HOW TO MAKE LASER SHOWS

The complete guide

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The different types

WHAT IS A LASER SHOW

Ask just about anyone, and they will agree that laser light is considerably the most beautiful light source available. And as a performer, you will find that laser is a very versatile medium to work with, allowing you to create a wide variety special FX, some of which are not possible using any other light source.

Laser shows can take many forms. But in general, a laser show is a display combining laser light, music and at times other multimedia elements (such as LED lighting, video, pyro and more) to create a choreographed sequence of effects captivating audiences, bringing people together in a fun, exciting, and unique way.

TYPES OF LASER SHOWS AND EFFECTS

Laser beam and aerial effects

Laser beams and aerials are considerably the most common type of “effect” created with laser. They generally consist of laser patterns and shapes that are combined or synchronized with music, and then projected from a standard laser show projector. These effects are most often programmed in software, and then run “live” to the beat of music, or “pre-programmed” and then played from a timeline.

Laser beam and aerial effects are generally broken down into a few basic categories. These include beams and aerial effects, laser fans and laser tunnels, and liquid sky laser effects (we call them liquid skies, as the effect projects a sheet or tunnel of laser light above your head, which looks like a liquid sky when combined with haze or fog).

At times, you might also see laser shows projected into an audience area, where people can actually touch the laser light. This is called “Audience Scanning” and it is one of the most beautiful effects that can be created with laser. However, it also requires a deeper understanding of laser safety to ensure no one in your audience is harmed from laser coming in contact with their eyes.

Laser graphics and effects *(including laser logos, text, abstracts and 3D content)*

Laser graphics are another fun type of laser effect that can be crated. These also take multiple forms and may include animated laser graphics, laser logos, laser text, laser abstracts, 3D laser images, and even fully animated graphical laser shows.

Laser mapping and architectural laser lighting

One of the newest and fastest growing laser effects, is called “laser mapping”. When you create laser mapping effects, you take a laser projection system and use it to map out the edges of a building, object or surface (such as a city building or structure, car, stage, etc.). This is very popular among architects and designers, looking to highlight and accent a structure or object.

Interactive laser shows

Interactive laser shows are where people in an audience or a performer control the movement of lasers, with their own body movement. This new technology has only been possible in recent years, thanks new technology from Pangolin, that allows our BEYOND software to work in conjunction with interactive devices like the X-Box kinect. Imagine people in your audience moving their hands back and forth, and the laser light following that movement in real time. That is what interactive laser shows are all about.

** All the different types of laser shows noted above, can be performed both indoors and outdoors **

Below you can find pictures and links illustrating all of the laser shows and effects we have discussed here.

LASER BEAM AND AERIAL EFFECTS

Beam shows and effects



Laser fans, sheets and tunnels



Liquid sky laser effects

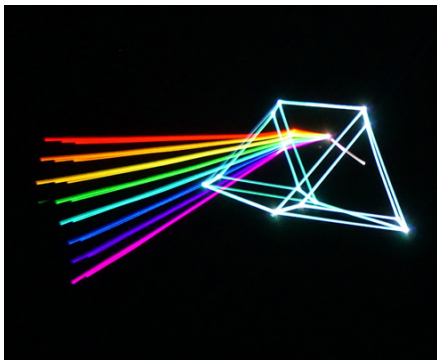
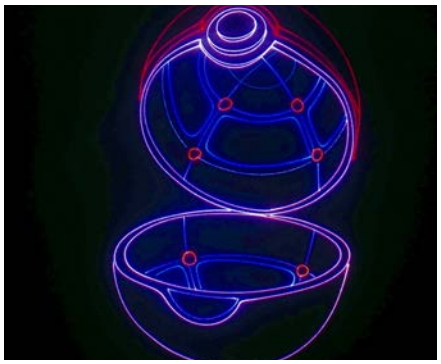


Audience Scanning laser effects (lasers come in contact with people)



LASER GRAPHIC EFFECTS

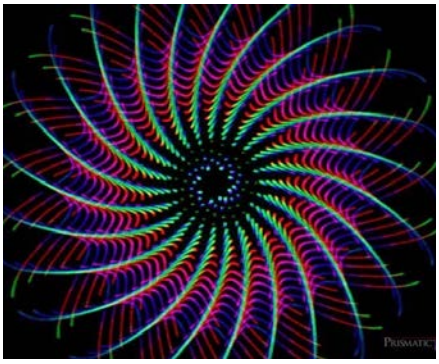
Laser graphics and images

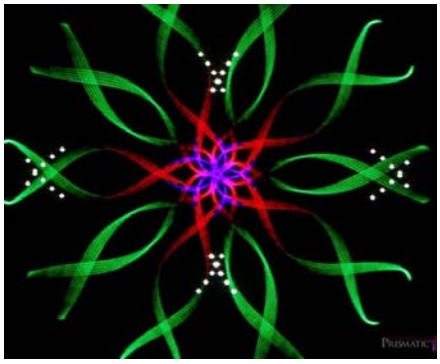




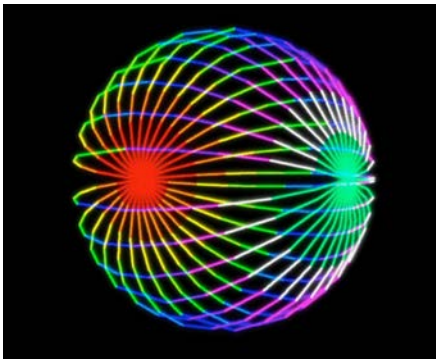
Laser logos and projections

Laser text

Laser abstracts







3D Laser animations (notice how you can layer images)

LASER MAPPING EFFECTS

Laser mapping projections on buildings and surfaces



INTERACTIVE LASER SHOWS

This is something you have to see, to fully understand.
Check out the links below, to learn more.

VIDEO LINKS

Check out these awesome videos, showing different types of laser shows!

