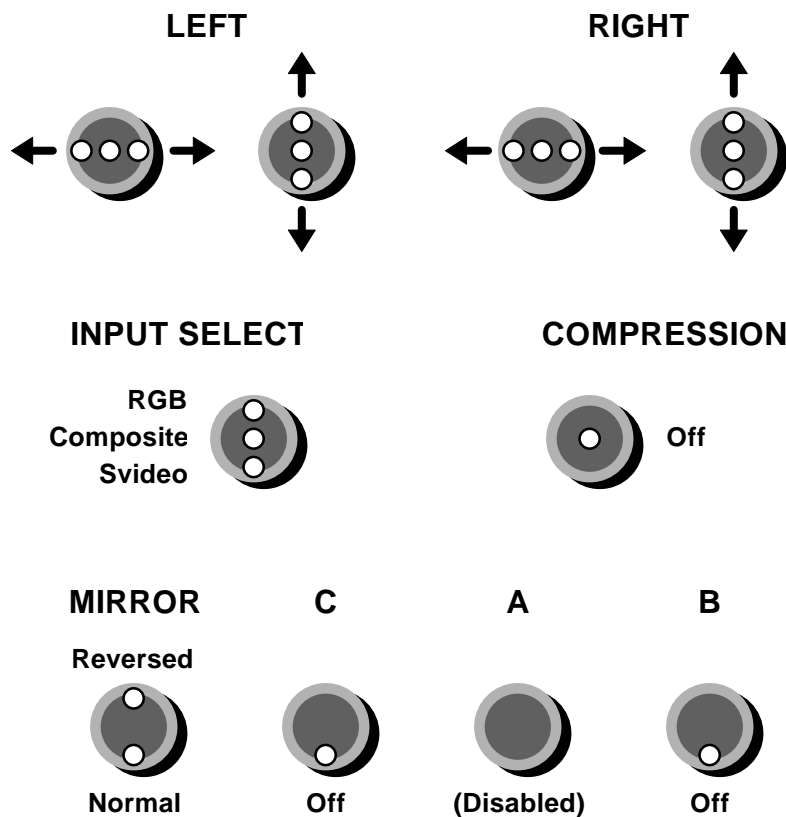
We take advantage of this system to store both right and left stereo views synchronized on a single videotape: right views to even fields, left views to odd fields. This yields 288 lines per frame for each eye. These tapes can then be viewed directly using ordinary VCRs and reasonably inexpensive LCD shutter glasses available from 3DTV. There is a noticeable flicker as each lens is alternately opened and closed for 1/50th of a second 25 times per second. The SpaceStation can be used to reduce this flicker in several ways described in "Flicker Fixers" starting on page 12.

The most basic function of the SpaceStation is the conversion of field sequential stereo video to separate right and left view outputs for projection and viewing with polarizing filters. We call this *delacing* the video because it separates interlaced fields. The stereo signal is run through a distribution amplifier (available from 3DTV or your local consumer electronics store) into both the right and left inputs on the SpaceStation. The right and left outputs are separate right and left views suitable for viewing on HMDs or for projection with polarizing filters and viewing with inexpensive polarizing glasses. Each eye sees the proper view field doubled and projected at 50 Hz instead of alternating with black, so flicker is greatly reduced. For PAL compatible output see "Delace" on page 5. For VGA compatible output see "VGA Delace and Expand" on page 8 and "Inserting an Extra Sync Pulse in VGA output" on page 15.

Delace

The primary function of the SpaceStation is to separate right and left views of interlaced field sequential stereo video. We call this *delacing* the video. To do this, attach two video feeds to the right and left inputs on the SpaceStation as described in “General Setup” on page 3, turn the **B**, **C** and **compression** switches **off** and choose the correct input format using the input select switch. The output is 288 lines per field using 512 pixels per line. The output is field doubled: the same 288 lines per view are shown twice at 50 Hz for an actual temporal resolution of 25 Hz per eye.

The right and left views usually will be sent to the correct outputs, although for some non-standard tapes the views will be reversed. If necessary, switch the right and left output cables. The mirror function is used for rear projection applications. Align the projected images using the right and left parallax controls described on page 3. Color adjustments are described on page 17.



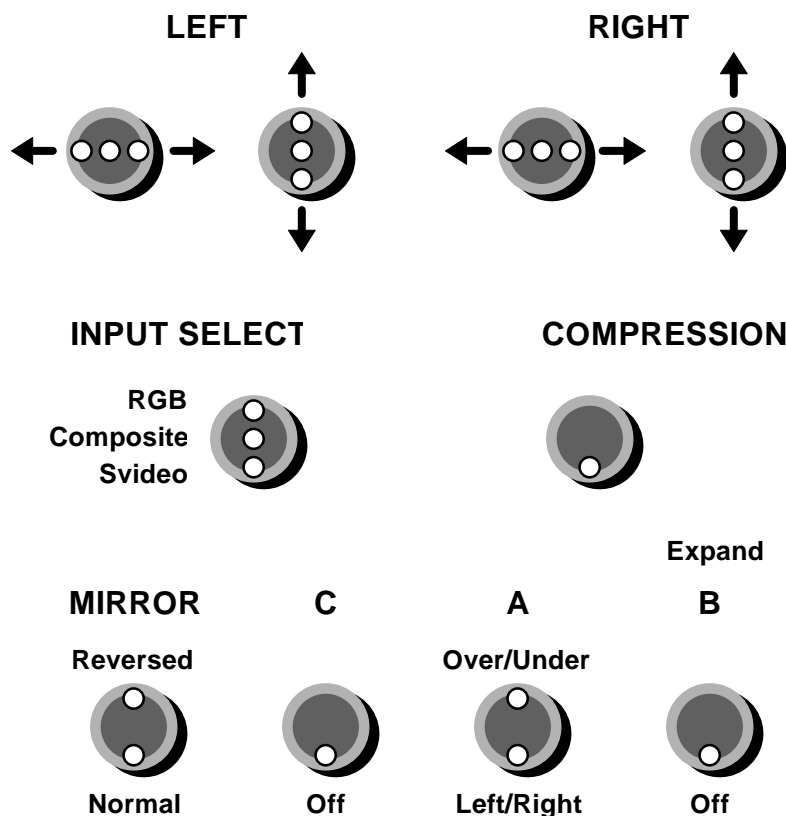
Horizontally or Vertically compressed tapes

Various schemes using vertical and horizontal compression for multiplexing and demultiplexing stereo video can be accomplished using the SpaceStation. This method produces smoother motion at the expense of vertical or horizontal image resolution. To produce tapes in this format see “Multiplexing Two Views” beginning on page 9.

