



**SD2020**  
Stereoscopic Monitor

USER'S GUIDE

[www.planar.com](http://www.planar.com)

## Usage Notice



To prevent the risk of fire or shock hazards, do not expose this product to rain or moisture.

Do not open or disassemble the product, as this may cause electric shock.

*Follow all warnings, precautions, and maintenance as recommended in this user's guide to maximize the life and performance of your unit.*

### Do

- Turn off the monitors before cleaning.
- Use only a dry, soft cloth or clean room wipe when cleaning the LCD panel surface or the half-mirror.
- Use a soft cloth moistened with water and/or mild detergent to clean the display housing and stand.
- Use only high quality and safety approved AC/DC power adapters.
- Disconnect the power plug from the grounded AC outlet if the product will not be used for a long period of time.

### Don't

- Do not touch the LCD panel or half-mirror surfaces with sharp or hard objects.
- Do not use abrasive cleaners, waxes, or solvents for your cleaning.
- Do not operate the product under the following conditions:
  - In an extremely hot, cold, or humid environment
  - In areas susceptible to excessive dust and dirt
  - Near any appliance generating a strong magnetic field
  - In direct sunlight

# Box Contents

The SD2020 shipping box contains the following components.



Bottom monitor assembly with mirror support arms and mirror adjustment screws



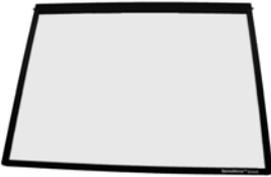
Bottom cable management cover



Top monitor assembly



Top cable management cover



Beamsplitter assembly



Two power cords (6-ft)



Two DVI cables (6-ft and 12-ft)



Two Analog VGA cables (6-ft and 10-ft)



Mirror-flip PCI card



Short DVI cables (14-in)



Two AC adapters



Product user's guide



Planar CD-ROM



Captain-style glasses (2 ea)



Spring clip-style glasses (1 ea)



Terminator-style glasses (2 ea)



Soft, dry cloths (3 ea)



Moistened cleaning pads (6 ea)

**NOTE:** Both the Captain-style and the Terminator-style glasses, for use with the SD2020 monitor, feature the Planar logo on each side and white arm tips. These two markers differentiate the glasses from those shipped with other stereo monitors.

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# Stereoscopic Viewing

We live in a three-dimensional world. The human visual system can process the slightly different views of the world and translate the views into the perception of depth. This process is called stereopsis.

In the last two centuries much effort has been devoted to the reproduction of depth perception, primarily with photography and more recently with computer graphic images.

Stereoscopic/3D viewing can help a viewer make faster, more accurate, and more enjoyable interpretations of imagery. The SD2020 StereoMirror™ monitor, in particular, creates an unprecedented level of stereo/3D viewing quality and viewer comfort.



The StereoMirror monitor.

Stereo viewing is useful for the following applications:

- Photogrammetry and remote sensing
- Geospatial image analysis
- Geophysical modeling
- Molecular modeling
- Computer games
- Oil and gas exploration
- Architecture and mechanical design
- Stereo photography or videography
- Medical imaging (not as yet FDA 510(k) approved)
- Surgical planning
- Teaching of anatomy
- Simulation
- Complex data analysis



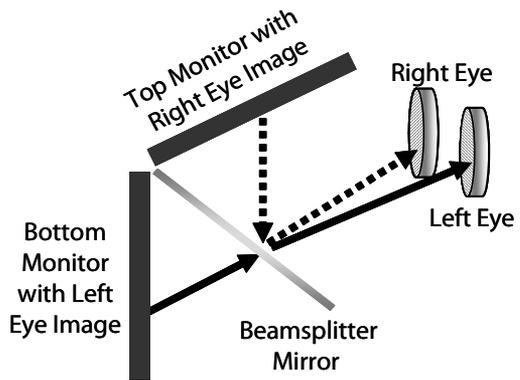
For some individuals, prolonged use of any stereoscopic monitor may cause discomfort. Take a break from stereo viewing if you sense eye fatigue. Individuals who are unaccustomed to using stereoscopic 3D monitors may require a period of adaptation.

