

# Monitor Field Guide

A practical guide to computer display technology  
for Information Technology professionals



US \$14.95

## **Monitor Field Guide**

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computer display technology for  
Information Technology professionals**

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## **Introduction**

This is a practical guide designed to help Information Technology professionals evaluate, specify, procure and support monitors. This is not a book for computer novices who need to know the basics about monitors, nor is it designed for the technology guru who wants to understand every detail of how a monitor works.

Monitor technology is not glamorous, which is why a guide like this is helpful. The concepts and data in this book are important, but not so critical that you will want to dedicate precious brain cells to remembering details about monitor technology.

The MonitorsDirect team has been manufacturing and supporting monitors and customers for over 15 years. Today we sell and support a wide variety of monitors and graphics cards. MonitorsDirect is not just a reseller, we are a manufacturer. We have developed a range of services specifically for monitors, which are designed to help IT managers improve their support of displays, while reducing the cost of monitors.

If you have questions or comments, send us an e-mail at [FieldGuide@MonitorsDirect.com](mailto:FieldGuide@MonitorsDirect.com).



**Important Monitor Facts  
You Don't Want to Memorize**



### **What is the right refresh rate?**

The answer to this question can vary from person to person and from culture to culture. In the 1980's and early 90's, the industry generally agreed that 72Hz was the minimum refresh rate (in other words the screen is repainted 72 times a second). The rationale was that for most people 72Hz is the minimally acceptable threshold where the human eye can no longer distinguish a "flicker" as the screen refreshes. A scientific study by A.J. Wilkins, outlined in his 1995 book Visual Stress, however, demonstrated that higher refresh rates can significantly reduce eyestrain. The research tested different refresh rates that were not noticeable to the test subjects and found that cumulative exposure to the slower refresh rates increased eyestrain.

Today the refresh rate standard in the United States is 85Hz and above. Interestingly in other countries, like Germany, the standard is at least 92Hz. As a general rule faster is better and heavy computer users should run their monitor at 85Hz or higher.

While faster is generally better, we do not recommend running the display above 100Hz because some monitors struggle to support this speed.

## Calculating the total cost of ownership of a monitor

### Step One: Collect Data

- Estimated failure rate (as a %) over the warranty life of the monitor. If you do not know the failure rate and cannot make an educated estimate, use a conservative estimate like 1% per year, or, for example, 3% for a product with a 3-year warranty. But, it is always best to ask the manufacturer who knows the exact failure rate (and should be willing to tell you).
- Warranty life and terms. You will need to know what your costs are when a monitor does fail. Who pays for parts and labor? Does the manufacturer pay for return shipping? How long will it take to fix?
- One-way shipping. What will it cost if you have to pay the cost of shipping the product back to the manufacturer? Will you have to pay for packaging materials or do you save packaging?
- Estimated cost of lost productivity when the monitor is out of service. This is simply the lost hours of work multiplied by the average hourly rate of your employees.
- Product cost
- Power consumption

### Step Two: Quick Calculation

*Annual Cost of Ownership* = Product Cost ÷ Warranty Period

### Step Three: Detailed Calculation

*Annual Cost of Ownership* = (Product Cost ÷ Warranty Period) + Cost of Electricity for a year + (Probability of Failure x (Cost of Packaging + Cost of Shipping + Other Charges + Lost Productivity))

### **What is the degauss button and why should I care?**

Monitors are very sensitive to interference from magnetic fields. Surprisingly even the earth's natural magnetic field can cause interference. The earth's magnetic field is always changing, and it has a constant influence on the picture. Monitors use magnetic energy to direct the electron gun and the degauss button essentially resets the monitor's magnetic field. All monitors will degauss automatically at boot up, but over time if you do not reboot your system, you may notice that the colors become dull or faded. The degauss circuit thus helps keep the colors pure and the geometry correct. A quick degauss is the best way to reset your monitor and keep it looking its best.

### **What is VESA?**

VESA is the acronym for (Video Electronics Standards Association). Started in 1989, VESA is a consortium of manufacturers who work together to develop standards that all monitor and graphics card manufacturers use when developing their products. The result is that monitor technology is highly compatible and truly “plug and play.”

While VESA has created a number of important standards, the association has left a number of areas undefined. The impact is minimal, however, since virtually all monitor and graphics card manufacturers have developed offerings beyond the VESA standards.

More information on VESA can be found at their web site:  
<http://www.vesa.org/>

### **How hot does a monitor run?**

While power consumption is a common specification, many corporate customers are also interested in the heat a monitor can generate. In large office environments, the heat a monitor puts out can have an impact on air conditioning requirements. The most common way of measuring heat is using the BTU scale (British Thermal Unit). An easy way to estimate how many BTUs a monitor puts out is to multiply the power consumption in watts by 3.4. The total equals heat dissipation in BTUs.

### Will this graphics card work with that monitor?

The key graphics card specification from the monitor's perspective is the RAMDAC (Random Access Memory Digital Analog Converter). Measured in megahertz (MHz), RAMDAC is the speed that the graphics card can convert the computer's digital video signal to the analog signal most monitors require.