To expand the two views of compressed tapes into separate right and left outputs follow the directions “General Setup” on page 3, turn the **B and C switches off** and set the **compression switch** to **expand**. The **A switch** selects between vertical and horizontal modes. The mirror switch is enabled for rear projection applications.

The output from over/under compressed tapes is effectively 512 pixels by 144 lines per field per eye. Each line is doubled in the display. From side by side compressed tapes the effective resolution is effectively 256 pixels by 288 lines per field per eye. Each pixel is doubled in the display. In both cases the spacial resolution is traded for temporal resolution; all 50 fields per second per view are preserved.

For VGA compatible output of compressed tapes see “VGA Delace and Expand” on page 8 and “Inserting an Extra Sync Pulse in VGA output” on page 15.

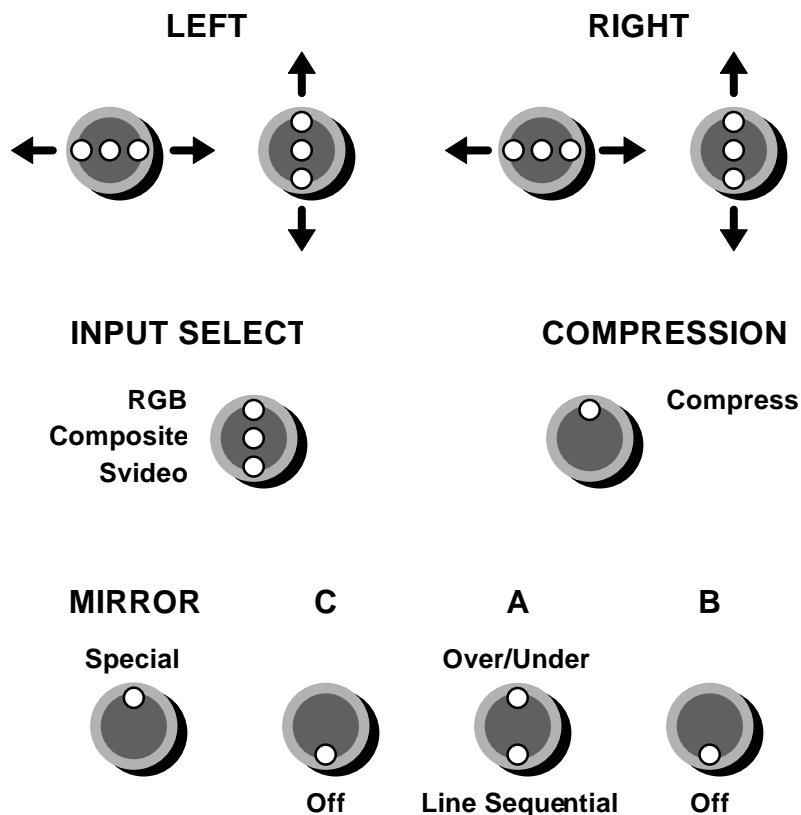


Converting from Field Sequential to Over/Under or Line Sequential PAL

With the **B** and **C** switches **off** and the compression switch on compress, the mirror switch is normally left off because the compress modes are not designed for rear projection. With the **mirror** switch **on**, the A switch chooses between two special modes designed to convert field sequential video to over/under compressed mode or line sequential PAL output

With the **A** switch **on** the SpaceStation compresses even fields to the top half of the screen and odd fields to the bottom half. All the lines are captured from each field, and then displayed in interlaced format. A few lines are cropped from the top and bottom of each image to clean up the ragged borders which would otherwise be visible. One application of this format is MPEG compression and recording of Stereo video. If the MPEG file thus recorded is played back full screen on an appropriate monitor using the StereoSpace Model 1 to insert an extra sync pulse, the stereo video can be viewed with LCD shutter glasses.