# StereoMirror™ Technology

A StereoMirror™ monitor consists of two AMLCD (Active Matrix Liquid Crystal Display) units, oriented at a 110° angle and mounted on a specially designed stand. A passive beamsplitter mirror bisects the angle formed between the two monitors, and there is a fine mechanical adjustment for the mirror angle between the two displays. One side of the glass mirror has a reflective coating, and the other side has an anti-reflective coating to minimize secondary reflections. The mirror has been treated with a hard top coating to accommodate cleaning.

In general, the objective of a stereoscopic display is to efficiently present a left eye image solely to the left eye while the right eye image is directed to the right eye. This allows the human visual system to merge the two images and results in the perception of depth, or stereopsis. In the StereoMirror™ design this stereo separation is achieved using the principle of conservation of polarization.

Liquid crystal displays operate based on the ability of liquid crystal material to modulate plane-polarized light. The two AMLCDs in the SD2020 model have been manufactured so that the



Operating principle of the StereoMirror monitor.

polarized light emitted from the top monitor is 90° rotated from that of the bottom monitor. The image from the lower monitor is seen through the mirror, as shown in the illustration above. When stereo pair images from the two monitors are viewed through crossed-polarizing glasses (glasses with polarizing films mounted on the eyepieces with their planes of polarization at a right angle to one another), the user only sees the left eye image with the eyepiece having the 0°-oriented polarizer and the right eye image with the eyepiece having the 90° polarizer. Light with a perpendicular polarization is not transmitted. The result is a single, fused stereoscopic image.

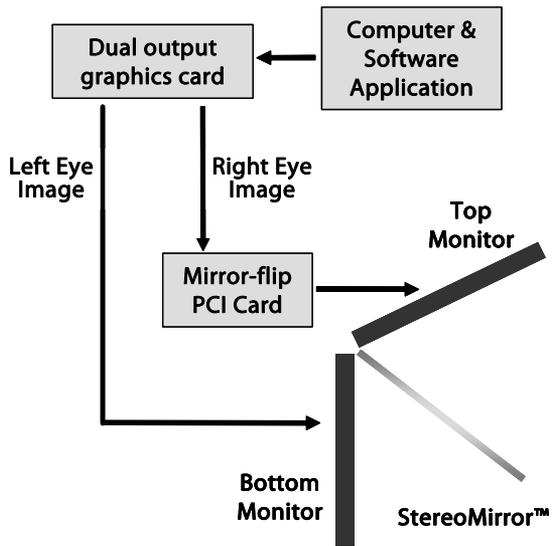
A block diagram describing the process of driving a StereoMirror™ monitor with a computer is shown in the illustration below. The left eye and right eye images are sent to their respective AMLCDs independently and without any special treatment (with the exception of accommodating for the fact that the upper monitor is seen in a mirror; see discussion below). Presenting the stereo pair of images requires a setup or software application that accommodates dual-monitor stereo viewing. No additional modification is needed for use with the StereoMirror™ monitor design.

Any software application that uses the OpenGL quad-buffered stereo features is compatible with the StereoMirror™. Quad-buffered stereo is a feature of the OpenGL 3D graphics library that allows an application to define two separate right/left eye viewpoints instead of the normal single monoscopic viewpoint. The two viewpoints are defined to give the correct parallax separation for the proper stereo effect. Once the two viewpoints have been defined the 3D scene is rendered identically for each of the two viewpoints. Many commercial 3D applications already have stereo viewing modes using the OpenGL stereo features.

Since the upper display of the monitor is seen in reflection, a mirror-flip operation must be performed on that data path. In the current product this is accomplished

using an auxiliary signal processing board in the data path to the upper monitor. Driving a StereoMirror™ monitor is identical to driving a pair of projection displays used to show stereoscopic images with crossed polarizers in the two separate light paths. An off-the-shelf, dual-output graphics card is employed to drive the two monitors, again with no special preparation.

For more information on StereoMirror™ technology, go to [www.planar.com/advantages/whitepapers](http://www.planar.com/advantages/whitepapers).



Driving the StereoMirror monitor.