The chart below illustrates minimum RAMDAC specifications. . Select the combination of resolution and refresh rate you require and the chart will identify the minimum RAMDAC specification needed for the graphics card (make sure the monitor will support it as well).

Resolution	Refresh Rate				
	60Hz	75Hz	85Hz	95Hz	100Hz
2048 x 1536	270MHz	338	380		
1856 x 1392	226	282	320	357	
1600 x 1200	162	203	230	250	280
1280 x 1024	108	135	158	176	186
1024 x 768	65	79	95	106	112
800 x 600	40	50	56	63	67
640 x 480	25	32	36	40	42

### **The link between monitors and graphics cards**

The saying “it takes two to tango” applies to displays as well. The graphics card and the monitor together define what resolution and refresh rate can be displayed. The graphics card uses its driver software to define what resolution and refresh rates it will support, and the monitor is pre-programmed in its firmware with the corresponding information.

In other words, to run a given resolution, the monitor and graphics card must match. Detailed specifications for both monitors and graphics cards will list the resolution and refresh rates they are capable of displaying. This is important anytime that you are not using VESA standards because your requirements might not be supported.

## Deciphering monitor advertisements

Unfortunately there is no standard for how monitors are advertised. Many manufacturers advertise the maximum resolution a monitor is capable of running, yet typically this requires running the monitor at an unacceptably low refresh rate.

The chart below will help you compare apples to apples. The resolution a monitor can run is defined by the horizontal scan rate measured in kilohertz (KHz). The chart groups resolution and refresh rate combinations that are supported by the maximum horizontal scan rate. For example, a monitor advertised at 1600 x 1200 @ 56Hz is a 70KHz class monitor. It is probably best used at 1024 x 768 @ 85Hz because of the higher refresh rate.

<b>70KHz Class</b>	<b>95KHz Class</b>	<b>107KHz Class</b>	<b>115KHz Class</b>
1600 x 1200 @ 56Hz	2048 x 1536 @ 60Hz	2048 x 1536 @ 65Hz	2048 x 1536 @ 75Hz
1280 x 1024 @ 75Hz	1856 x 1392 @ 66Hz	1856 x 1392 @ 70Hz	1856 x 1392 @ 85Hz
1024 x 768 @ 85Hz	1600 x 1200 @ 75Hz	1600 x 1200 @ 85Hz	1600 x 1200 @ 95Hz
	1280 x 1024 @ 85Hz		



### **The great resolution myth**

Is higher resolution always better? It should be, but many people believe that high-resolution monitors have a disadvantage: small fonts.

Higher resolution levels increase both the quantity and quality of the monitor image. It increases detail by adding pixels to the screen creating truer diagonal lines and curves. It also helps improve productivity by displaying more information on the screen at once. So why are the fonts so small?

The Windows operating system was really not optimized for high-resolutions. All Windows fonts, however, can be adjusted for high-resolution displays. While we have created software that adjusts the fonts automatically, you can also go into Display Properties from the Windows Control Panel to adjust the fonts manually. You only have to make the adjustment once and can then load the definitions on your users' systems. The result: all the benefits of high-resolution without the frustration of small fonts.

### What do terms like VGA and SVGA mean?

IBM first coined the term VGA to describe 640 x 480 resolution and went on to create additional terms to describe resolution. Unfortunately today these terms are not used consistently. We strongly advise using specific resolution levels when describing the display. If you want to use these terms, however, we recommend using IBM's original definitions.

<b>IBM Resolution Term</b>	<b>Resolution by Pixel Dimensions</b>
VGA	640 x 480
SVGA	800 x 600
UVGA	1024 x 768
XGA	1280 x 1024
UXGA	1600 x 1200

### **Justifying the cost of a larger monitor**

A larger monitor can improve legibility, but larger monitors that support higher resolution levels allow users to see more on the screen at one time. Seeing more means that the user can scroll less, or display two applications at once. The bottom line is that high-resolutions can reduce mouse clicks and boost productivity. But how much are a few saved mouse clicks worth?

Let's assume that stepping up to a higher resolution monitor saves just one mouse click every four minutes. Let's further assume that each click costs you a second of time to find the mouse, click and return to the keyboard. That is fifteen seconds of saved time an hour. This may not sound like much, but over eight hours a day, 250 days a year that adds up to eight hours a year and 25 hours over the life of the typical monitor (3-years). If the average employee in your organization earns \$25 an hour, the productivity savings of stepping up to a larger monitor saves over \$200 a year or \$625 over the life of the monitor.

This example is designed to be conservative, but it demonstrates the power of high-resolution displays. Try it out on your boss!

### **Do monitors need software drivers?**

No. But again, there is confusion here. Graphics cards need drivers, but monitors can use INF files (sometimes referred to as monitor drivers). However, installation of the INF file is only required in rare circumstances. In fact, the INF file is simply a small text file that lists the capabilities of the monitor. This information is also stored in the monitor's firmware and is communicated to the operating system every time the computer boots up.

Monitor INF files contain specific information about the monitor including:

- Manufacturer name
- Model name
- Maximum resolution and refresh rate

Resist the urge to install the INF file unless the operating system asks you for it. Many of the Windows operating systems use Plug and Play technology, also known as DDC (Display Data Control), to automatically detect the monitor and install the appropriate information.