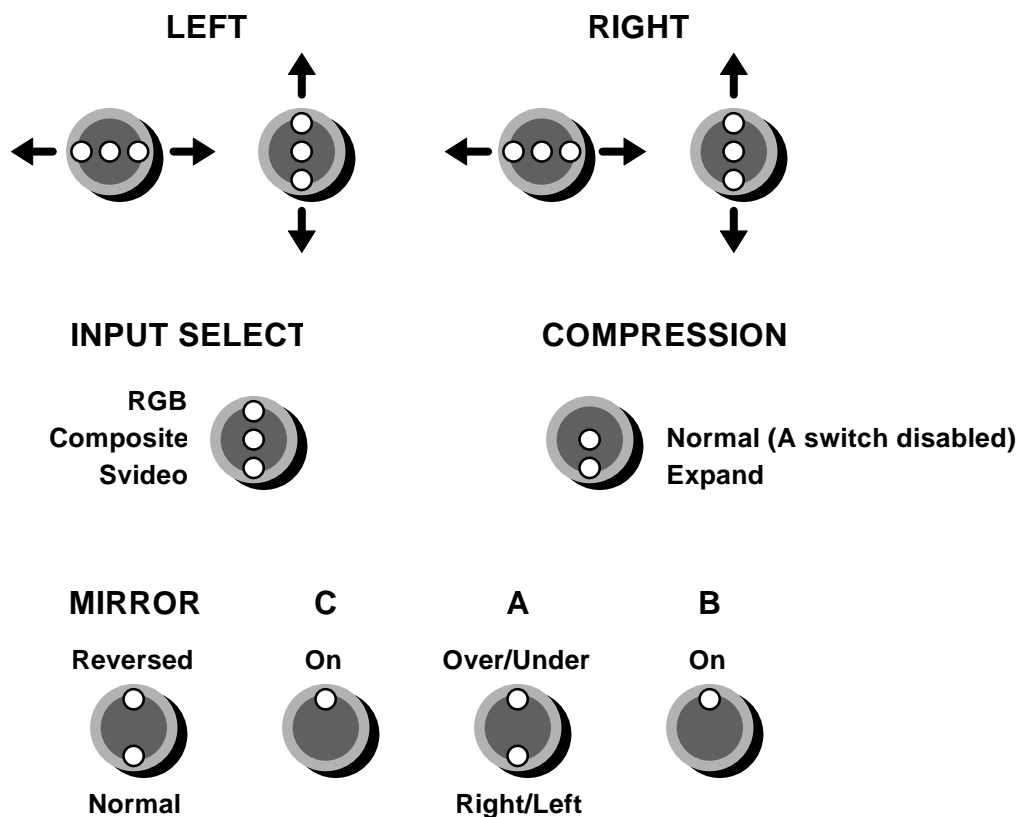
With the **A** switch **off** the SpaceStation captures half of the lines from each input field. Each output field is made up of alternating lines from even and odd input fields. This mode is designed for display on special monitors coated with narrow horizontal stripes of cross-polarized material and viewing with polarizing glasses.



VGA Delace and Expand

With the **B and C switches on** the SpaceStation accepts multiplexed stereo video input exactly as in normal delace and expansion modes but the right and left view outputs are a line doubled format compatible with VGA monitors. The output is 512 pixels by 576 lines, with 16 million colors, non-interlaced 60 frames per second per channel.

Begin by following the directions in “General Setup” on page 3. The compression switch is used to select delace mode for field sequential tapes or expansion mode for compressed tapes, and the A switch selects the mode of expansion. Each of the separate outputs from field sequential tapes has the 25 Hz fields displayed at 60 Hz per eye, doubling some fields and tripling others. The 288 lines per field are doubled to 576 lines per field, using 512 pixels per line. The outputs from over/under compressed tapes display 60 Hz fields for each eye, showing each of the 144 recorded lines from each view four times each frame to yield 576 lines using 512 pixels per line. Side by side compressed tapes yield 60 Hz fields per eye, with each of the 288 lines doubled, and doubling each of the 256 pixels per line.

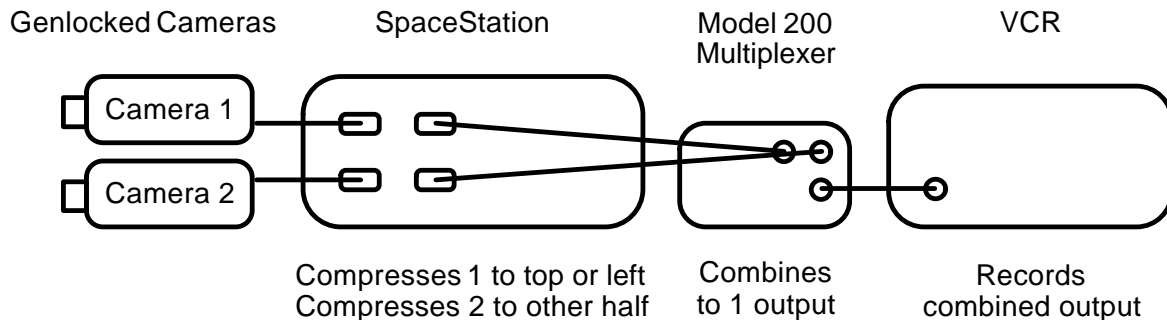


Multiplexing Two Views

General Setup

The SpaceStation can be used in conjunction with the 3DTV Model 200 or 300 StereoMultiplexer to combine input from a pair of cameras or stereo pair of tapes into a single video signal for recording to tape. Right and left images are compressed spatially either top to bottom or side to side. This preserves a full fifty fields per second for each eye at the cost of halving the spatial resolution. For a high resolution multiplexed frame sequential VGA output mode see "Multiplexed VGA: every pixel, line and field from both views" on page 11.

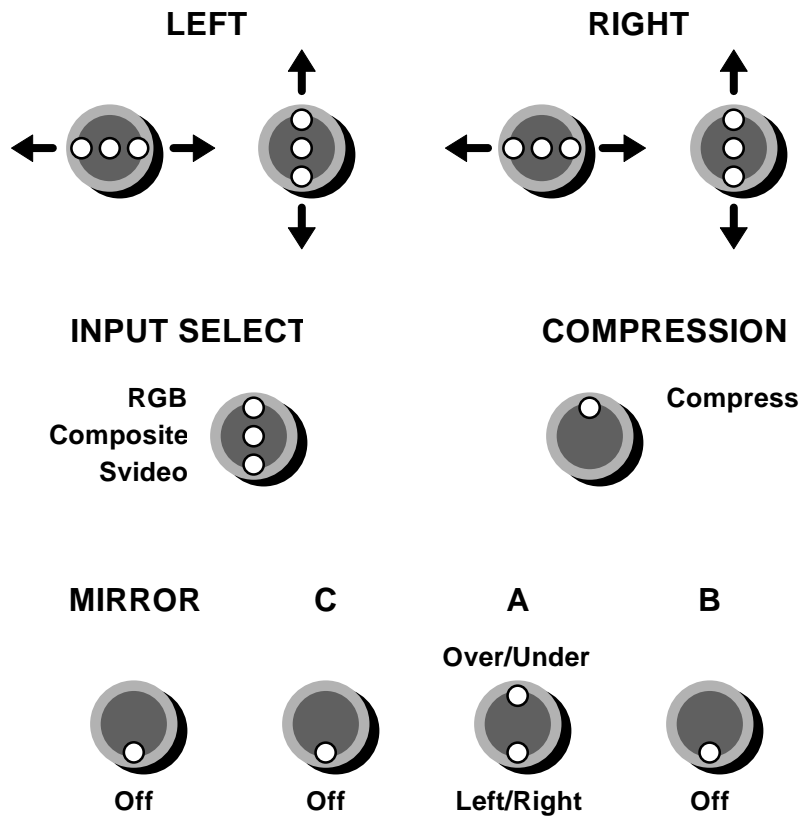
1. If using the Model 200 to combine PAL, genlock the two cameras. With the Model 300 no genlock is needed.
2. Set the **input select** switch to the correct position (composite, YC or RGB) and connect each camera to one of the video inputs on the SpaceStation.
3. For recording PAL output set the switches as described in "Compressed PAL for Videotape" on page 10.
4. Connect the two outputs of the SpaceStation to the Model 200 StereoMultiplexer and turn the switch on the Model 200 to the correct split screen position.
5. Carefully adjust the two signals to match brightness and color balance.
6. Record the output of the model 200 to a VCR.
7. To play the recorded tape, use the SpaceStation with the compression switch on expand as described in "Demultiplexing Stereo Video".