Laser beam and aerials:

- https://www.youtube.com/watch?v=ZPgYwEhhzEA&list=PLYN8RZ0FldXHgWU8aPJSLZ2LSuRJ39u8T&index=19
- https://www.youtube.com/watch?v=XpZmlYW9Jdg&index=6&list=PLYN8RZ0FldXHgWU8aPJSLZ2LSuRJ39u8T
- https://www.youtube.com/watch?v=muFaTkmY7fU

Laser graphics:

- https://www.youtube.com/watch?v=otFM46BpfOs&list=PLYN8RZ0FldXHgWU8aPJSLZ2LSuRJ39u8T&index=13
- https://www.youtube.com/watch?v=-WIIWemMcUY&index=21&list=PLYN8RZ0FldXHgWU8aPJSLZ2LSuRJ39u8T
- https://www.youtube.com/watch?v=g8fubr6I5Io

Laser mapping:

- https://www.youtube.com/watch?v=ZubQNEmXMDM
- https://www.youtube.com/watch?v=mPyK4-IMT9w

Interactive laser shows:

- https://www.youtube.com/watch?v=HRVW0WBQPf8&t=17s
- https://www.youtube.com/watch?v=w3A8x7wXzVo&list=PLYN8RZ0FldXHgWU8aPJSLZ2LSuRJ39u8T&index=22

HOW TO SETUP LASER SHOWS

What hardware setup is right for you

HOW TO SETUP A LASER SHOW

What laser control hardware is right for you

To create and run a laser show, you need a laser control system. A laser control system is a combination of laser control hardware and software. The software allows you to design and create your desired laser shows and effects, and the hardware plays that content back across the laser projector. In order to create laser shows like the ones shown above, you need to have a laser control system.

When you are new to lasers, an important thing to consider when purchasing a laser control system and laser projector is “how” you want to run your show - literally meaning, how do you want to physically setup and run everything. Below we will discuss the most commonly used laser show control hardware systems, and explain how you can setup them up in a real world scenarios. This will provide you with a better understanding of what laser control hardware setup is right for you.

FB3QS - Simple, plug-and-play, laser control hardware

- **Protocols supported: USB, ILDA (DMX and ArtNet through Pangolin software)**

FB3QS Hardware

Front view

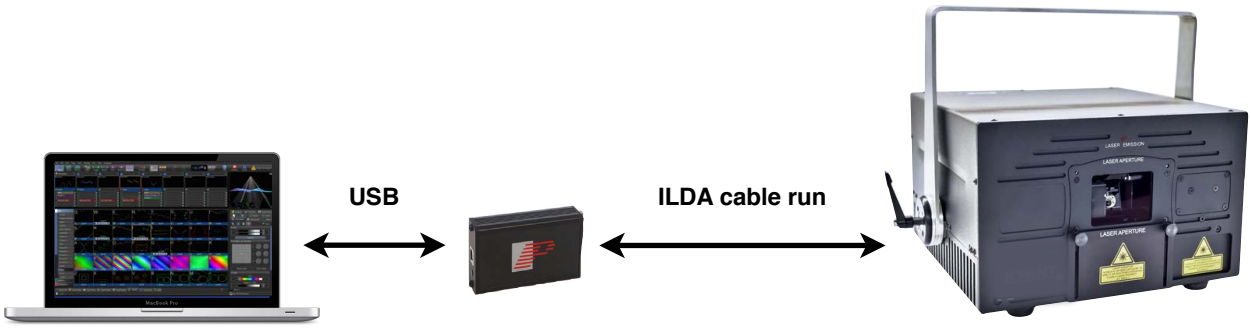
USB connection

Back view

ILDA connection

The FB3QS hardware is a simple and easy to use laser control hardware, great for people who are new to lasers. It connects to your PC via USB, and then to the laser projector using an ILDA cable. Diagrams showing the basic setups available with this hardware are shown below.

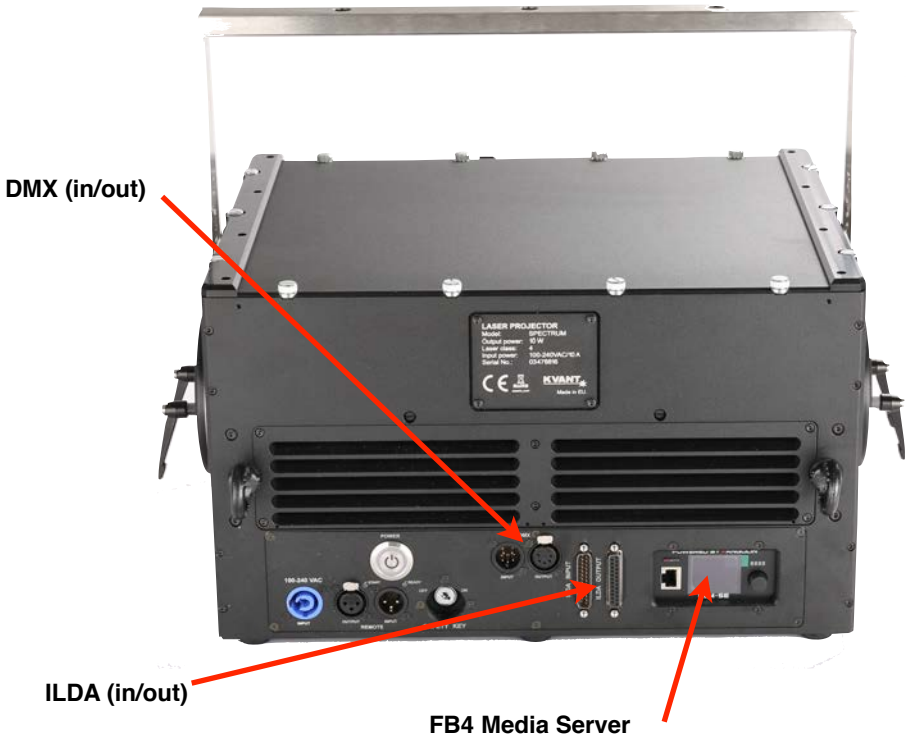
Basic diagram showing FB3QS and laser setup



NOTE: *Here we have PC running Pangolin software. It connects to the FB3QS via USB, and then to the laser projector using a ILDA cable run. You can also control this setup from a DMX console if you desire, when using Pangolin QuickShow or BEYOND software together with the FB3QS.*

FB4 INSIDE - The future of laser projectors

- **Protocols supported: Network, DMX, ArtNet, Stand-alone (with real time clock), ILDA**



