

# Computer screen or monitor

## Introduction to computer monitors

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A **monitor** (or *screen*) is a computer display unit. There are generally said to be two families of monitors:

- Cathode-ray tube monitors (or *CRT* for short), which are used with most desktop computers. They are heavy and voluminous, and use a great deal of electricity.
- Flat-screen monitors are used with most laptop computers, personal digital assistants (PDAs), and digital cameras, as well as an increasing number of desktop computers. These monitors are thinner (hence the name), light, and are less power-consuming.

## Technical specifications

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The most common specifications for monitors are:

- **Definition:** the number of pixels that the screen can display. This number is usually between 640x480 (640 pixels long, 480 pixels wide) and 2048x1536, but higher resolutions are technically possible. The table below gives recommended definitions based on the size of the screen's diagonal:

| Diagonal | Definition |
|----------|------------|
| 15       | 800x600    |
| 17       | 1024x768   |
| 19       | 1280x1024  |
| 21       | 1600x1200  |

- The **size:** This is calculated by measuring the screen's diagonal, and is expressed in inches (an inch is about 2.54 cm). Be careful not to confuse a screen's *definition* with its *size*. After all, a screen of a given size can display different definitions, although in general screens which are larger in size have a higher definition. The standard screen sizes are as follows (this list is non-exhaustive):
  - 14 inches, a diagonal of about 36 cm;

- 15 inches, a diagonal of about 38 cm;
- 17 inches, a diagonal of about 43 cm;
- 19 inches, a diagonal of about 48 cm;
- 21 inches, a diagonal of about 53 cm.
- The **dot pitch**: This is the distance between two phosphors; the smaller it is, the more precise the image is. A dot pitch equal to or less than 0.25 mm will be comfortable to use, while monitors with a dot pitch equal to or greater than 0.28 mm should be avoided.
- The **resolution**: This determines the number of pixels per surface unit (given in linear inches). This is abbreviated **DPI**, for *Dots Per Inch*. A resolution of 300 dpi means 300 columns and 300 rows of pixels per square inch, which means that there are 90,000 pixels per square inch. By comparison, a resolution of 72 dpi means that one pixel is 1"/72 (one inch divided by 72) or 0.353 mm, which corresponds to one *pica* (a typographical unit).

## Graphics modes

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The term *graphics mode* refers to how information is displayed on the screen, in terms of definition and number of colors. It represents the ability of the graphics card to handle details, or the ability of the monitor to display them.

### MDA

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The **MDA** (*Monochrome Display Adapter*), which appeared in 1981, was the display mode for monochrome monitors, which could display text in 80 columns and 25 rows. This mode could only display ASCII characters.

### CGA

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**CGA** (*color graphic adapter*) mode appeared in 1981 shortly after *MDA*, with the release of the PC (personal computer). This graphics mode included:

- improved text mode display, with the ability to display characters in 4 colors
- graphics mode display which could show pixels in 4 colors with a resolution of 320 pixels by 200 pixels (320x200)

## EGA

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**EGA** (*Enhanced Graphic Adapter*) mode was released in early 1985. It could display 16 colors with a resolution of 640 by 350 pixels (640x350), much finer graphics than were possible in CGA mode.

## VGA

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**VGA** (*Video Graphics Array*) mode appeared in 1987. It offered a resolution of 720x400 in text mode and a resolution of 640 by 480 (640x480) in 16-color graphics mode. It could also display 256 colors with a definition of 320x200 (a mode also known as **MCGA** for *Multi-Color Graphics Array*). The VGA quickly became the baseline display mode for PCs.

## XGA

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In 1990, IBM introduced **XGA** (*eXtended Graphics Array*). Version 2 of this display mode, dubbed *XGA-2*, offered a resolution of 800x600 in 16 million colors and 1024x768 in 65536 colors.

## SVGA

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**SVGA** (*Super Video Graphics Array*) is a graphics mode which can display 256 colors at resolutions of 640x200, 640x350 and 640x480. SVGA can also display higher definitions such as 800x600 or 1024x768 by using fewer colors.