Compressed PAL for Videotape

To record fifty fields per second per view to one PAL videotape, you must compress the images. This causes the loss of some detail but is sometimes preferable when a great deal of motion is present in the image. Use the general setup for multiplexing two views using the 3DTV Model 200 or 300 StereoMultiplexer as described on page 9. With the B and C switches off set the **compression switch** to **compress**. The **A switch** selects between vertical and horizontal modes.

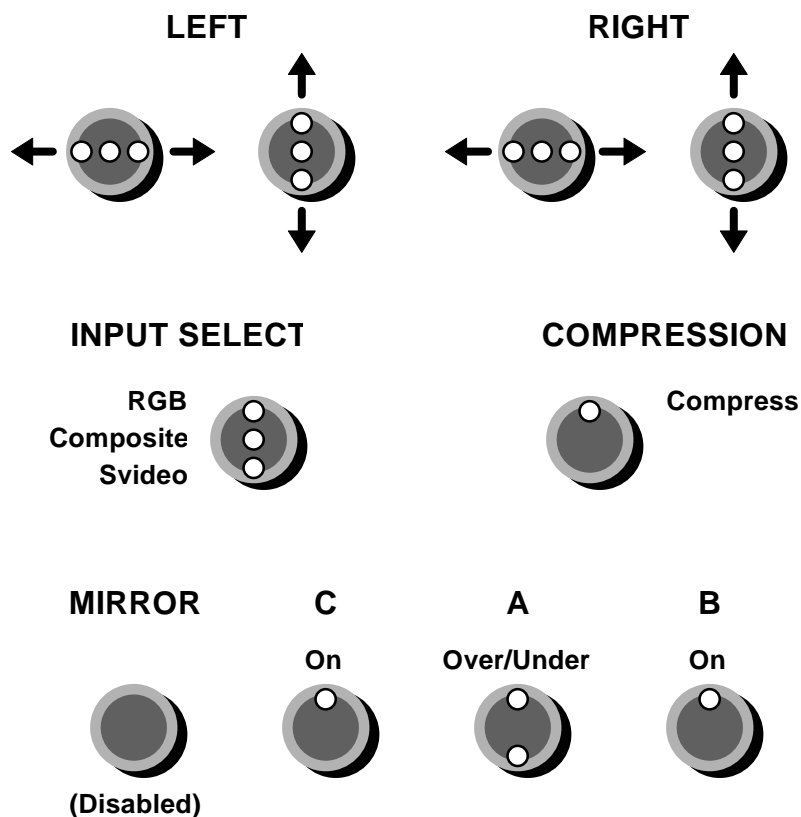
The over/under compressed output from the SS3 is 512 pixels per line, 144 lines per field. Side by side compressed output is 256 pixels by 288 lines. In both cases all 50 fields per second are preserved by the SS3 and combined by the Model 200 to one videotape.



Multiplexed VGA: every pixel, line and field from both views

With the **A, B and C switches on**, and the **compression switch on compress** the SpaceStation compresses every line from every field of the left channel into the top half of the left output, and every line from every field from the right channel into the bottom half of the right output. Combining the two outputs with the 3DTV Model 200 StereoMultiplexer produces 512 pixels by 576 lines, with 16 million colors, non-interlaced VGA 50 frames per second with the left view compressed on top and the right view compressed on the bottom.

The bandwidth of this signal is too high to record to standard videotape. Instead, replace the VCR in the diagram under General Setup with the 3DTV StereoSpace Model 1 to insert an extra sync pulse in the middle of every frame to give 288 line 100 Hz frame sequential stereo containing all the detail from every pixel, line and field from both right and left views. Contact 3DTV Corporation for optional equipment and instructions to genlock the output of the two boards, and to pass separate red, green, blue and sync components through the Model 200 StereoMultiplexer.



Flicker Fixers

Field sequential tapes can be viewed in stereo using liquid crystal diode (LCD) shutter glasses. These glasses are made with right and left lenses that can be changed quickly from transparent to opaque in sync with the video signal so that each eye only sees the appropriate view. This creates a flickering effect which can be reduced or eliminated completely by the SS3.

The simplest way to do this is to increase the *horizontal refresh rate*, the speed at which each line is displayed. This proportionally increases the *vertical refresh rate* and reduces the perception of flicker. Most PAL and some VGA monitors can only function within a narrow range of horizontal refresh rates so we also provide a way to reduce the number of lines displayed in each output field. This proportionally increases the vertical refresh rate at the cost of cropping off the top and bottom of the image. See page 13 for variable frequency PAL output and page 14 for variable frequency VGA output. .