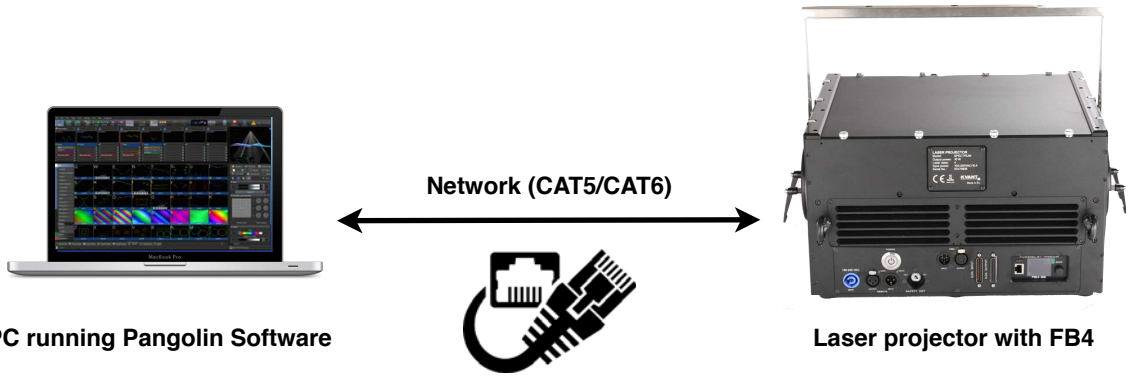
- **Network and ArtNet (ethercon available, as well as daisy chain)**
- **Full color display (controls colors, safety, geometry and more)**
- **Real Time Clock (for stand alone operation - i.e. auto-mode)**
- **SD Memory System (up to 64GB)**
- **DMX in/through**
- **ILDA in/through**

The latest technology on the market now, is having the FB4 media server entirely integrated with your laser projector. This setup offers a wide variety of advantages, as it substantially simplifies the control setup, reduces cabling, and makes control of multiple projector shows a lot easier. Not only that, but it allows lighting professionals to integrate lasers into multimedia setups, in a much more convenient way. Currently most professional laser projectors have the ability for FB4 to be integrated, and in time, all laser projectors will operate in this manner. It truly is the future of laser show technology in that regard.

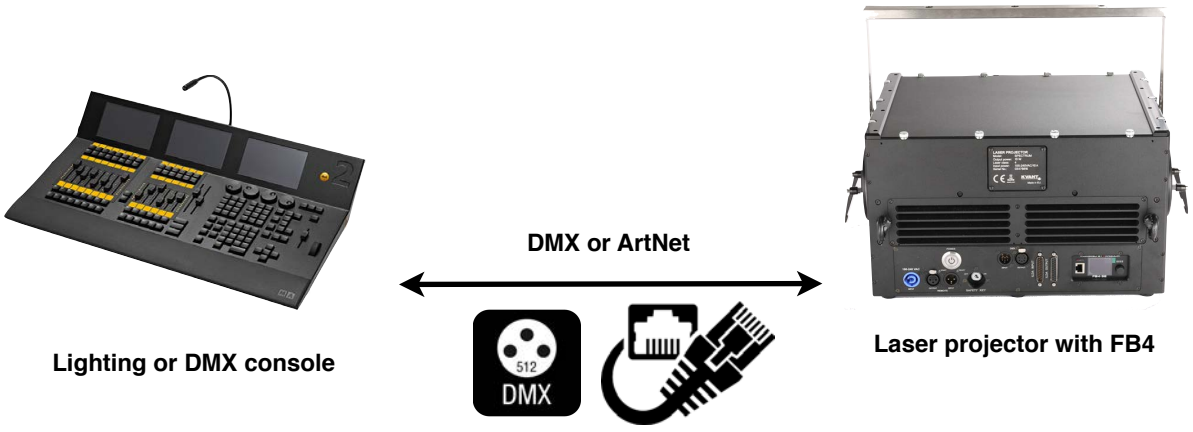
When working with FB4, there are three powerful, yet easy to use setups for controlling your laser show. These are outlined below.

How to use FB4 inside your laser

PC mode - Simply run a network cable from your PC to your laser projector with FB4, and you are setup and done. It's just that simple.



Lighting console mode - Lasers with FB4 support both the DMX and ArtNet protocols . And as mentioned above FB4 also has on board SD card memory. This makes it easy to control a laser with FB4, from any lighting or DMX console. Simply create your laser content in software (QuickShow or BEYOND), and save it to FB4. Then, you can run a DMX or ArtNet feed to the laser projector with FB4 and you are setup and done. You can then control your laser with FB4 from any lighting or DMX console of your choice. Pangolin also has profiles available, for all popular lighting consoles on the market.



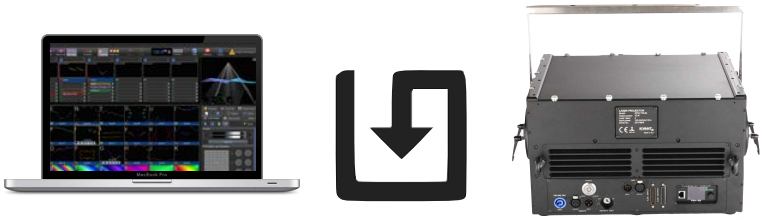
Stand alone operation (RTC) - All lasers with FB4 inside support a standard called “RTC” or real time clock. We also call this “stand alone operation” or “auto mode”. When using a laser with FB4 in this setup, you can create your content in laser design software (like QuickShow or BEYOND), and then save it to the memory system on the FB4. FB4 has a built in clock, so that you can tell the system to play the show or content you created back at a specified date and time. And you do not need to have a PC, console or anything connected, to trigger the playback. Just run power to the laser, and you are setup and done. The show will run itself automatically, without the need of for PC or console to trigger and start the show. This is a "true" auto-mode in that regard.

You can also update content on the laser with FB4, over a network cable. Making it very easy to change and edit content, when you need to.

- ***Example...*** *Lets say you programmed a show, and you want it to run every Friday evening at 20:00 hours (8:00pm). You can create that content in laser design software like QuickShow or BEYOND, save it to FB4, and then set the clock on FB4 to play it back automatically at that specified date and time. As long as the laser projector with FB4 inside has power, the show will run automatically at the date and time you specified. And no PC or console needs to be used to trigger this.*

Step 1 - Program your content in software, and save to FB4 inside your laser.