So when should you use INF files? Only when the operating system asks for it, or when there is a problem.

### **What is color temperature?**

Most monitors have presets for three-color temperatures that can improve legibility in different applications.

9300 degrees Kelvin is the default setting on virtually all desktop monitors. It is often referred to as “computer monitor white” and gives the highest absolute luminance but is distinctly bluish in color.

6500 is generally considered a “whiter” white and is often referred to as “daylight white.” It is the standard temperature used in the TV industry and is the best choice if you are displaying video on your computer monitor.

Another common setting is “standard white” (5500 or 5000 degrees Kelvin). It is more red than 6500 and often is referred to as “paper white.” As you might guess, it is most often used in document management, photographic and pre-press applications.

## **Everything you need to know about monitor cables**

Monitor cables might be the easiest part of the technology. In general, an integrated cable (one that does not unplug) creates the best connection because the cable is soldered to the video amplifier. This is always the best cable connection.

There are two common options for detachable video cables: “BNC” cables and “15-pin Mini D Sub” cables. There is virtually no difference between the two in terms of visual quality, but there are few subtle differences. The BNC cables tend to be more robust and less likely to break, but they do not support Window’s Plug & Play technology. The BNC cables also require five separate connections, which can make them difficult to use. The “15-pin Mini D Sub” is the standard today.

Historically Macintosh users have had to purchase a “Mac adapter” to connect their system to a standard monitor. All Macintosh computers built since the introduction of the G4 chip use the same video connection as Windows systems based on the Intel chip, thus eliminating the need for a Mac adapter.

### **What is digital in a digital monitor?**

Virtually all CRT monitors have been analog since the introduction of the first VGA monitor.

There is a new digital interface standard emerging called the Digital Visual Interface (DVI), but a digital monitor may not be what you think. A monitor is basically an analog device and both CRTs and LCDs ultimately require an analog signal. A traditional monitor relies on the graphics card to convert the digital signal to an analog signal using the RAMDAC chip. The DVI interface does the conversion in the monitor instead of on the graphics card.

The primary advantage of using a digital monitor is that the digital signals are less prone to degradation and interference than analog signals as they travel across the cable.

The DVI standard has not been extended to high-resolution monitors that have a high refresh rate. Instead they are most popular with LCD monitors which run at relatively slow refresh rates. Note that digital monitors do require an appropriate graphics card.

### **What is the TCO emission standard and should I care?**

Originally the TCO standard was designed to develop standards that protect users from monitor emissions. Most experts agree that all monitors on the market today are safe, no matter what emission rating they have. Today the most significant aspect of the TCO 99 standard is the proportion of the monitor that can be recycled. If your organization has a strong commitment to recycling you should consider standardizing on monitors developed to the TCO 99 standard.



### **Determining the tube technology**

The fastest way to tell what kind of tube technology a monitor uses is by giving it a quick slap on the side while the monitor is running. That's right hit your monitor! While users should not make a habit of hitting their monitor, it is the easiest way to determine whether the monitor uses shadow mask or aperture grille technology. After a slap a shadow mask tube will retain a steady image, while the aperture grille picture will shake and waver for a few seconds. A second method, that is not nearly as fun, is putting a pure white screen up and looking for the two horizontal damper lines characteristic of an aperture grille monitor that will divide the screen into thirds.

## **Buying a Monitor**

## **Choosing the right CRT Part 1: Shadow mask tubes**

There are four common CRT (Cathode Ray Tube) monitor tube technologies to consider. The shadow mask is a thin metal grill with tiny holes that produce a sharp electron beam. There are two common types of shadow mask tube.

### **Conventional Shadow Mask Tube**

- Sometimes called a “flat square” tube although the tube does have some curvature.
- Advantages:
  - Least expensive
  - Typically the sharpest tube for text based applications.
- Disadvantages:
  - The curvature can create a distracting reflection.

### **Flat Shadow Mask Tube**

- Uses a perfectly flat surface
- Advantages:
  - Shadow mask technology is good for text based applications.
  - Flat surface aids reflection management
- Disadvantages:
  - While flat on the outside, the tube is curved on the inside. The result is thicker glass at the edges, which can impact the optics at the edges.
  - Currently commands a premium price
  - Is significantly heavier than conventional tubes

## **Choosing the right CRT Part 2: Aperture grille tubes**

There are two types of aperture grille technology that use vertical metal strips to mask the electron beam. Aperture grille monitors thus let more light through but do not produce as sharp of a beam as shadow mask monitors.

### **Conventional Aperture Grille Tube**

- Advantages:
  - These tubes let out more light and generate brighter colors making this technology ideal for graphically intensive applications.
- Disadvantages:
  - Text detail and diagonal lines may not be as sharp as shadow mask models.
  - Two horizontal lines running across the entire screen can be annoying.