## VESA

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In order to make up for the lack of standardization in graphics modes, a consortium of major graphics card manufacturers was created (the **VESA**, *Video Electronic Standard Association*) in order to develop graphical standards.

## SXGA

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The **SXGA** (*Super eXtended Graphics Array*) standard, defined by the VESA consortium, refers to a resolution of 1280x1024 with 16 million colors. This mode is characterised by a screen ratio of 5:4, unlike the other modes (VGA, SVGA, XGA, UXGA).

## UXGA

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**UXGA** mode (*Ultra eXtended Graphics Array*) uses a resolution of 1600 x 1200 with 16 million colors.

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#### WXGA

**WXGA** mode (*Wide eXtended Graphics Array*) uses a resolution of 1280 x 800 with 16 million colors.

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#### WSXGA

**WSXGA** mode (*Wide eXtended Graphics Array*) uses a resolution of 1600 x 1024 with 16 million colors.

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#### WSXGA+

**WSXGA+** mode (*Wide Super eXtended Graphics Array+*) uses a resolution of 1680 x 1050 with 16 million colors.

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#### WUXGA

**WUXGA** mode (*Wide eXtended Graphics Array*) uses a resolution of 1920 x 1200 with 16 million colors.

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#### QXGA

**QXGA** mode (*Wide eXtended Graphics Array*) uses a resolution of 2048 x 1536 with 16 million colors.

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#### QSXGA

**QSXGA** mode (*Wide eXtended Graphics Array*) uses a resolution of 2560 x 2048 with 16 million colors.

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#### QUXGA

**QUXGA** mode (*Ultra eXtended Graphics Array*) uses a resolution of 3200 x 2400 with 16 million colors.

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#### Summary

The table below summarizes the various resolutions, as well as the corresponding ratios:

| Display format | Horizontal resolution | Vertical resolution | Number of pixels | Ratio |
|----------------|-----------------------|---------------------|------------------|-------|
|----------------|-----------------------|---------------------|------------------|-------|

|       |      |      |           |      |
|-------|------|------|-----------|------|
| VGA   | 640  | 480  | 307,200   | 1    |
| SVGA  | 800  | 600  | 480,000   | 1.56 |
| XGA   | 1024 | 768  | 786,432   | 2.56 |
| SXGA  | 1280 | 1024 | 1,310,720 | 4.27 |
| SXGA+ | 1400 | 1050 | 1,470,000 | 4.78 |
| SXGA+ | 1280 | 1024 | 1,310,720 | 4.27 |
| UXGA  | 1600 | 1200 | 1,920,000 | 6.25 |
| QXGA  | 2048 | 1536 | 3,145,728 | 10.2 |
| QSXGA | 2560 | 2048 | 5,242,800 | 17.1 |
| QUXGA | 3200 | 2400 | 7,680,000 | 25   |

## Energy and radiation standards

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There are numerous standards for guaranteeing monitor quality, as well as to assure the consumer that the machine has been designed so as to limit radiation from electrostatic waves and to reduce energy consumption.

In the late 80s, the standard MPR1 was created by the Swedish testing authority in order to measure the radiation emitted by hardware that gives off electrostatic waves. This standard was amended in 1990 to produce MPR2, which is recognised internationally.

In 1992, the Swedish Confederation of Professional Employees introduced the TCO standard, which describes radiation emission levels not in terms of minimum safety levels, but in terms of the minimum technically achievable level.

The TCO standard was revised in 1992, 1995 and 1999, resulting in the *TCO92*, *TCO95* and *TCO99* standards, respectively.



In 1993, a consortium of computer component manufacturers (*VESA -- Video Electronics Standards Association*) created the standard *DPMS (Display Power*

*Management Signaling*), which offered 4 operating modes for devices which conformed to it:

- On.
- Standby, with power consumption lower than 25W.
- Suspended, with power consumption lower than 8W. In this mode the electron gun is shut off, which means that the recovery time is longer than for standby.
- Off.

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