# Getting Started

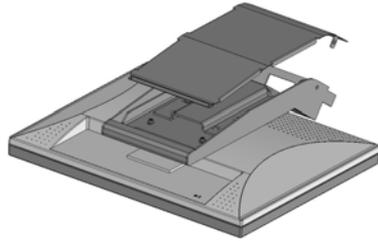
Read all instructions before assembling the monitor. Improper assembly can result in damage to the display components.

## Assemble the unit

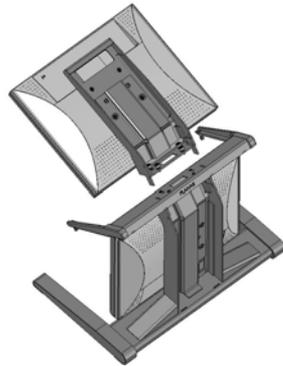
1. Remove the bottom monitor assembly from the shipping box and place it on a sturdy table or desktop. To keep the display surface clean, avoid touching the screen.



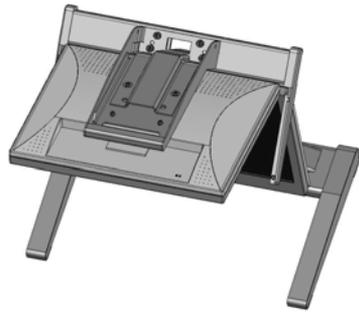
2. Remove the top monitor assembly from the shipping box. Remove the cover of the cable management compartment.



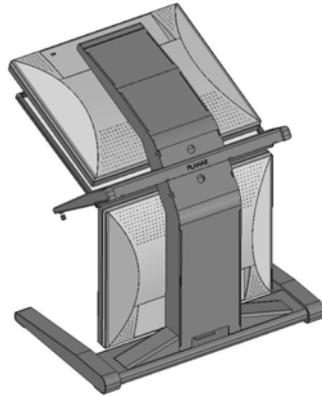
3. Slide the aluminum flanges of the upper assembly into the holes on the cross bracket of the bottom monitor assembly until fully seated. Continue to support the top monitor assembly and tighten the four thumb screws.



4. Thread the cables from the top monitor through the rectangular hole in the cross bracket.



5. Replace the top and bottom cable covers, if desired.



6. Remove the beamsplitter from the shipping case. With the StereoMirror™ logo oriented to the lower right, insert the pins located on either side of the mirror frame into the corresponding slots on the mirror support arms. The pins should rest in the fully forward position of the mounting arm slots.



## Select a graphics card

The SD2020 unit requires a dual-output graphics card to drive the two monitors with a DVI signal. For professional applications that use OpenGL quad-buffered stereo, the graphics card should support OpenGL stereo as well. Typically, the two monitors should be in clone mode for these applications.

There are several compatible graphics card families. The Matrox® Parhelia™ line, the nVidia® Quadro™ FX line, and the 3DLabs® Wildcat Realizm™ line have all been tested and are compatible. Matrox® offers the Parhelia Precision SDT card which incorporates the image inversion functionality of the mirror-flip PCI card. The nVidia® GeForce® line offers several dual-DVI output graphics cards that work well for PC gaming and DirectX® applications.

## Install the mirror-flip PCI card



Proper ESD (electro static discharge) handling precautions should be exercised when installing the mirror-flip PCI card. Consult the computer manual for the installation procedure on graphics cards.

Because the viewer will see a reflection of the top monitor, this image needs to be flipped on the horizontal axis. A mirror-flip PCI card is included with the SD2020 unit. Plug this card into a free PCI slot in your computer. There are no drivers to load with the card.

1. Remove the blank bracket from an available PCI slot.
2. Insert the mirror-flip PCI card into the slot, align the connector pins, and press the board down until it is firmly seated.
3. Secure the mounting bracket.



Mirror-flip PCI card installed.

## Connect the cables

The SD2020 unit comes with one 6-foot DVI cable, one 12-foot DVI cable, and one 14-inch DVI cable.

1. Plug one end of the 6-foot DVI cable into the primary port of the dual-channel DVI graphics card. Plug the other end into the bottom monitor of the SD2020 unit.
2. Plug one end of the 14-inch DVI cable into the secondary output of the dual-channel graphics card. Plug the other end into the input port (labeled "IN") of the mirror-flip PCI card.
3. Plug one end of the 12-foot DVI cable into the output port of the mirror-flip PCI card (labeled "OUT"). Plug the other end into the top monitor of the SD2020 unit.