### **Flat Aperture Grille Tube**

- Advantages:
  - These tubes let out more light and generate brighter colors making this technology ideal for graphically intensive applications.
  - Flat glass allows for reflection management.
- Disadvantages:
  - Without a shadow mask sometimes detail can suffer. This is usually noticed in text or line based applications.
  - Two horizontal lines running across the entire screen can be annoying.
  - While flat on the outside, the tube is curved on the inside. The result is thicker glass at the edges, which can impact the optics at the edges.
  - Currently commands a premium price

## **Why is dot pitch the most confusing monitor specification?**

There are numerous ways to measure dot pitch and, unfortunately, most manufacturers do not always tell you which measure they are reporting—be sure to ask.

### **Diagonal Dot Pitch**

- Definition: Measures the diagonal distance between like color pixels.
- Diagonal dot pitch is the best measure of dot pitch and good when comparing two shadow mask monitors. It cannot be used, however, to compare a shadow mask monitor to an aperture grille monitor.

### **Horizontal Dot Pitch**

- Definition: Measures the horizontal distance between like color pixels. Sometimes referred to as “stripe pitch” for aperture grille monitors.
- The best measure for comparing all monitor technologies to each other.

### **Mask Pitch vs. Phosphor Pitch**

- Definition: Mask pitch measures the distance holes or stripes on either the shadow mask or the aperture grille. Phosphor pitch measures the distance between like colored dots.
- By definition “mask pitch” is always smaller than “phosphor pitch” because it sits closer to the source of the electron beam. Mask pitch is only used because it allows manufacturers to show a tighter specification.

### **How manufacturers hide flaws**

If you have shopped for monitors recently you know that it can be difficult to tell one monitor from another. Typically key specifications like dot pitch, resolution, and tube technology are the same. It can be very difficult to distinguish the differences.

We believe that the “default viewable area” may be the best indications of a monitor’s overall quality. It is fairly straightforward to get a good sharp picture in the center of the monitor, but keeping the image sharp across the entire screen and into the edges can be difficult.

When image quality at the edges degrades, some manufacturers choose to simply reduce the viewable area as a way of hiding its design or manufacturing flaws. The smaller viewable areas tend to make the display look sharper and hide visual defects. Be careful. Default viewable area is not the maximum viewable area that is most commonly advertised but instead the image size pre-programmed as the monitor’s default image size.

All things being equal, the monitor with the larger default viewable area probably has a better overall manufacturing and design process. More importantly it probably has less to hide.

### **What do I need to know to buy a LCD monitor?**

The good news is that there are fewer things that can go wrong in the manufacturing process of LCDs. Also, quality from one brand or model to another tend to be closer than their CRT cousins. Here is what is most important.

- Check and compare prices on a monthly basis. These products are expensive and prices change constantly.
- Remember that unlike CRTs, LCDs work best in a fixed resolution. It is important to make sure you know what resolution you will be using before you purchase the monitor.
- Compare specifications for brightness, pixel density and both the horizontal and vertical viewing angles. Viewing angle ensures color consistence, pixel density improves image quality, and brighter LCDs look better.
- From a warranty perspective, make sure you understand the warranty for the backlight. Many warranties have different warranties for the monitor and the backlight. If the backlight fails most monitors must be returned to a repair facility.
- Ask the manufacturer about their dead pixel policy. Unlike CRTs, LCDs use dedicated pixels, and a dead pixel can be very annoying and cannot be repaired. Look for guarantees that the monitor will be replaced if more than five dead pixels appear or if any two adjoining pixels are dead.

### **Ask monitor manufacturers questions before you buy**

There is a lot that manufactures do not publish. We suggest you call and ask them about a few specifications they do not publish. You will get a sense for the company and a better sense for the monitor. If you cannot find a sales rep to talk to, call the technical support line with your questions.

We recommend you ask about the “convergence” specification. Few manufacturers publish this specification and yet it is critical to a sharp display. Convergence is the degree of alignment of the electron beams. Perfect convergence will perfectly align the red, blue and yellow beams to create a white dot. Even small levels of misconvergence can result in a fuzziness in text based applications. Convergence is especially important for reading text. Manufacturers should provide two numbers - one measure for the center and one for the edges. Look for specifications at the edges of .35mm or less.



### **Analyzing the manufacturer's warranty**

Below is a list of suggested questions to ask the monitor manufacturer about their warranty program.

- What is the standard term of the warranty?
- What is the turn around time for repairing the monitor?
- Will they pay for return shipping?
- What is the failure rate of the monitor you are considering?
- What is the defective "dead pixel" policy?
- Does the policy cover mask or grille damage in shipping?
- What is not covered by the warranty?
- If the monitor is defective will you receive an advance replacement unit?

Some of these questions are appropriate for the manufacturer, while some are appropriate for the reseller. Frequently this requires reading the fine print or, better yet, calling the customer service department before you buy the product—they know the warranty program better than anyone does.

### **Negotiating the best price**

Identify a product you want to purchase and make sure you know the key specifications. Over 80% of the monitors on the market today are not manufactured by the company whose name is on the product. Take a look at lesser-known brands with similar specifications. Chances are they are identical to better-known brands and are more flexible about pricing. If you specify a specific brand you will limit your ability to negotiate a better price.