There is another way to get a high refresh rate on a suitable multisync VGA monitor using the SpaceStation in conjunction with the 3DTV StereoSpace™ Model 1. The SS3 is used to display right and left views compressed into the top and bottom halves of a single VGA output signal. This can be done with field sequential tapes as well as over/under compressed tapes. See “Inserting an Extra Sync Pulse in VGA Output” on page 15. The SS1 is used to insert an extra sync pulse in the signal, doubling the vertical refresh rate and eliminating any trace of flicker.

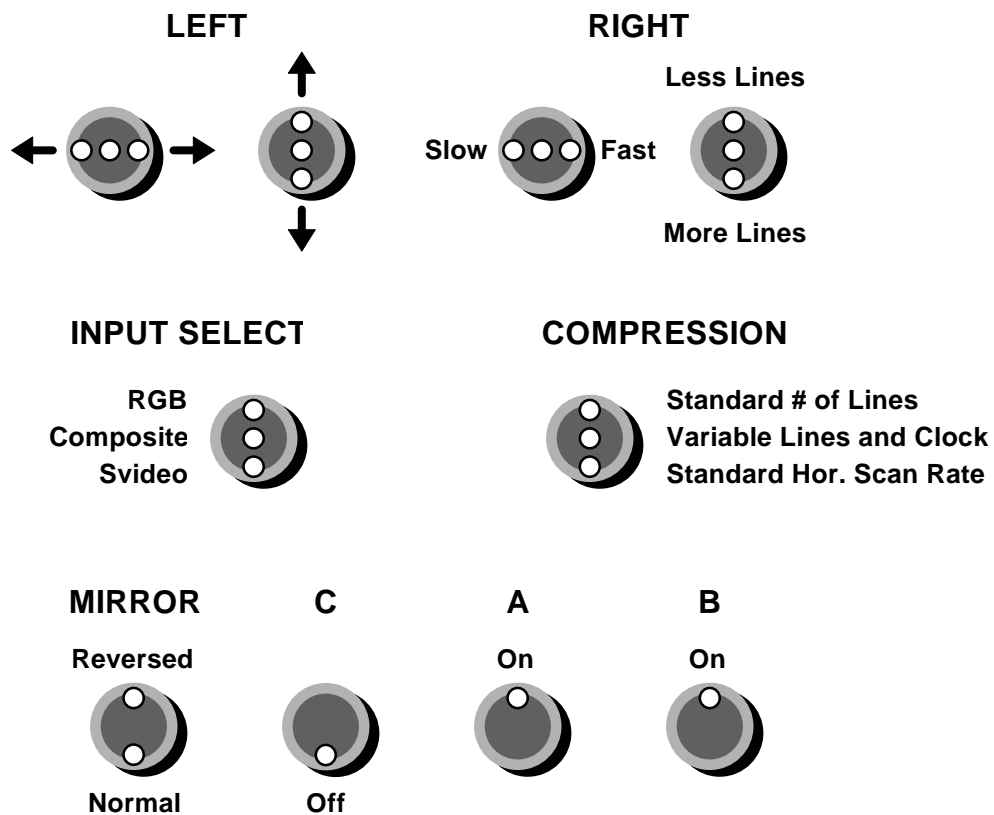
Warning: The SpaceStation is capable of generating vertical refresh rates as high as 250 Hz and horizontal refresh rates as high as 63 KHz. This exceeds factory specs for every monitor we have seen and could damage your monitor. Use caution in experimenting with these modes. 3DTV (and your monitor manufacturer) can not be held liable for damage caused by exceeding recommended monitor refresh rates.

Variable Frequency PAL

Setting the **A and B switches on** and the C switch off configures the left channel of the SpaceStation as a scan converter, producing output similar to PAL standard, but with continuously variable refresh rate. Even and odd fields are preserved as such so it can be used to reduce the flicker experienced with field sequential stereo and LCD shutter glasses.

In this mode, only the left channel is used. The right parallax adjust switches are used to control the refresh rate of the left channel output in two ways. Holding the right horizontal adjust switch to the right increases the horizontal scan rate of the left channel and proportionally increases the vertical refresh rate. Holding it to the left reduces the refresh rate. Holding the right vertical adjust switch up reduces the number of lines displayed on the left channel and proportionally increases the vertical refresh rate. The lost lines are cropped from the bottom of the image. Holding it down increases the number of lines displayed and reduces the refresh rate. If the number of displayed lines is increased beyond the size of the input image, random data is displayed in the extra scan lines at the bottom of the screen.

To reset the horizontal refresh rate to PAL standard flip the compression switch down. To reset the number of displayed scan lines to PAL standard flip the compression switch up.



Variable Frequency VGA: converting PAL to non-interlaced VGA

With the **A** and **C** switches **on** and the **B** switch off, the SS3 doubles each line of PAL video input to the left channel to produce non-interlaced VGA compatible output from the left channel. Adjustments can be made to reduce or increase the total number of lines displayed per frame and to increase or reduce the horizontal scan rate in combination to eliminate any trace of flicker. Two default settings are built in: 50 Hz and 90 Hz. You will have to experiment to find settings that work best with your monitor. Although refresh rates exceeding factory specs can damage some monitors, we have found combinations of the two adjustments that work at over 150 Hz with a compatible monitor.

Adjusting the scan rate

Because the right channel is not being used, the right parallax adjust switches can be used to control the vertical refresh rate. Holding the right vertical adjust switch up reduces the number of lines displayed on the left channel and increases the refresh rate. Pushing it down reduces the refresh rate. Holding the right horizontal adjust switch to the right increases the horizontal scan rate of the left channel and proportionally increases the refresh rate. Pushing it to the left reduces the refresh rate. Note that reducing the number of displayed scan lines crops the image from the bottom, maintaining a consistent line doubled format rather than proportionally shrinking the image to fit the remaining scan lines. If the number of displayed lines is increased beyond the size of the input image, random data is displayed in the extra scan lines.