Short DVI cable installed.



The two monitors must be connected with an off-the-shelf video cable to comply with FCC regulations. Ferrite-core interface cables are provided. This device will not be in compliance with FCC regulations when a non-ferrite-core video cable is used.

## Connect the power cords

Two power cords and two AC adapters shipped with the stereo monitor unit. Use only the power cords and adapters supplied with the unit.

1. Plug an AC adapter into the DC power jack on one monitor. Attach the power cord to the AC adapter. Then plug the power cord into a grounded outlet. Repeat for the other monitor.
2. Turn on the soft power switch located on the front bezel of each LCD monitor.
3. Power up the computer.

## Check the alignment

Although the SD2020 unit is aligned during manufacturing, it may require realignment after reassembly at your site. There are two fine adjustment screws located on the mirror support arms. Rotating these screws raises or lowers the beamsplitter mirror. Adjust the screws so that the corners of the reflected image of the upper monitor are aligned with the corners of the transmitted image from the lower monitor.

A simple grid pattern might prove useful for this process. Samples are available at [www.planar.com/stereomirror](http://www.planar.com/stereomirror). Confirm the alignment by donning the glasses to view the result.

Perfect alignment is not required since the two images are fused by the visual system in the StereoMirror™ design when the glasses are used. Give priority to alignment in the vertical direction. While the human eye can perceive depth from a small amount of displacement in the horizontal dimension, the human visual system has no ability to correlate vertical displacement to depth perception. In fact, coarse vertical misalignment can lead to eye fatigue in some users. Customer feedback and research and testing at Planar verify that the StereoMirror™ design provides excellent extended viewer comfort when aligned with the adjustment provided.

# Product Use

## Operating in 2D mode

Your SD2020 unit can operate either as a 3D stereoscopic monitor or in the standard 2D mode. There are two options to convert to 2D:

- Simply turn off the power to one monitor.
- Lift the mirror and slide it into the locked, upright position.

To return to 3D/stereo, simply reverse the procedure.



StereoMirror in 2D mode.

## User controls and OSD menu

The two monitors have a soft DC power switch near the center of the bottom bezel. This control is used for turning the monitor on or off. To the right of the power switch is an LED power indicator. When the LED is green, the power is on. A yellow light indicates that the monitor is in power-saving mode. The left and right Function Select buttons [Fn] can be used to control the On-Screen Display (OSD) menu selection. The left and right Adjustment Control buttons [+/-] can be used to increase or decrease the OSD setting, respectively.



Controls and LED indicator.

The two monitors have an OSD menu that allows control of the brightness, contrast, and color settings. Adjustment of the brightness setting is not a direct increase or decrease to the overall luminance, but a driving voltage adjustment of the LCD panel. In other words, setting the brightness to 0 (zero) does not reduce the luminance to 0 cd/m<sup>2</sup>.

**NOTE:** Changing the Brightness setting can reduce the number of discernable gray levels.

# Monitor Specifications

## Displays

Size	20.1" diagonal (510 mm)
Display type	Active matrix color TFT LCD panel
Resolution	1600 x 1200 (UXGA)
Display dot	1600 x (RGB) x 1200
Display area (mm)	408 x 306 (H x V)
Pixel pitch	0.255 mm
Brightness (2D mode, mirror raised)	250 cd/m <sup>2</sup> (typical), 200 cd/m <sup>2</sup> (minimum)
Brightness (Stereo/3D Mode)	150 cd/m <sup>2</sup> (typical, through the glasses)
Contrast ratio (2D mode, mirror raised)	700:1 (typical)
Response time	25 ms (15 ms rise, 10 ms fall)
Response time (gray to gray)	16 ms (typical)
Display color palette	16.7 million colors
Refresh rate	49 – 75 Hz (60 Hz recommended)
Power requirements, input voltage	Single phase, 100 – 240 VAC (50/60 Hz)
Power requirements, input current	1.2 A maximum per monitor
Power supply	External
Power consumption	72 W (max) per monitor, 144 W total (6 W total standby)
Product approvals	UL/CUL, CSA, TUV-GS, VCCI, FCC-B, TOC '99
MTBF	50,000 hours at 25 ± 5°C

## Video

Input signal	Analog (VGA), Digital (24-pin DVI-D)
Input impedance	75 Ohm ± 2%
Sync input signal	Digital TMDS, separate TTL compatible horizontal and vertical synchronization
Polarity	Positive, negative
Horizontal scan	24 – 80 kHz
Vertical refresh	49 – 75 Hz

## Plug and Play

The unit supports the VESA DDC2B functions of Plug and Play.