You have the best price potential when you purchase factory-direct. If you want to purchase through a reseller, use a “shopping bot” (a Web site that summarizes the reseller prices) to find the lowest price on the Internet (do not forget to factor in shipping prices and sales tax, if appropriate). As a general rule, the low Internet price is within 5% of the product’s cost to the reseller. Use this price to negotiate with your favorite reseller. Resellers do have the ability to go back to the manufacturer and ask for a special “big deal” price, but these “bid” situations are generally reserved for purchases in excess of 50 monitors at a time.

We cannot address this topic without mentioning the authors’ web site, [MonitorsDirect.com](http://MonitorsDirect.com), which specializes in factory-direct pricing as a way of reducing price and improving services.

### **How much video RAM should a graphics card have?**

Video RAM on a graphics card is important for running 3-D applications. It has no impact on running most business applications. If your employees play a lot of games during the day you might want to consider a 32MB card. For the rest of us, 16MB is sufficient in our 2-D computer world.

## **Evaluating a Monitor Part 1: What are you looking for?**

Manufacturing a monitor is part art and part science. Evaluating just one unit is sort of like determining your favorite type of apple by tasting just one apple from each bin. Monitor quality can vary dramatically and the unit you sample may not always resemble the units you purchase. This is especially true when you are looking at larger monitors.

We believe that an evaluation is an important part of the process, but far from the only criteria. Start with a complete list of specifications. The specifications represent the standard that 100% of all monitors will meet. In general, the published specifications speak more to overall quality than an examination of any one unit. Ask for specifications that are not published like “convergence” and the “failure rate.”

There are two common evaluation strategies. A side-by-side evaluation allows for a quick comparison. It is also a good idea to set up a heavy user with a prospective monitor and allow them to use the monitor for at least four hours if not longer. Because the human eye is very good at accommodating imperfections on the display, only after long exposure can you get an accurate read of overall image quality.

## **Evaluating a Monitor Part 2: Side-by-side comparison**

### **Set up the monitors**

- Maximize viewable area
- Run at “recommended” resolution and refresh rate
- Use a high quality video splitter or a dual head graphics card

### **Compare monitor**

- The side-by-side evaluation works best when one monitor is the model your organization is currently using.
- For a technical evaluation use monitor test software. We recommend DisplayMate at [www.displaymate.com](http://www.displaymate.com).
- Many evaluators prefer a real world evaluation running real world applications across both screens and comparing the results.

### **Key tests**

- Run DisplayMate’s video obstacle course
- Pay close attention to the corners and edges
- Listen to the monitor. Monitors should be seen, not heard.

## **Supporting Monitor Users**

### **My user is complaining of jumpy wavy lines**

This is called a moiré pattern. Moiré patterns happen when two grids are layered and slightly offset. While these patterns can be annoying technically it is an optical illusion and not a defect. It is also a sign that you have a high-quality monitor because moiré is only noticeable when the monitor image is particularly sharp.

OK, but so far we have not said anything about how to help your users.

The first step is to check what resolution the user is running. Moiré patterns typically are seen when a high-resolution monitor is run at low resolutions. Most users should be happy to step up to the resolution that the monitor is optimized for.

The second step is to see if the monitor has a moiré adjustment. This feature actually “softens” the focus as a strategy for clearing up the moiré pattern.

Finally, moiré is usually an issue when the user has selected a light colored background for the Windows Desktop. By simply changing to a darker color or adding a pattern to the desktop display, most issues can be quickly resolved.

### **Speakers: the mortal enemy of monitors!**

Monitors and speakers do not get along, and it is not about politics. Both technologies create magnetic fields that do not always get along together.

Monitors use an electromagnetic field to deflect the electron beam. Speakers, especially larger sub woofers, use a magnet to create sound. While a monitor is unlikely to bother the speaker, the speaker can wreak havoc on the monitor.

The magnetic interference caused by speakers can cause shaking, jitter or cause problems with color. It is best to keep speakers, and anything that creates a magnetic field, away from the monitor. In addition to speakers, you may want to check for electric fans, cellular phones, fluorescent lamps, air conditioners or anything with an electric motor.



## **Monitor ergonomics**

Monitor ergonomics involve creating a working environment that minimizes eyestrain and reduces neck and back fatigue. Here is a list of tips to consider:

- The monitor should be positioned at least 18 inches from the user's eyes.
- Eyes are most comfortable reading when they are looking down, thus the user should be seated high enough so that they are looking down slightly at the center of the screen.
- Operating system fonts should be adjusted so that they can be read comfortably.
- Adjust the display brightness first to make the black characters as dark as you can make them. Then adjust the contrast until it is comfortable.
- Use a refresh rate of 85Hz
- Minimize the use of direct lighting
- Minimize ambient light
- Look away from the screen periodically
- Blink!

### **When it is time to buy a new monitor**

Monitors generally have a long life expectancy but here are some signs that your monitor has outlived its useful life and needs to be replaced.

