Inside the laser projector

The laser projector is the heart of a graphics system. It contains the galvanometer scanners and scanner amplifiers, which together move the beam fast enough to create graphics. It also contains an intensity device that blanks and/or colors the laser beam. This section discusses these two vital parts of a projector.

There can be other parts, such as beam tables and lumia special effect devices. However, this section will concentrate on the graphics-specific parts, since graphics are vital to today's laser shows.

Here's some essential information on what's necessary to put together a good graphics projector.

X-Y scanners

Scanners move tiny (3 x 5 mm) mirrors that deflect the beam. Two are needed; one for horizontal motion (X) and one for vertical (Y). Together, they can position the beam anywhere on the display screen.

For the most accurate graphics reproduction, use closed-loop galvanometer scanners (they're also called "position-detecting" scanners). The two largest companies providing these are Cambridge Technology and GSI Lumonics (formerly General Scanning).

The mirrors and mirror mounts for the scanners may be included with the scanners, or may be priced separately.

You also need a positioning mount. This holds the scanners at right angles to each other, in the best orientation for X-Y scanning. You can purchase this or machine your own. The mount design is especially important for Cambridge scanners, as the mount must dissipate enough heat from these small, fast scanners.

Scanner amp

Each closed-loop galvo scanner requires a closed-loop scanner amplifier, to condition and amplify the computer's laser control signals. You can obtain the amplifiers either as circuit boards or as fully assembled units.

Circuit board amps use trimpots for control adjustments, and require a power supply, usually +/-

Two GSI model G-120 scanners, with mirrors and mount. The scanner bodies are about 1" x 1" x 0.5".

In this photo, the laser beam travels right to left. It first bounces off the X-axis mirror, then travels up to the Y-axis mirror, and finally goes out to the screen.

Note that both mirrors are the same size. This ensures that each scanner has the same speed and response characteristics.

Click here to see the entire laser projector head.

Scanner amp circuit board, Cambridge model 6580 (drives a model 6800 scanner). Tuning adjustments are done using the blue trim pots.

To run a complete X-Y scan head, you need two of these boards plus a power supply.

15 VDC or +/- 24 VDC at 2 to 4 amps. Fully assembled amps come in a case with 110 volt AC power supply and knobs to adjust controls. An advantage of boards is that you save money and you can mount them inside your projector chassis, avoiding another box to carry around.

A cable connects the boards to the scanners. You can purchase this or make your own. The cable is usually short, to provide the most accurate feedback signals between the scanners and the amp.

Recommended scanners

Before you buy scanners, be sure you know exactly what you're getting. For example, you may see ads for "abstract graphics" projectors. This term means that the projector is not intended for accurate computer control. It usually uses open-loop scanners with simple amps. Also avoid resonant scanners; these scan only simple patterns at fixed frequencies.

Based on Pangolin's tests and experience, we recommend that you buy one of three different classes of scanners and scanner amplifiers.

- For **best performance**, there are two choices: 1) Cambridge Technology's 6800 or 6210 scanners and matching amps; and 2) General Scanning's G120 scanners with LSDI's TurboTrack scanner amps. Both are closed-loop scanner systems that can run the ILDA test pattern at 30,000 points per second (ILDA 30K) or more.

- You can get **good performance** with the G120 using medium speed scanner amps. These amps can run at 24,000 pts/sec. (or 30,000 pts/sec at a reduced angle. A good scanner amp in this category is the MediaLas CatWeazle.

- You can do **decent graphics** with General Scanning's G100 (and similar GS open-loop) scanners when paired with LSDI's Accelerator 124 scanner amps. These run at 12,000 pts/sec (ILDA 12K), considered to be the minimum for graphics capability.

Incidentally, used scanners of any type are often a wise buy -- if you know the scanners are in good condition. Should you be purchasing new scanners, note that there is often a backlog. Lead times can be as much as ten weeks.

We cannot recommend other types or brands of scanners for computer graphic use at this time. This may change as Pangolin tests newer equipment.