**** NOTE -*** *You can also send content to the memory of FB4 on your laser, over the network cable.*

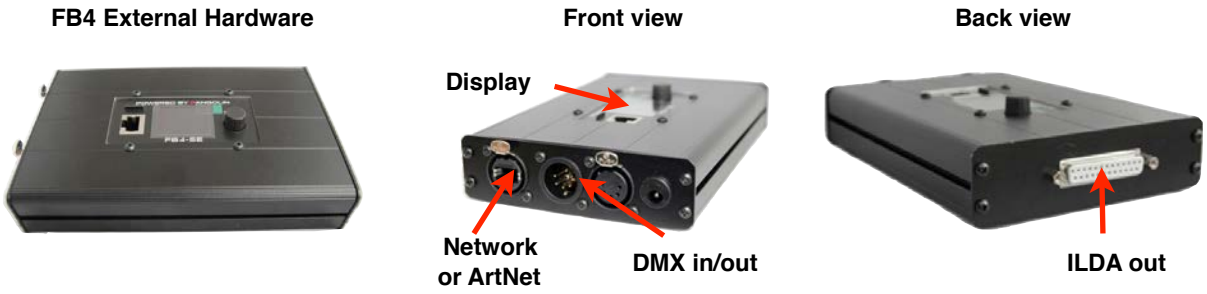


Step 2 - Set the clock on FB4, to display that content at a given date and time.

Step 3 - Your show will run itself automatically, at the date and time you specified. No PC or console needed to trigger this. It is truly automatic in that regard.

FB4 EXTERNAL - An external media server, for laser shows

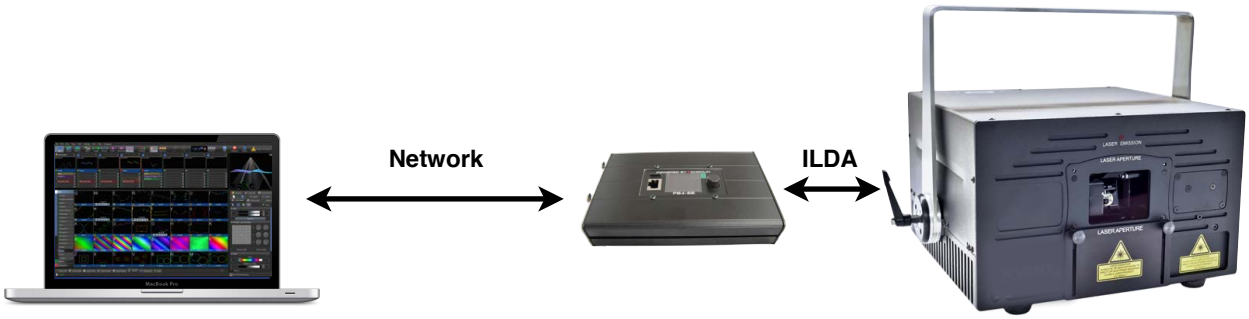
- **Protocols supported: Network, DMX, ArtNet, Stand-alone (with real time clock), and ILDA**



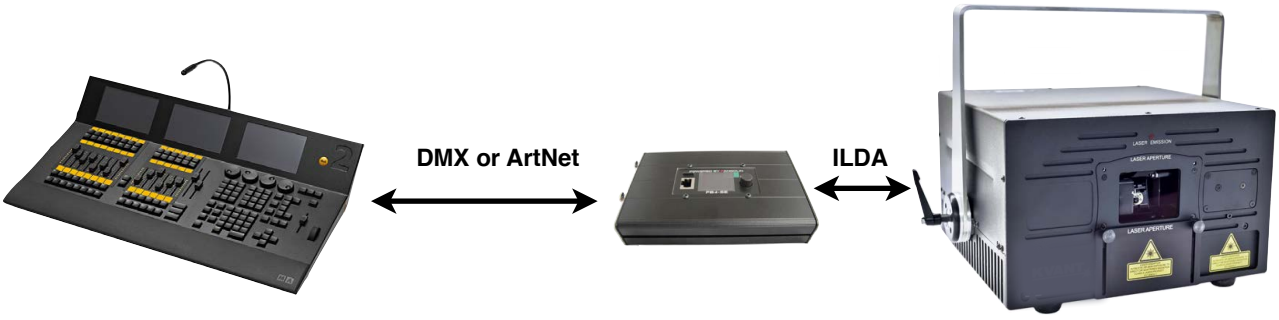
FB4 is a media server for laser shows. It is a network based control system with support for all major lighting protocols (network, DMX, ArtNet, stand-alone and ILDA). It features a full color display, as well as an onboard SD card memory system. When using an external FB4 device, you have a few more control possibilities, than you do with the standard FB3QS. These are outlined below.

How to use FB4 external with your laser

PC mode - Simply run a network cable from your PC to the FB4 external hardware, and then from the hardware, run an ILDA cable to the back of the laser.



Lighting console mode - FB4 supports both the DMX and ArtNet protocols and as mentioned above it has on board SD card memory. When operating in lighting console mode, you can create your content in software (QuickShow or BEYOND), and save it to FB4. Then, you can run a DMX or ArtNet feed to the FB4 external hardware, and then an ILDA cable to the laser projector. You can then control the content on FB4, from the lighting or DMX console of your choice.



Lighting or DMX console **ILDA based laser projector**

Stand alone operation (RTC) - All FB4 devices support a standard called “RTC” or real time clock. We also call this “stand alone operation”. When using FB4 External in this setup, you can create your content in laser design software (like QuickShow or BEYOND), and then save it to the memory system on the FB4. FB4 has a built in clock, so that you can tell the system to play the show or content you created back, at a specified date and time. And you do not need to have a PC, console or anything connected, to trigger the playback. Just run power to the FB4 External and laser show projector, and the show will run itself automatically, without the need of a PC or console, to trigger and start the show.