- Image rolls and does not synchronize
- Excessive adjustments required for brightness or focus
- Low brightness that cannot be adjusted
- Colors faded or dull and degaussing does not help
- A squeal or whining noise
- The image gets very large for short periods of time, sometimes called “blooming”
- Horizontal lines that streak across the screen
- Smoke or electrical burning smells. Turn off the monitor immediately!
- Poor focus or fuzzy text that cannot be corrected
- Image compression that gives picture a “squashed” look that fails to fill the screen
- Missing colors when you can confirm it is not a cable problem
- Ghosting, shadows or streaks adjacent to the vertical edge of an image
- Recurring requirement to adjust the image

### **When it is time to buy a new graphics card**

Sometimes it can be difficult to tell if a video problem is the result of a failing monitor or a failing graphics card.

The easiest test, of course, is to replace the failing display with a new monitor and see if that clears up the problem. If it does not, then it is most likely the graphics card that is failing.

Installing a new monitor:

- Unplug the current monitor from the system.
- Delete the hardware profile in the Windows device manager.
- Plug in the monitor you know is working well and power it up.
- Reboot the system and step through the instructions as it recognizes the monitor.

Common signs that a graphics card is failing include:

- Screen flickers and refresh rate cannot be adjusted up
- Poor focus or fuzzy text that is not attributable to a failed monitor

**Technical Support contact information for  
major manufacturers**

**ADI**

<http://www.adiusa.com/support.html>  
1-408-944-0100 ext.152

**Apple Computers**

<http://www.apple.com/support/>  
1-800-500-7078

**Compaq Computers**

<http://www.compaq.com/support/>  
1-800-345-1518

**Cornerstone**

[http://www.monitorsdirect.com/online\\_store/service.shtml](http://www.monitorsdirect.com/online_store/service.shtml)  
1-888-338-6490

**CTX**

[http://www.ctxintl.com/sts/sts\\_index.htm](http://www.ctxintl.com/sts/sts_index.htm)  
1-800-266-1491

**Dell Computers**

<http://support.us.dell.com/us/en/index.asp?redir=1>  
1-800-624-9897

**Eizo**

<http://www.eizo.co.jp/welcome/contact/index.html>  
1-562-431-5011

**Gateway Computers**

<http://www.gateway.com/support/choose.shtml>  
1-800-846-2301

**Hewlett Packard**

[http://www.hp.com/cposupport/mail\\_support.html](http://www.hp.com/cposupport/mail_support.html)  
1-970-635-1000

**Hitachi**

<http://www.hitachidisplays.com/support/index.htm>  
1-800-536-6721

**IBM**

<http://www.pc.ibm.com/support>  
1-800-772-2227

**Iiyama**

<http://www.iiyama.com/>  
1-800-594-7480

**Impression**

[http://www.impression-brand.com/tech\\_contact.asp](http://www.impression-brand.com/tech_contact.asp)  
1-888-523-7878

**KDS**

<http://www.shopkds.com/service/helpdesk.asp>  
1-800-283-1311

**LG**

<http://www.lgservice.com/bin/HPI/HpiHomeMain.exe>  
1-800-243-0000

**Mag Innovation**

[http://www.maginnovation.com/Service\\_Support/default.asp](http://www.maginnovation.com/Service_Support/default.asp)  
1-800-827-3998

**Mitsubishi**

<http://www.necmitsubishi.com/css/index.cfm>  
1-800-632-4662

**MonitorsDirect**

[http://www.monitorsdirect.com/online\\_store/service.shtml](http://www.monitorsdirect.com/online_store/service.shtml)  
1-888-338-6490

**NEC**

<http://www.necmitsubishi.com/css/index.cfm>  
1-800-632-4662

**Princeton**

<http://www.prgr.com/Support/SupportF.html>  
1-800-747-6249

**Proview**

<http://proview.net/servicedrv.htm>  
1-800-776-8439

**Samsung**

<http://www.samsungmonitor.com/html/support/>  
1-800-SAMSUNG

**Sceptre**

<http://www.sceptre.com/Support/index.htm>  
1-800-788-2878

**Sony**

<http://www.ita.sel.sony.com/support/displays/>  
1-800-326-9551

**Viewsonic**

<http://www.viewsonic.com/support/>  
1-800-688-6688

## Trouble Shooting Guide

Symptom	Causes	Solution
Color is wrong	Usually a cable problem	<ul style="list-style-type: none"> <li>• Make sure the cable is properly inserted</li> <li>• Test with another cable to see if the cable connection has broken</li> </ul>
Colors are impure	Possible magnetic interference	<ul style="list-style-type: none"> <li>• Degauss monitor</li> <li>• Remove other electronics that may be interfering</li> </ul>
Corner focus problem	Problem common with "short-neck" displays. If this is a new problem that has not happened before, it is likely a convergence issue.	<ul style="list-style-type: none"> <li>• Use a magnifying glass and look at a white line on black background. Look for convergence visible red, blue or green colors.</li> <li>• Use convergence adjustments</li> <li>• Call the manufacturer's technical support line</li> </ul>
Dark spot in screen	Likely an issue with the shadow mask or aperture grille.	<ul style="list-style-type: none"> <li>• Call the manufacturer's technical support line</li> </ul>
Displays only 16 colors	Probably means the graphics card is not properly installed.	<ul style="list-style-type: none"> <li>• Reinstall the graphics card's software driver. You may have to uninstall the software, then reboot, then reinstall.</li> </ul>
Flicker - Screen seems to jump especially when viewed out of the corner of your eye	Refresh rate is too low	<ul style="list-style-type: none"> <li>• Use the Display Properties to check the refresh rate. It should be 85Hz or higher.</li> <li>• Try rebooting and make sure monitor power is turned on during the boot process.</li> </ul>