## Power management

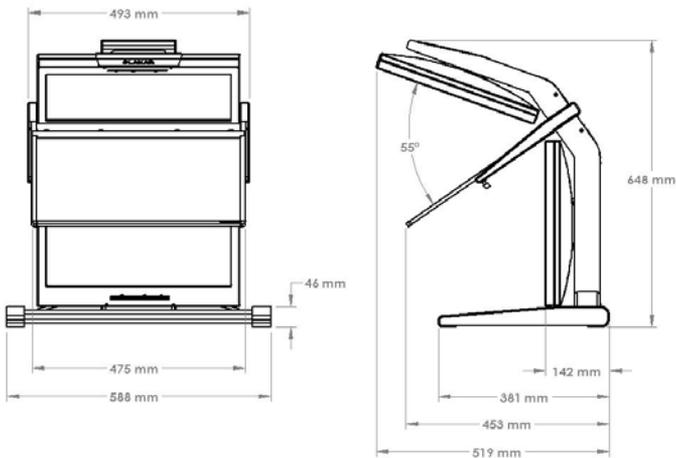
This LCD monitor complies with the VESA DPMS (version 1.0) Power Management guidelines. The VESA DPMS provides four power-saving modes through detection of a horizontal or vertical sync signal. When the LCD monitor is in power-saving mode, the monitor screen is blank and the power LED indicator light is amber.

## Environment

Operating conditions, Temperature	0°C - 50°C (32°F – 122°F)
Operating conditions, Relative humidity	8% - 95%
Storage Conditions, Temperature	-20°C to 60°C (-4°F to 140°F)
Storage Conditions, Relative humidity	8% - 95%

## Size and weight

System width	23.1" (588 mm)
System depth	20.4" (519 mm)
System height	25.5" (648 mm)
System weight	47 lb (21 kg)



Dimensions of monitor unit, front and side.

## System Care

**Monitors.** Turn off the monitors before cleaning. Use a dry, soft cloth, clean room wiper, or compressed air when cleaning the LCD panel surface. A soft cloth moistened with water and/or mild detergent can be used to clean the display housing and stand. Do not touch the LCD panel surfaces with sharp or hard objects. Do not use abrasive cleaners, waxes, or solvents for your cleaning.

**Mirror.** Use a dry, soft cloth, clean room wiper, or compressed air when cleaning the mirror surface. A soft cloth moistened with glass cleaner, water, and/or mild detergent can also be used to clean the mirror. Do not touch the half-mirror surfaces with sharp or hard objects. Do not use abrasive cleaners, waxes, or solvents for your cleaning.

**Polarized glasses.** Use a dry soft cloth, clean room wiper, or compressed air when cleaning the polarized glasses. A soft cloth moistened with water and/or mild detergent can also be used to clean the glasses. Do not touch the surfaces of the polarized glasses with sharp or hard objects. Do not use abrasive cleaners, waxes, or solvents for your cleaning.

## Software Compatibility

**OpenGL®.** The SD2020 unit is compatible with OpenGL stereo. An appropriate graphics card is required to drive the two monitors with DVI signals. For professional applications that use OpenGL stereo support, the graphics card should support OpenGL stereo as well. Stereo viewing of professional applications is typically done in the so-called clone mode where most of the same information is duplicated on the left and right monitor, except for the stereo imagery. In other words, the desktop, windows, and menus are identical, but the bottom monitor shows the left-eye image while the top monitor exhibits the right-eye image.

**DirectX®.** The SD2020 unit is compatible with the DirectX® application programming interface.

## Accessories

For repetitive transportation of the SD2020 unit, a reusable, ruggedized shipping case is available from Planar Systems. The case features a tough plastic shell, locks, customized foam inlay, and removable wheels.