Single-color control

Most graphics projectors use some type of blanking device, to turn off the laser's beam as it moves between the visible lines of a drawing. Blanking in a single-color projector can be done with a galvo scanner or with an acousto-optic modulator (AOM) crystal.

The advantage of galvo blanking scanners is their compatibility with galvo mirror scanners. Their on/off response time inherently synchronizes with the galvo mirrors' movements. The disadvantage is that this response time is relatively slow. It is not enough to simply use an arm which rotates in and out of the beam. Complex, multi-mirror optical paths are required, so that a small movement of the blanking galvo can instantly cut off the laser beam.

AOMs operate much faster than galvos, automatically giving clean on/off response. Many people feel they are easier to work with, since they do not require the optical path lengthening of galvo blanking. However, timing adjustments are necessary in the laser software or in the AOM driver circuit so that the AOM is synchronized with the much slower X-Y scanners. The AOM signal must lag the scanner signal.

If you are using blanking devices, work with your projector manufacturer or component supplier to be sure the blanking system is best for your application. Pangolin's software is adjustable, so it works with whatever blanking system you choose.

Full-color projectors

Since 1992, most full-color projectors use polychromatic AOMs (PCAOMs). These control both blanking and color selection in one device. They are usually used with so-called "white-light" beams to do full-color graphics.

A white-light laser beam enters the PCAOM crystal from the right, while a radio-frequency signal is injected from the top. The RF signal sets up a diffraction pattern which acts as a prism.

The result is two beams exiting on the left: the desired color (red in this photo) and a "waste" beam with all colors except the desired color (cyan).

Click here to see the entire laser projector.

You can create a white-light beam on a budget by using an air-cooled argon and a helium-neon laser. The two beams are mixed using a dichroic filter into a single white-light beam containing red (HeNe) plus green and blue (argon). For more power and convenience, select a mixed-gas laser. This will provide white light (either red-green-blue or red-yellow-green-blue) in a single beam.

Color balance is important, so be sure your beam has a good mix of colors to make a balanced white. Because the eye is more sensitive to green, there should be more red and blue light than green.

In a PCAOM system, a white-light beam is directed into a crystal. Signals from the computer go into the PCAOM driver, which causes the crystal to diffract different wavelengths (color) away from the original beam. The diffracted, colored beam continues on to the X-Y scanners.

PCAOM driver electronics come in 4-, 6- or 8-channel models. This refers to how many wavelengths (colors) can be simultaneously controlled. Usually, the more channels the better. For example, Pangolin's LD Pro controls up to six channels. This lets you create unique colors such as a pure violet. It is not a mixture of red and blue, but it is the argon's natural violet wavelength coming through.

PCAOMs have become the *de facto* method of color control. This is because they are simple to align, relatively inexpensive, and provide extremely fast control. PCAOMs are so fast that each point in an image can have a different color. (One benefit of this speed is that TV-like raster images can be created.)

Even if you don't have a white-light laser beam, you may still want to consider a PCAOM. It can give higher throughput since it will modulate all available wavelengths (such as the greens and blues

in an argon laser). And, you can move up to full color at any time, simply by using a white-light beam as input to your projector.

Basics and add-ons

Here are some suggested system configurations. Costs given are only for the parts in a graphics projector; they do not include the projector chassis, laser or computer.

If you're a hobbyist on a very tight budget, start with a simple two-scanner system. One scanner controls the X (horizontal) axis, the other controls the Y (vertical) axis. At a minimum, you will need: two scanners with mounted front-surface mirrors, a mount to position the scanners relative to one another, two single-channel scanner amps (or one dual-channel amp), a power supply for the amp(s), and a cable to connect the amps and scanners.

To give an idea of costs, the above is about $2000 using the fastest available scanners, Cambridge Technology model 6210. Cambridge can provide everything except the power supply.

The system above will not have blanking. Although it is possible to do clever drawings which hide the retrace line, most people should also add a blanking or color control device. It is certainly easier to create images when you can hide the beam.