Symptom	Causes	Solution
Fuzzy text	Hard to diagnose. Likely a graphics card issue.	<ul style="list-style-type: none"> <li>• Try the monitor on another computer with a different graphics card</li> <li>• Try a lower resolution</li> <li>• See suggestions for “corner focus” problem</li> </ul>
Geometric distortion	Numerous causes when an image doesn’t look “square”	<ul style="list-style-type: none"> <li>• Remove other electronics that may be causing magnetic interference</li> <li>• Set resolution to monitor’s optimal setting</li> <li>• Install INF file</li> </ul>
Ghosting or streaking	Typically caused when using an extension cable or an inexpensive video splitter box	<ul style="list-style-type: none"> <li>• Monitor cable should not be more than six feet</li> <li>• Monitor cable may not be attached correctly</li> <li>• Horizontal settings adjusted improperly</li> <li>• Purchase a high-end video splitter</li> </ul>
Moiré pattern Wavy pattern Shaky image	Naturally occurs on really sharp displays. Especially noticeable when high-resolution display runs at low resolutions.	<ul style="list-style-type: none"> <li>• Set resolution to monitor’s optimal setting</li> <li>• De-focus using the monitor’s moiré adjustment</li> <li>• Make sure refresh rate is 85Hz or higher</li> <li>• Check for external electronic devices including florescent lights, speakers and other devices that create magnetic interference.</li> </ul>
Noisy high pitch squeal	Something is loose inside the monitor.	<ul style="list-style-type: none"> <li>• Call the manufacturer</li> </ul>

Symptom	Causes	Solution
Power light does not come on	Monitor is not getting power	<ul style="list-style-type: none"> <li>• Turn on the monitor</li> <li>• Confirm that the power and video cables are correctly attached</li> <li>• Replace the power cord</li> <li>• If still not working, monitor power supply is broken. Call manufacturer's technical support line.</li> </ul>
Power light is on but no picture	Various causes	<ul style="list-style-type: none"> <li>• Check monitor cable is plugged in correctly</li> <li>• Confirm video cable is working</li> <li>• Reboot in safe mode and if you get video, then the refresh rate is set outside of the monitor's capabilities.</li> <li>• Try testing a monitor that you know works. If it works then you can isolate the issue to the monitor.</li> </ul>
Screen burn	Occurs when an image has been left on the screen for a long time	<ul style="list-style-type: none"> <li>• Use a screen saver</li> <li>• Probably time for a new monitor</li> </ul>
Screen looks concave	Flat screen monitors are flat on the outside but not on the inside	<ul style="list-style-type: none"> <li>• A design feature that cannot be adjusted</li> </ul>
Stuck in sleep mode	Not getting the proper signal from the video card	<ul style="list-style-type: none"> <li>• Reinstall the graphics card and cable</li> <li>• If not effective, replace the graphics card</li> </ul>



## Loading INF Files

### INF File Installation

First, if you are using Windows 95, determine which version of Windows 95 you are using. To do this, place your mouse cursor over the My Computer icon and perform a right click. From the list, select Properties. Look at the General tab. You should see System: Microsoft Windows 95 4.00.95xx. Look at the line that starts with 4.00. If your system reports either 4.00.950 or 4.00.950a then proceed to section 1. If your system reports 4.00.950b proceed to section 2. For Windows 98 proceed to section 3. For Windows ME proceed to section 4. For Windows 2000 proceed to section 5.

## **SECTION 1 -- Installing In Windows 95, (Classic)**

NOTE: Be sure to exit all applications before starting the setup.

1. Begin by going to your Display Properties page. You can do this by right clicking on your desktop and selecting Properties or by going to the Control Panel and double clicking on the Display icon.
2. Go to Settings tab.
3. Click the Change Display Type button.
4. In the Change Display Type window, click the Change button to the right of the Monitor Type Field.
5. In the Select Device window, click the Have Disk button.
6. Supply the location of INF file and click OK. The default location is A:\. If you have copied the file to a different drive, type the location in the "Copy manufacturers files from" field.
7. From the list choose the appropriate monitor and click OK.
8. Once your selection appears in the Change Display Type window, click Close.
9. Click Apply and then the OK button to save the changes.
10. Adjust your monitor as needed. Consult your Display Manual for further information on adjusting screen size and position.

## **SECTION 2 -- Installing In Windows 95, (OSR2)**

NOTE: Be sure to exit all applications before starting the setup.

1. Begin by going to your Display Properties page. You can do this by right clicking on your desktop and selecting Properties or by going to the Control Panel and double clicking on the Display icon.
2. Go to Settings tab.
3. Click the Advanced Properties button.
4. Click the Monitor tab.
5. Click the Change button.
6. In the Select Device window, click the Have Disk button.
7. Supply the location of INF file and click OK. The default location is A:\. If you have copied the file to a different drive, type the location in the "Copy manufacturers files from" field.
8. From the list choose the appropriate monitor and click OK.
9. Once your selection appears in the Advanced Display Properties window, click on OK.
10. Click Apply and then the OK button to save the changes.
11. Adjust your monitor as needed. Consult your Display Manual for further information on adjusting screen size and position.