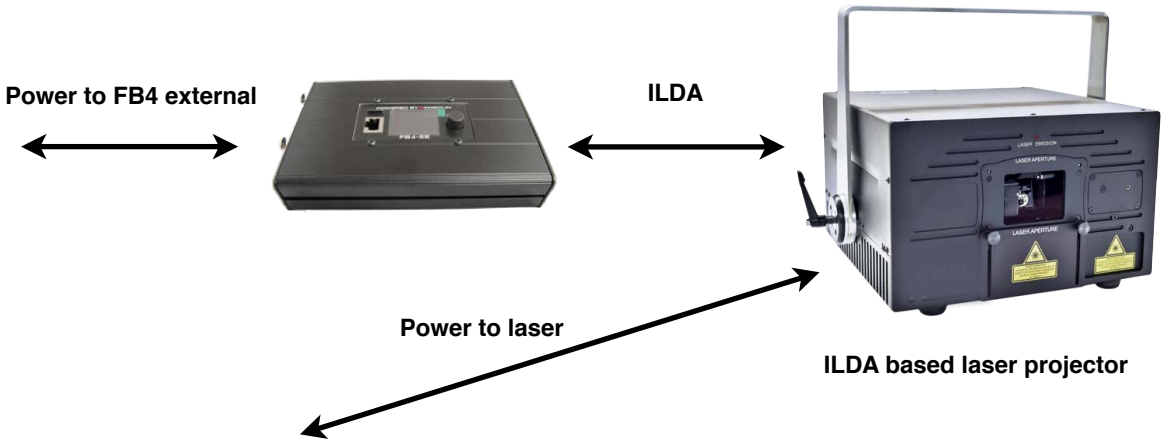
- ***Example...*** *Lets say you programmed a show, and you want it to run every Friday evening, at 20:00 hours (8:00pm). You can create that content in laser design software like QuickShow or BEYOND, save it to FB4, and then set the clock on FB4 to play it back automatically at that specified date and time. As long as the FB4 External and laser projector have power, the show will run automatically at the date and time you specified. And no PC or console needs to be used, to trigger this.*

Step 1 - Program your content in software, and save to FB4

Step 2 - Set the clock on FB4, to display that content at a given date and time

Step 3 - Run your show in stand alone mode (no PC or console required)

As long as the FB4 external and laser have power, your show will run at the specified date and time you define. You can also update content on the FB4, over a network cable



HOW TO DESIGN LASER SHOWS

What software is right for you

HOW TO DESIGN A LASER SHOW

What laser show software is right for you

In order to create a real laser show, you need laser show software. These programs are required in order to create laser shows and effects, like the one's we described above. There are two industry standards for laser show software. These are called QuickShow and BEYOND. A brief overview of both is noted below:

QuickShow - Powerful, affordable and easy to use, QuickShow is considerably the world's most widely used laser show software. It is perfect for people who are new to lasers, or who prefer a powerful, yet simple user interface.

QuickShow allows you to create all types of laser shows and content, including laser beam effects, laser graphics, laser text, laser logos and full scale laser animations. This software allows you to run your shows "live" to the beat of music, or preprogrammed on a timeline. And you can control your shows with QuickShow from a PC, MIDI console, DMX console or lighting console.

There are several tools in QuickShow, that make creating custom laser content and effects very easy. These include...

- **QuickText -** Easily create laser text in seconds.
- **QuickShape -** Allows you to create laser beam effects and abstracts.
- **QuickTrace -** Creates laser logos, fast.
- **QuickTargets -** For fun targeted beam sequences.
- **QuickDMX -** For easy control of QuickShow with DMX.
- **QuickTimeline -** Great for creating timeline based laser shows, to the beat of music.
- **QuickCapture -** So you can easily combine laser images (both beams and graphics).
- **QuickFX -** Easy to implement laser effects, that can be applied to any piece of content.
- **Virtual Laser Jockey and BPM control -** Powerful, pinpoint BPM and show control.
- **Plugins for DJ Software -** So you can tie QuickShow with your favorite DJ software.

QuickShow also includes hundreds of FREE laser shows, and thousands of pieces of laser clip art all accessible through the integrated Pangolin Cloud feature.

The QuickShow software is FREE, with the purchase of any Pangolin hardware device. The system also includes several tutorial video which help learn how to get the most out of the program

Learn more about QuickShow, see videos and try a FREE demo here:

www.Pangolin.com/QuickShow

BEYOND - BEYOND is the world's most powerful laser show design and multimedia control software. BEYOND not only allows you to design, create and control laser shows, but it can also control multimedia content (including video, LED based lighting, pyro, audio and more).

The BEYOND software supports all major lighting industry protocols, including network, DMX, ArtNet, SMPTE, MIDI, OSC, and ILDA. It also features a variety of powerful tools allowing you to easily control a show from any lighting, DMX or MIDI console you prefer. And you can also map those devices out, and create custom profiles, using the software's "scripting tools" (these allow you to access the core of the software, and then customize it to meet you specific needs).

BEYOND also has an immensely powerful effect engine, allowing you to create a multitude of sophisticated and complex laser effects, in an easy to use manner.

And for clients who enjoy laser graphics, or who enjoy designing 3D laser content, BEYOND has a powerful 3D animation program built directly inside the software, allowing you to create any type of laser animations, or 3D objects you like. It also supports popular 3D animation software programs including 3D Studio Max, Cinema 4D, Maya, Blender, and others.

The advanced drawing program inside of BEYOND is truly like “photoshop” for lasers, allowing you to draw and design any type of laser content you can imagine. It also features in incredibly powerful abstract generator, that can be used to create stunning abstract laser content.

When it comes to color mixing, BEYOND cannot be beat. The software’s advanced color palette training systems allows you to quickly and easily balance colors across all laser show projectors in your setup. And it allows you to get more colors, from a laser projector.

The program also has excellent tools for geometric correction, and laser mapping. Making it easy to project lasers onto complex surfaces, or to set specific projection areas for laser to go into.

One new and innovative new tool emerging in the laser show industry, is the ability to create interactive laser displays. BEYOND features an awesome interactive show module, that allows you to make the lasers move, using your body movement.

And just like QuickShow, BEYOND comes with hundreds of FREE laser shows and laser clip art frames included, and gives you full access to the revolutionary new Pangolin Cloud.

BEYOND is software, and when you purchase BEYOND, is gets licensed to one of your Pangolin hardware devices (such as the FB3QS or FB4). It works in a master / slave setup, so that you only need one BEYOND license for a piece of hardware, and then that unit becomes your “master dongle”. Then, any additional laser control hardware you connect in the setup, will work as a slave within the system. This makes the cost of running large scale laser shows with BEYOND, very affordable. Because you only need one BEYOND license, and then you can control multiple pieces of laser show control hardware.

BEYOND software is available in three versions, called Essentials, Advanced and Ultimate. And clients can also easily upgrade between these three versions.