A blanking projector adds a blanking device (galvo or AOM), a driver (scanner amp or AOM driver), a bracket to hold the device in position, and a power supply for the driver. Expect to pay roughly $1000 for a monochrome blanking device and driver. A PCAOM can be the best way to go. At a cost of $1000 - $3000, it serves not only to blank the beam, but to control color of all but the highest power laser beams. Having a PCAOM gives you great flexibility to move up in power and capabilities without buying any new equipment.

The costs given above do not include a chassis. One important reason to buy a fully assembled projector is that the manufacturer provides the chassis plus additional convenience and safety features, such as a shutter. In the United States, the manufacturer should also provide CDRH certification.

This last item means that the projector has been built to the standards of the U.S. laser safety agency, the Center for Devices and Radiological Health. If you perform public shows in the U.S., you must certify both your equipment and show sites to the CDRH. Most manufacturers of complete, turnkey projectors will include equipment certification as part of their service.

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Member, International Association of Amusement Parks and Attractions

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- Job opportunities at Pangolin and elsewhere
- Info on animal & companies named "Pangolin"

PANGOLIN 2002 Meeting
- Report on the 2002 Pangolin Meeting

PAST PANGOLIN Meetings
- Report on the 2001 Pangolin Meeting
- Pangolin Meeting 2001 Videos
- Pangolin Prize 2001 Winners

For our clients

CLIENT COMMUNICATIONS
- Pangolin LaserChat discussion forum
- Pangolin Pro mailing list sign-up
- Customer registration form

UPDATE FILES FOR CLIENTS
- Pangolin ID laser show
- LD2000 2.50 update files
- LD (QM32) update files
- Upgrade from LD to LD2000

TECH SUPPORT - TROUBLESHOOTING
- Troubleshooting LD and LD2000
- Troubleshooting DMX
- QM2000 color chip fix
- ATI video card fix
- Returning boards to Pangolin
- How to ship the QM board

Award-winning products

LASERSHOW DESIGNER 2000
- LD2000 main page
- LD2000 feature overview
- Comparing LD2000 with other systems
- LD2000 Software Development Kit
- Using LD2000 on a notebook
- QM2000 board
- Music for free LD2000 laser shows

Related products:
- Lasershow Converter MAX plug-in
- Lasershow Player CD playback
- Lasershow Performer console
- VST2002 realtime video system
- DMX controller boards
- SMPTE timecode

OTHER PRODUCTS
- Lasershow Designer (older QM32 system)
  - Upgrade from LD to LD2000
- CADA-MOD for ADAT recorders

PRODUCT QUALITY
- Awards won by Pangolin, clients
- Sample frames (photos)
- Sample videos (MPEG files)

OBTAINING PRODUCTS
- Pangolin price list
- Pangolin dealer list
- How to order
- Charge authorization form

FREE DOWNLOADS
- Download Central
- Free Windows wallpaper
- Free printed brochures and ads
- Cheerleaders and lasers

TECH SUPPORT - LASERSHOW DESIGNER
- Using multimedia in Showtime 2000
- Combining two shows into one
- Running two projectors from one board

Pinouts and info for Pangolin boards:
- QM2000 (new, PCI bus)
- QM32 (older, ISA bus)
- QM8 (Amiga 3000)

Information about laser shows

INTERNET LINKS
- Our clients and their websites
- Our dealers and their websites
- Other Internet laser resources

SPECIAL REPORTS
- Lasers at SIB 2002 show in Rimini Italy
- Faster scanning
- More special reports...

LASER SHOW RESOURCE GUIDE
- Laser Show Resource Guide home page
- About lasers and projectors
- Sources for parts
- Sources for frames, shows

TECH SUPPORT - GENERAL INFO
- Scan angle tables
- About the ILDA Test Pattern
- About DMX512 (lighting control)
- Making 3D, floating images

LANGUAGES


Chinese


French


German


Italian


Portuguese


Russian (LaserAction website)

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