Additional polarized glasses are available from Planar in three styles: Captain, Terminator, and Spring-Clip (for attaching to prescription glasses).

Contact Planar via the web site ([www.planar.com](http://www.planar.com)) or send e-mail to [stereomirror@planar.com](mailto:stereomirror@planar.com). Accessories can also be purchased through the Planar SD2020 resellers.

# CRT Recycling

If your new Planar monitor is replacing a CRT, keep the following in mind:

- If the CRT is in good working condition, consider donating it to a school or non-profit organization. It may qualify as a charitable tax deduction.
- Do not throw away a CRT unit. Cathode Ray Tubes contain hazardous materials and cannot be discarded with other refuse. A number of recycling programs are available. Do an online search of “CRT Recycling” for potential service providers in your area.

# Troubleshooting

Problem	Possible Solution
No image appears on the screen.	<ul style="list-style-type: none"><li>• Check that all the power cord connections are secure.</li><li>• Check that the power buttons on the side and front of both monitors are switched on and that the power indicator light is green.</li><li>• Check that the DVI cables are securely fastened to the graphics card, the mirror-flip PCI card, and the two monitors.</li><li>• Make sure the pins of the DVI connectors are not bent or broken.</li><li>• If only the bottom monitor appears to be working, make sure the graphics card is not in the single-monitor mode.</li></ul>
Partial image or incorrectly displayed image.	<ul style="list-style-type: none"><li>• Check to see if the resolution of the computer/graphics card is higher than that of the LCD panels (1600 x 1200).</li><li>• Check to see that the output timing of the video signals are within the synchronous range of the LCD panels (horizontal: 24 ~ 80 KHz; vertical: 49 ~ 75 Hz). The “Out of Range” message appears on the screen if the timing is not supported by the LCD panel.</li></ul>
Both displays work but there is no stereo functionality.	Be certain the graphics card is properly set up for the dual-monitor stereo mode. If you are using a professional application, make sure that OpenGL settings are enabled. Refer to the owner’s manual for your graphics card.
The stereoscopic image appears to be inverted.	Be certain the video cable to the bottom display is the left channel and the cable to the top display is the right channel. Also make sure that the image sent to the top monitor is mirror-flipped either by software or the mirror-flip PCI card.
Only one display is showing an image.	Be certain that your graphics card is configured for two monitors. Use clone mode, horizontal span (also called stretch mode), or dual-monitor mode configuration. Be sure that all video cables are securely connected.

## Warning Signals

Green power indicator light. Monitor has a signal and is working properly.

Amber power indicator light. Monitor is in power-saving mode.

LED power indicator is out. Monitor power is off.

“Out of Range” message. Video input has an output timing that is outside the synchronous range of the monitor.

“No Input Signal” message. Monitor is powered on, but is not detecting a video signal.

## Warranty

The SD2020 standard warranty includes a 1-year return to depot replacement warranty service. Return the defective part of the system for a replacement with a comparable product.

- All components have a 30-day inspection warranty period
- All system components have a 1-year warranty
- Two business day delivery
- Expedited Delivery Service available
- Warranty Term Extensions available

Go to [www.planar.com](http://www.planar.com) for the complete details of the warranty, including support procedure, returning a nonfunctioning unit, extended warranty limitations, and exclusion of damages.

## Product Registration

To register your product, go to <http://www.planar.com/Support/cust.asp>.

## Important Recycle Instructions



LCD lamp(s) inside this product contain mercury. This product may contain other electronic waste that can be hazardous if not disposed of properly. Recycle or dispose in accordance with local, state, or federal laws. For more information, contact the Electronic Industries Alliance at [www.eiae.org](http://www.eiae.org). For lamp specific disposal information, check [www.lamprecycle.org](http://www.lamprecycle.org).



Customer Service

Online Support: <http://planar.custhelp.com>

E-mail: [desktopmonitors@planar.com](mailto:desktopmonitors@planar.com)

Telephone: 1-866-PLANAR-1 (1-866-752-6271)

Hours: Monday to Friday, 8 A.M. to 9 P.M. Eastern Time

020-0455-00A

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