Learn more about BEYOND, see videos and try a FREE demo here:
www.Pangolin.com/beyond

HOW TO CONTROL LASER SHOWS

Live, programmed, and stand alone

HOW TO CONTROL LASER SHOWS

Live laser shows

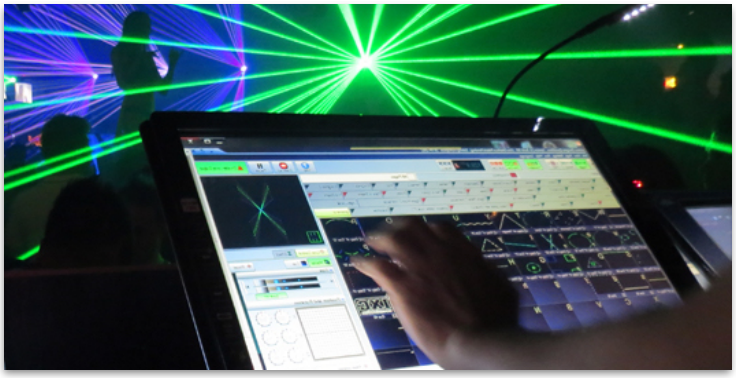
Live laser shows are perhaps the most popular way of controlling a laser show. You see these often at festivals, nightclubs, and similar events and they are mostly “laser beam and arial shows” but may at times also include various laser graphics and in rare cases, laser mapping and interactive effects. When performing a live laser show, you are generally performing to the beat of the music playing, and you can run this from a PC, touchscreen, MIDI, DMX or lighting console.

** Examples are shown below.*

Live from a PC or touchscreen

Many clients will control their live laser shows from a PC or touchscreen computer. This sort of setup is very common. A picture showing a basic setup is below.

PC or touchscreen
running Pangolin QuickShow or BEYOND software

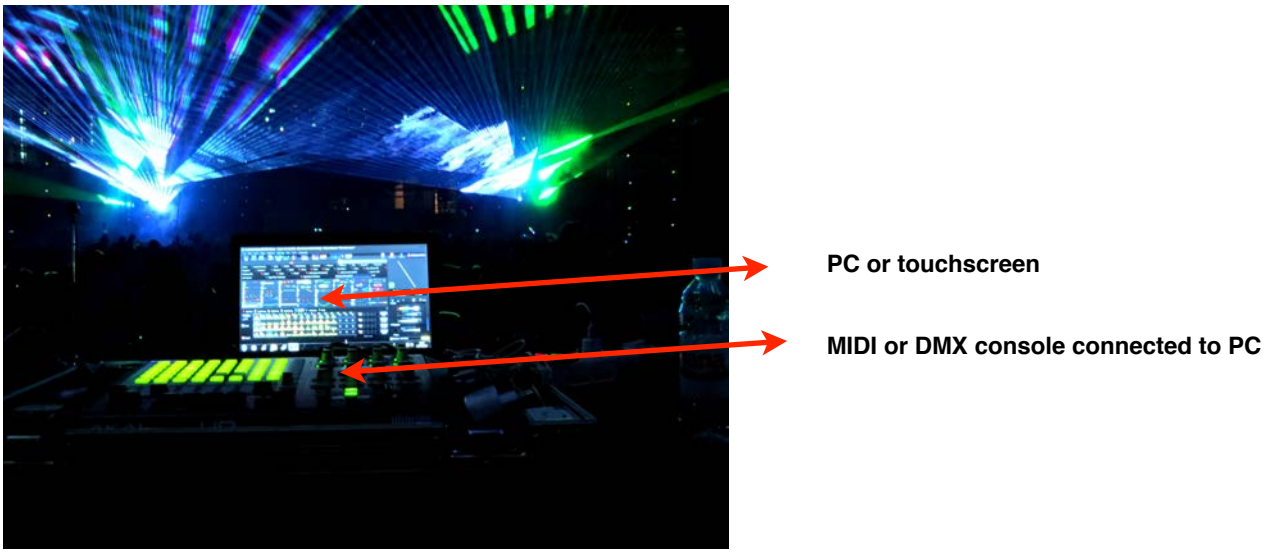


Live from a MIDI or DMX console (with a PC)

Some clients prefer the touch and feel a MIDI or DMX console has to offer. And in this fashion, they connect their MIDI or DMX console to the PC, and then control the software and show live, from that device.

PC or touchscreen running Pangolin QuickShow or BEYOND software

MIDI or DMX console



Live from a Lighting / DMX console (with a PC)

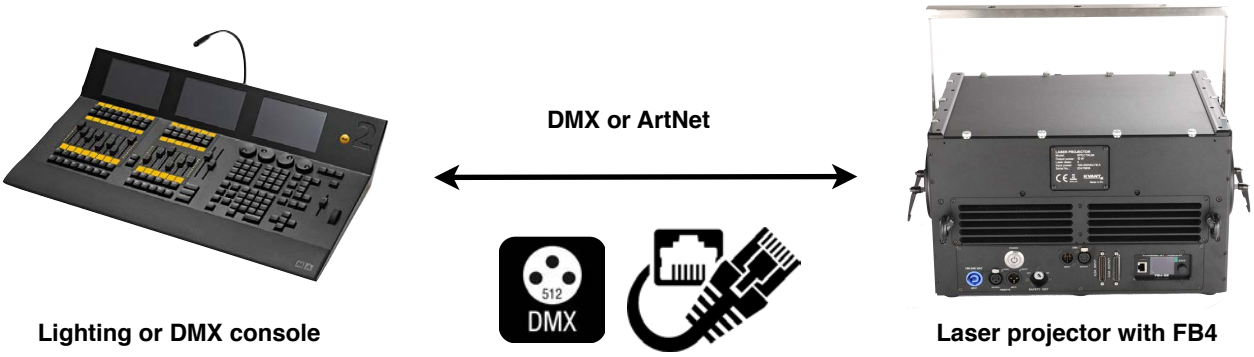
We also have clients who come from lighting design background, and prefer to control their entire show from a lighting or DMX console (such as a GrandMA, Chamsys, Hog, Avolites, etc). This can also be done with our without a PC connected. Examples are shown below.

PC or touchscreen running Pangolin QuickShow or BEYOND software

Lighting or DMX console

From a Lighting / DMX console (no PC)

You can also run the entire show from a lighting or DMX console, without a PC in the setup. This is very popular with lighting designers. In such a setup, you design your desired laser show and content in software (QuickShow or BEYOND). Then, you save that content to the FB4 hardware (Internal or External version). After that, you can control the content saved on FB4, from any lighting console of your choice.