Flipping the compression switch down, then back to the middle position works as a toggle to choose one of two default settings. The first time it is flipped down the left channel is set to display 544 lines, plus 20 blanked lines, at 50.76 KHz for a vertical refresh rate of 90 Hz. Flip the compression switch back up to the middle position to make custom adjustments using the right position switches. The next time the compression switch is flipped down the left channel is set to display 576 lines, plus 39 blanked lines, at 31.25 KHz for a vertical refresh rate of 50 Hz. Each time the compression switch is flipped back down the frequency alternates between the two default settings. Once a frequency is established, incoming odd and even fields are displayed consistently as alternating VGA frames, allowing the use of LCD glasses with the StereoSpace Model 1 for stereo viewing of field sequential tapes.

Special modes

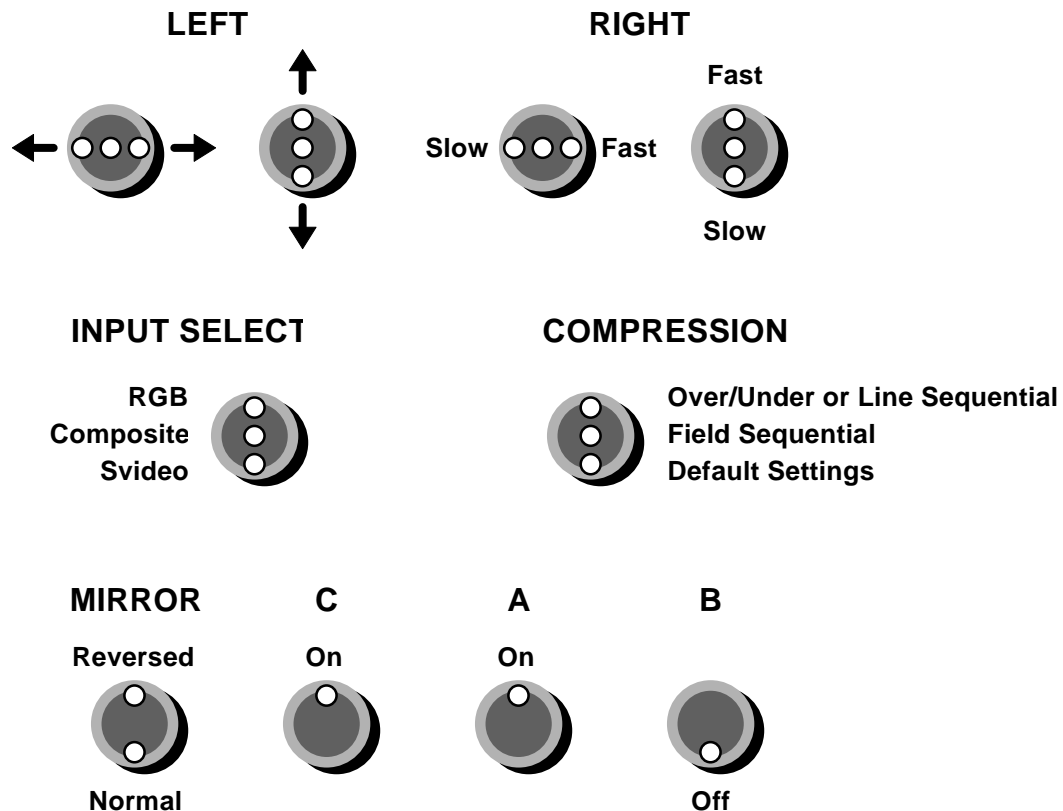
You may toggle between two special display modes by flipping the compression switch up and leaving it there. The first time you flip the compression switch up, the SS3 configures the left

channel to convert field sequential video input to line sequential stereo VGA output used by some head mounted displays. Switching back to normal, then up again toggles the special over/under compression mode used for when inserting an extra sync pulse in field sequential tapes as described below. In both cases, frequency adjustments can be made as usual.

Inserting an Extra Sync Pulse in VGA Output

The second special mode configures the left channel to compress even fields into the top and odd fields into the bottom half of VGA compatible output. The 3DTV StereoSpace Model 1 is used to insert an extra sync pulse between the top and bottom compressed images, doubling the vertical refresh rate of the output and producing frame sequential VGA format output. By first setting the 50 Hz default mode, then choosing the special over/under compressed mode, the SS1 can convert the output to 288 line 100 Hz VGA, showing each field of the field sequential stereo tape twice, without losing any lines.