### SECTION 3 -- Installing In Windows 98

NOTE: Be sure to exit all applications before starting the setup.

1. Begin by going to your Display Properties page. You can do this by right clicking on your desktop and selecting Properties or by going to the Control Panel and double clicking on the Display icon.
2. Go to Settings tab.
3. Click the Advanced button.
4. Go to Monitor tab.
5. Click the Change button.
6. This will start the Update Device Driver Wizard. Click Next.
7. Select "Display a list of drivers in a specific location," so you can select the driver you want. Click Next.
8. Click the Have Disk button.
9. Supply the location of INF file and click OK. The default location is A:\. If you have copied the file to a different drive, type the location in the "Copy manufacturers files from" field.
10. From the list choose the appropriate monitor and click Next.
11. You should now see your monitor model and driver location. If the wrong information appears then click the Back button and repeat steps 6-8. If the correct model is listed then click Next and Windows 98 will install your monitor driver.
12. Click the Finish button. Click Apply and then OK button to save the changes.
13. Adjust your monitor as needed. Consult your Display Manual for further information on adjusting screen size and position.

## Section 4 -- Installing in Windows ME

NOTE: Be sure to exit all applications before starting the setup.

1. Begin by going to your Display Properties page. You can do this by right clicking on your desktop and selecting Properties or by going to the Control Panel and double clicking on the Display icon.
2. Go to Settings tab.
3. Click the Advanced button.
4. Go to Monitor tab.
5. Click the Change button.
6. Select "Specify the location of the driver." Click Next.
7. Select "Display a list of all the drivers in a specific location" so you can select the driver you want. Click Next.
8. Click the Have Disk button.
9. Supply the location of INF file and click OK. The default location is A:\. If you have copied the file to a different drive, type the location in the "Copy manufacturers files from" field.
10. From the list choose the appropriate monitor and click Next.
11. You should now see your monitor model and driver location. If the wrong information appears then click the Back button and repeat steps 8-10. If the correct model is listed then click Next and Windows ME will install your monitor driver.
12. When done click the Finish button. Click Apply and the OK button to save the changes.
13. Adjust your monitor as needed. Consult your Display Manual for further information on adjusting screen size and position.

## Section 5 -- Installing In Windows 2000

NOTE: Be sure to exit all applications before starting the setup.

1. Begin by going to your Display Properties page. You can do this by right clicking on your desktop and selecting Properties or by going to the Control Panel and double clicking on the Display icon.
2. Go to Settings tab.
3. Click the Advanced button.
4. Go to Monitor tab.
5. Click the Properties button.
6. This will open the Monitor Properties. Select the Driver tab.
7. Click the Update Driver button.
8. This will start the Update Device Driver Wizard. Click Next.
9. Select "Display a list of the known drivers for this device so that I can choose a specific driver" and click Next.
10. Click on the Have Disk button.
11. Supply the location of INF file and click OK. The default location is A:\. If you have copied the file to a different drive, type the location in the "Copy manufacturers files from" field.
12. From the list choose the appropriate monitor and click Next.
13. You should now see your monitor model. If the wrong information appears click the Back button and repeat steps 10-12. If the correct model is listed here click next and Windows 2000 will install your monitor driver. You may be prompted with a warning about this driver not having a Microsoft Digital Signature. Click on the Yes button to continue with the installation.

14. When done click on the Finish button. Adjust your monitor as needed. Consult your Display Manual for further information on adjusting screen size and position.





## About the Authors

### **MonitorsDirect**

MonitorsDirect.com was launched in January 2000 as a means of selling monitors and graphics cards factory-direct. The MonitorsDirect team has been manufacturing the Cornerstone brand since 1986, and in 2000 became the first manufacturer to move to a factory-direct pricing model over the Internet. The result is that by eliminating two tiers of middlemen prices dropped approximately 20%. MonitorsDirect also launched a range of service programs designed specifically to meet the unique requirements of computer monitors. The result: better pricing and better service on high quality monitors.

Today MonitorsDirect offers more than 100 different monitors from most of the major manufacturers. The Internet side also offers a range of on-line tools to help buyers research and compare monitors.

### **Jim Witkowski**

Jim is the Chief Engineer at MonitorsDirect. He has been evaluating and designing monitors for years and has generated a few hard and fast opinions that are reflected in this book. Jim spends a lot of time working with customers to help them evaluate their display requirements. Along the way he has developed a good understanding for what is important to users and buyers alike.

### **Nathan Hogan**

Nathan is the Director of Technical Services at MonitorsDirect. Nathan's technical team specializes in solving problems and making customers happy. Nathan knows better than most what is confusing about monitors and has helped to make life a little simpler with this book.

**Greg Harris**

Greg, in his role as Vice President of Marketing for MonitorsDirect, authorized the budget for this book. He offered virtually no expertise or insight in the development of this book, but really likes to see his name in print.

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