Lighting or DMX console

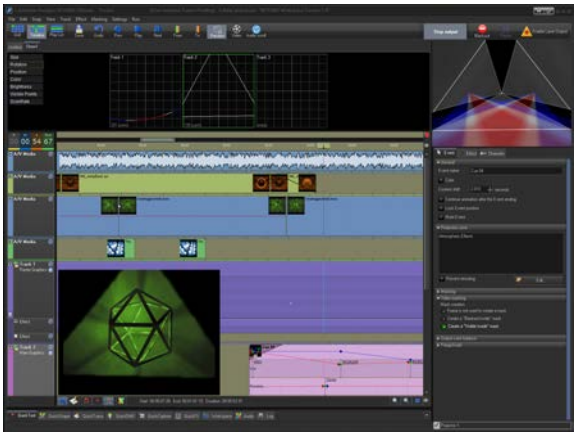
Laser projector with FB4

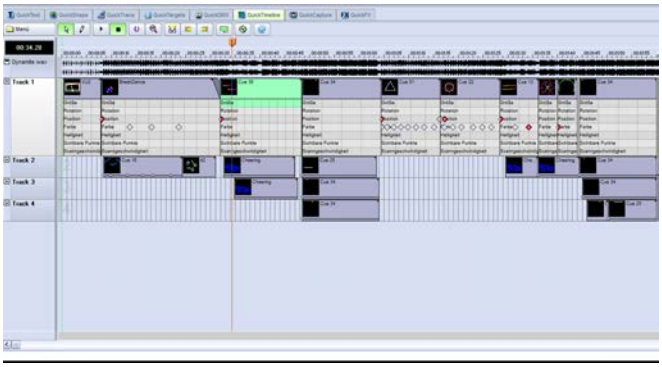
Pre-programmed laser shows

Pre-programmed laser shows are perhaps the second most popular type of laser show you will see. These are common on large scale musical tours, and corporate events (where the exact music that will play is known ahead of time) as well as at permanent installations (theme parks, hotels, etc.).

Pre-programmed shows may consist of laser beam and arial shows, as well as laser graphics, laser mapping effects, and interactive laser shows.

Pre-programmed laser shows are generally made on a timeline (in QuickShow or BEYOND software). And artists will put an audio file onto the timeline, and use the tools within the software to exactly match their laser effects to the beat of the music they are working with. So that the timing of the laser effects is in perfect harmony with the music playing. That show content is then saved, and trigged at the actual show venue. The triggering of the show can be done from a PC, console (MIDI, DMX, or Lighting console) or it can also be done using SMPTE timecode (using devices like the TC2000 SMPTE converter).





Stand-Alone laser shows

A stand-alone laser show is one where the show “runs itself”. Stand alone laser shows can consist of laser beam and arial effects, laser graphics, and laser mapping effects.

Stand alone laser shows are accomplished using a laser projector or laser setup with FB4 hardware. In such shows, the show content is created in software (QuickShow or BEYOND), and then saved to the memory on FB4. Then, using RTC (real time clock feature) the show content can be set to project at a specified date and time. When

running stand alone laser shows, you can project complete laser shows, as well as specific laser content, cues and workspaces. The laser projector and FB4 only need to have power, and they will run your show automatically, without the need to trigger anything. It is truly automatic, in that regard.

TWO COMMON QUESTIONS WE GET ABOUT RUNNING LASER SHOWS:

- **How do I control multiple laser projectors at the same time**
- **How do I make my lasers do something different, at the same time**

** The principles described here apply to all means of controlling a laser show (live, pre-programed, and stand-alone). These principles are also universal in both QuickShow, BEYOND and all laser show software.*

To begin, you should first understand the difference between “shared control” and. “independent control”.

Independent control - This is where each of the lasers in your setup can do something different, at the same time. When working in this fashion, each laser projector needs to have it’s own control hardware behind it, so that it can receive an independent control signal from your control station. This is the most common type of laser setup, especially when working with multiple laser projectors, as it allows you to create more types of laser effects, and more sophisticated laser shows.

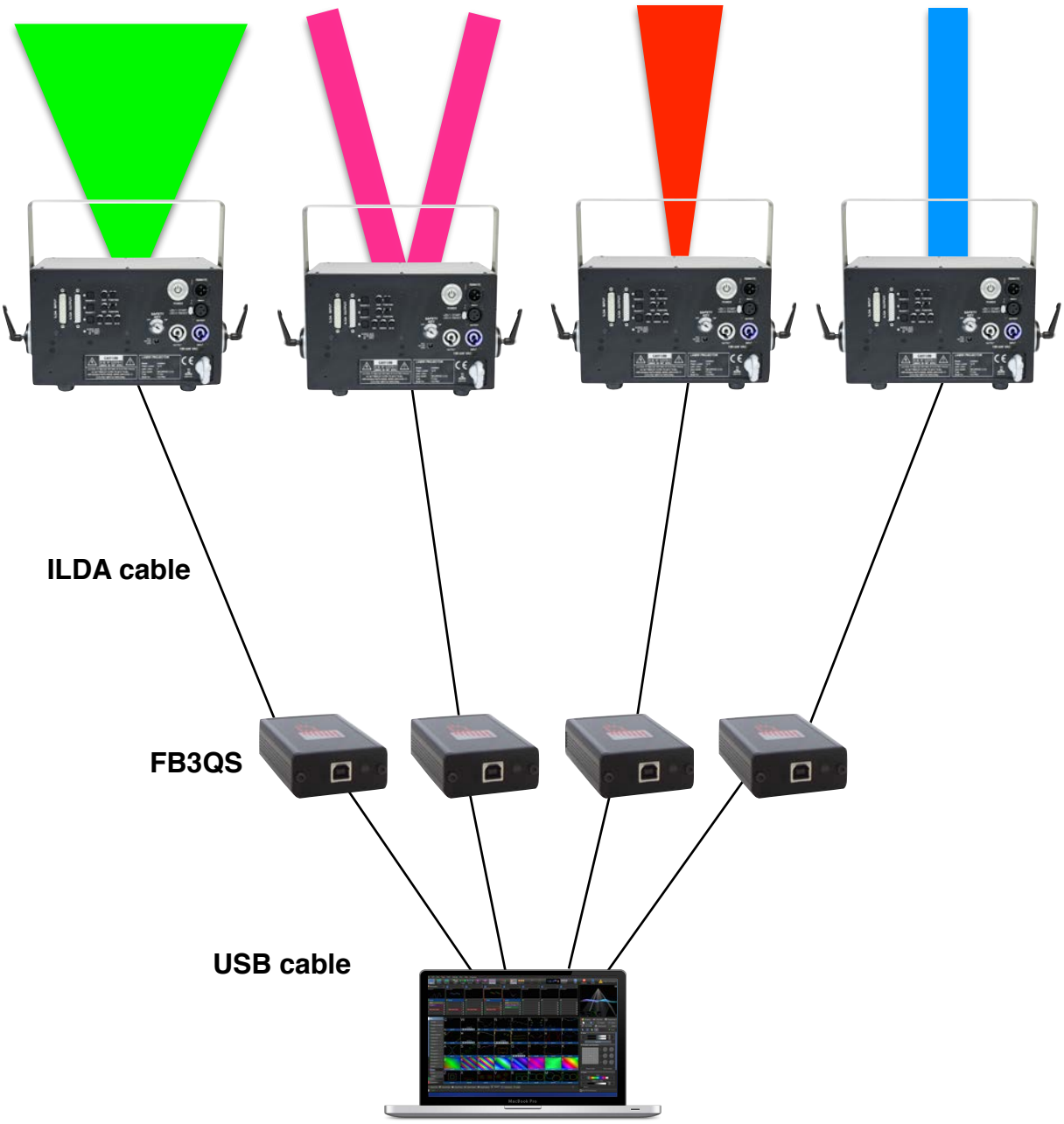
Shared control - This is where each of the lasers in your setup are doing the same thing, at the same time, as they are sharing the same control signal.