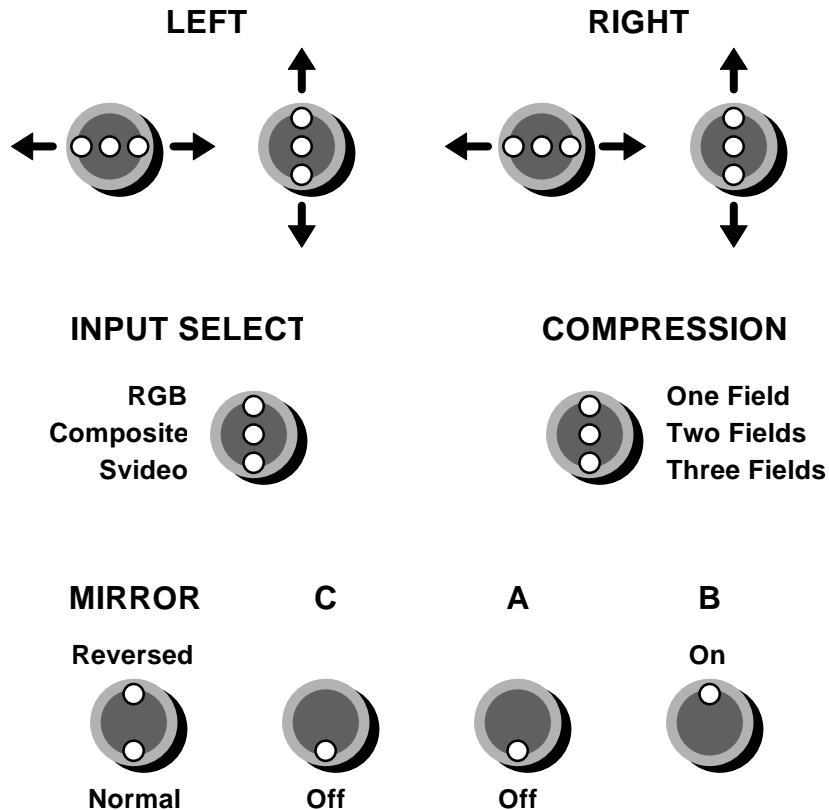
With the compression switch in the normal position, an over/under compressed videotape can be played through the left channel of the SS3 and sync pulse added as above with the Model 1 to produce line doubled (144 recorded lines per field, displayed as 288 lines per 100 Hz VGA frame) output containing all fifty original fields per view. In both cases the alternating right and left VGA frames can be aligned by using the position adjust switches to move the bottom image and the output frequency can be customized with the right position adjust switches.



Other Controls

Delay

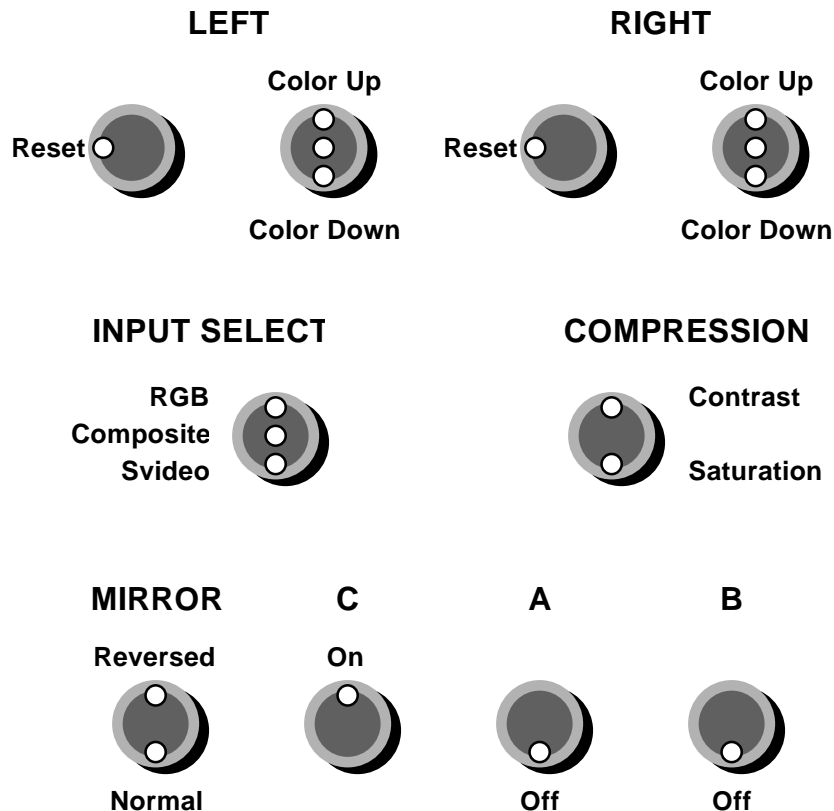
The SpaceStation can produce delays of 1/50th to 3/25th of a second for creating synthetic stereo from objects moving side to side. Turn the A and C switches off and the **B switch** on for Delay mode. The compression switch is used to choose one, two or three fields (1/50, 1/25, or 3/50 second) of delay for each channel. The channels can be chained together, feeding the output from the left channel into the input of the right channel, to double the delay times. The one field delay mode uses 24 bit (16 million) colors, while the two and three field delay modes use 15 bit (32 thousand) colors. The delayed output is run through a TBC and the 3DTV Model 200 StereoMultiplexer, along with the undelayed signal to produce synthetic stereo.



Contrast and Saturation

The color output from the SpaceStation can be adjusted by turning off the A and B switches and turning on the **C switch**. The vertical position switches for each channel then change contrast or saturation of the output depending on the position of the **compression switch**. Factory defaults can be reset by briefly holding the horizontal adjust switch (which is otherwise disabled in this mode) to the left. Once the adjustments are made, return the A, B and C switches to their previous positions to return to normal operation. The color changes remain in effect until they are changed again or the SpaceStation is turned off.

In general, the SpaceStation remains in the previously selected mode while colors are being adjusted. If more than one switch must be changed to get from another mode to color adjust mode, the switches must be changed quickly (within about a half second) to avoid inadvertently changing to some intermediate mode.



Parallax Controls

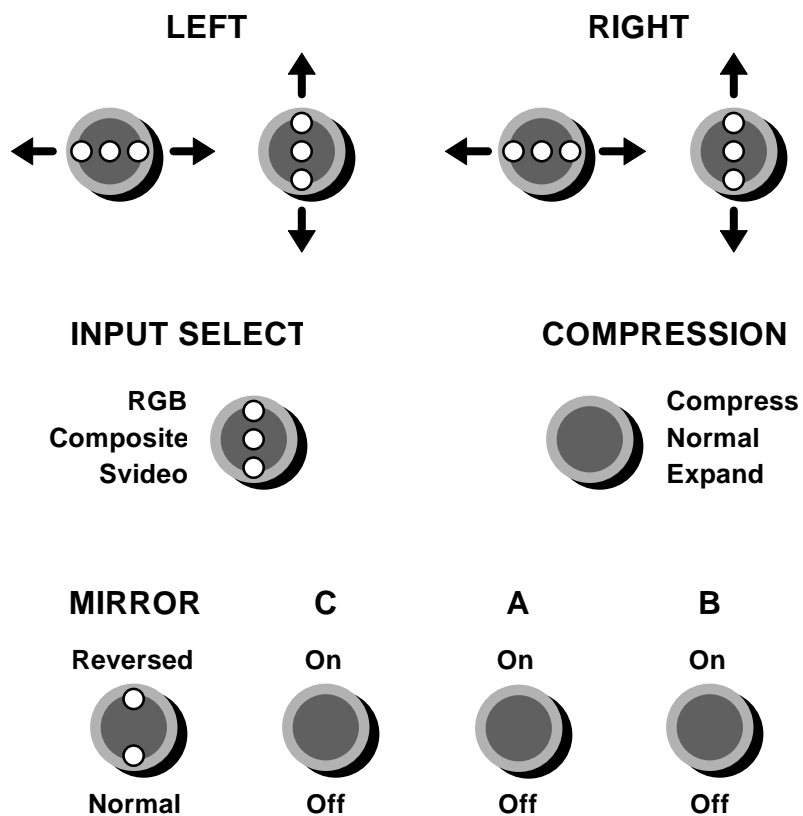
Parallax adjustments are made using the top row of switches on the remote. The left switches adjust the vertical and horizontal position of the left channel, and the right switches adjust the vertical and horizontal position of the right channel. The switches have been redefined in the color adjustment mode to control the output color. The right switches have been redefined in the variable frequency modes to control the left channel output frequency.

Mirror Function for Rear Projection

The mirror switch reverses the image from left to right for rear projection applications in every mode except color adjust mode and compression modes (the compress modes are designed for multiplexing two video channels, not for viewing).

Input Selection

The input select switch works the same in every mode; down for Svideo, center for composite and up for analog RGB with composite sync.



Additional information

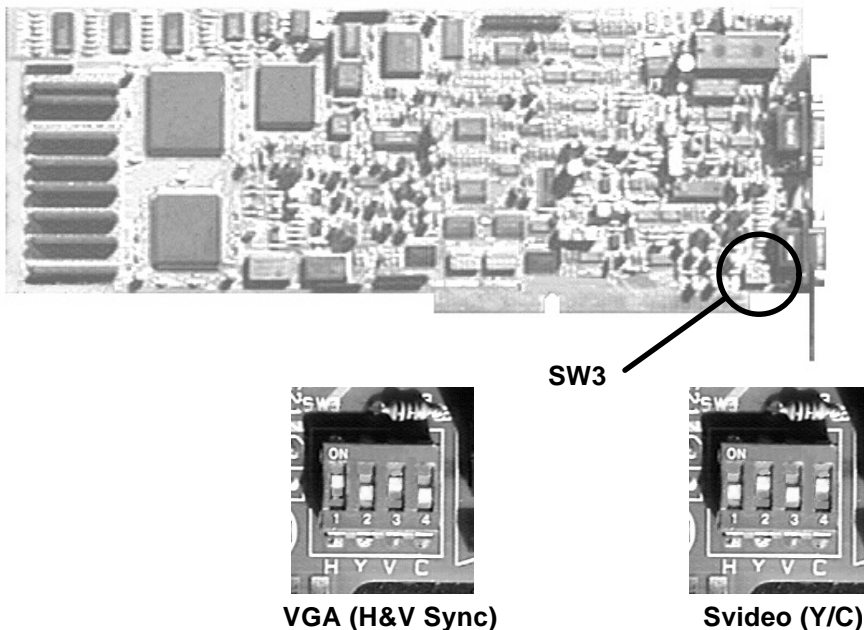
Cables and Adapters

RCA to nine pin adapters are provided for normal composite video input and output. Also included are combination nine pin adapters with several cables attached. These terminate in BNC connectors for analog red, green, blue and sync signals, a BNC connector for composite video, and a four pin mini-DIN for Svideo. Also available is a special nine to fifteen pin adapter for VGA output.

Output Configuration

The SpaceStation always produces composite and analog RGB output and *either* VGA compatible *or* Svideo (Y/C) output. It must be internally reconfigured to switch from VGA compatible output to Svideo output or back again:

1. Turn off and unplug the SpaceStation and remove the cover.
2. Remove the left board and find SW3.
3. For Y/C output turn on the Y and C switches and turn off the H and V switches.
4. For VGA output, turn on the H and V switches and turn off the Y and C switches.
5. Repeat for the right board, replace both boards and the cover.

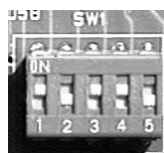


Color Calibrating the SpaceStation

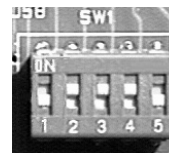
1. Unplug SpaceStation and remove cover.
2. Replace small parallel card with video card and attach monitor.
3. Attach a video source and monitor to the left board.
4. Turn on SpaceStation. It should beep once, then display a text screen and cursor.
5. Hit <esc> to exit the Space program and get the A:\ prompt.
6. Type VPCAL11A <enter>.
7. Use the keyboard arrow keys to pick the menu that you need, then hit <enter> to select that menu.
8. Use the ←→ keys to move the individual adjustment bars, and ↑↓ keys to select the next/previous lines.
9. When satisfied (or close to it) hit <esc> and save to the EPROM (Y <enter>).
10. Use steps 8 through 10 to make all desired adjustments to this board then <esc> to quit VPCAL11A.
11. Turn off and unplug the SpaceStation and remove the left board.
12. Find SW1 on the right board turn switch 1 on (up) and switch two off (down).
13. Attach a video source and monitor to the right board and repeat steps 4 through 10.
14. Turn off and unplug the SpaceStation.
15. Turn switch 1 off and switch two on.
16. Replace the left board.
17. Remove the video card, replace the parallel card and cover.



SW1: I/O ADDRESS



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1 3 4 on



Right Board
2 3 4 on

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