Understanding Zones - A zone is a feature inside of laser control that allows you define the exact area laser content will be projected. Each laser projector can also have multiple zones assigned to it, so that it can project content in multiple areas. when controlling multiple laser projectors in a show, zones also help you define which laser projector, content will go to. It’s a great feature, and helps you create better looking laser shows and effects.

Watch and learn - Check out this great tutorial video illustrating these principles in action (the tutorial was made using QuickShow software and FB3QS hardware, but again, the principles are universal in this regard).
https://www.youtube.com/watch?v=4I-hWbi7E5E

***** *Diagrams on the following pages show various independent show setups, using both FB3QS and FB4 laser control hardware.*

FB3QS - Independent control example

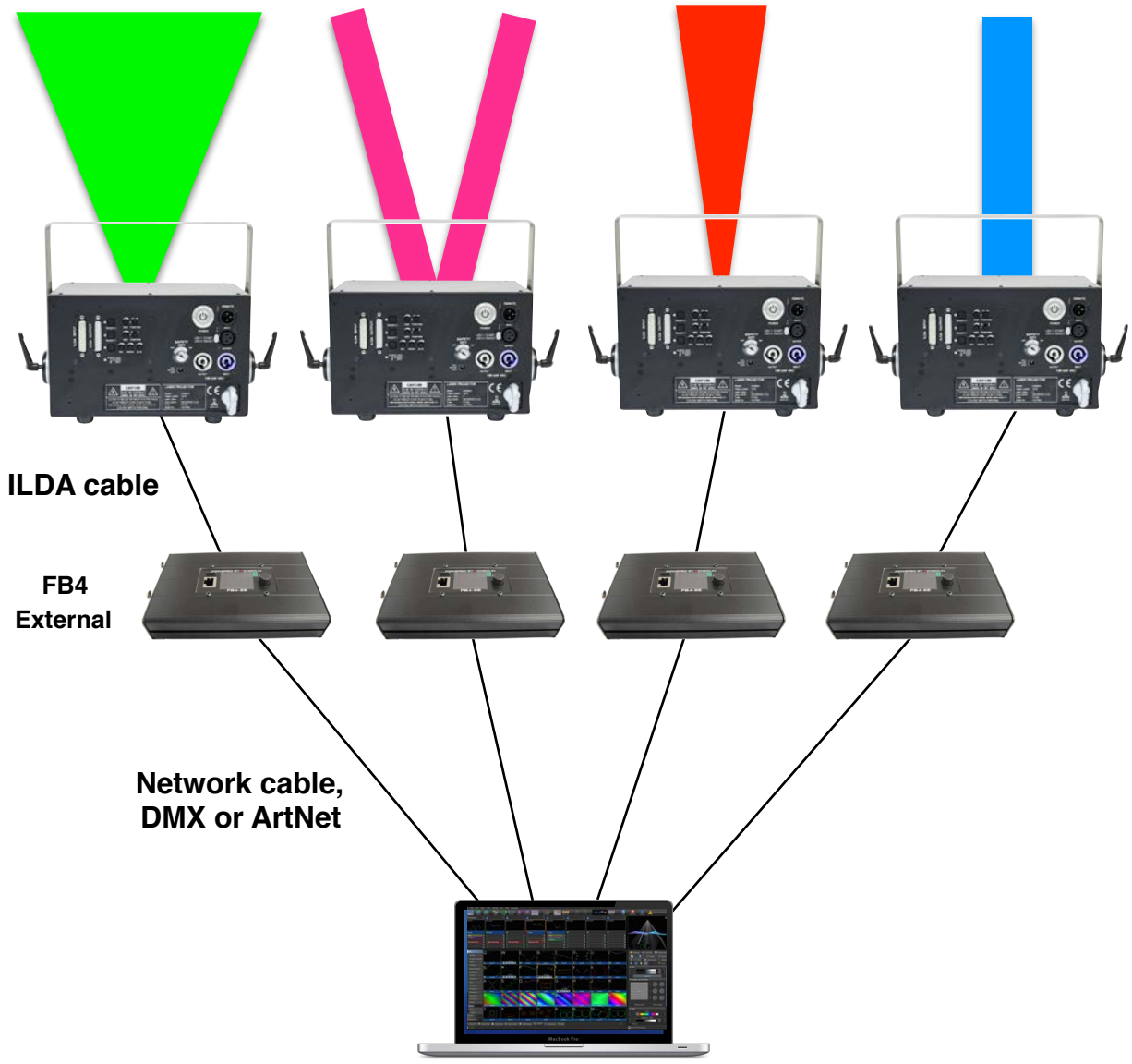


Control Station

This can be a PC, console, etc.

Each laser in this setup has it's own FB3QS controlling it, so each laser can do something different at the same time.

FB4 External - Independent control example

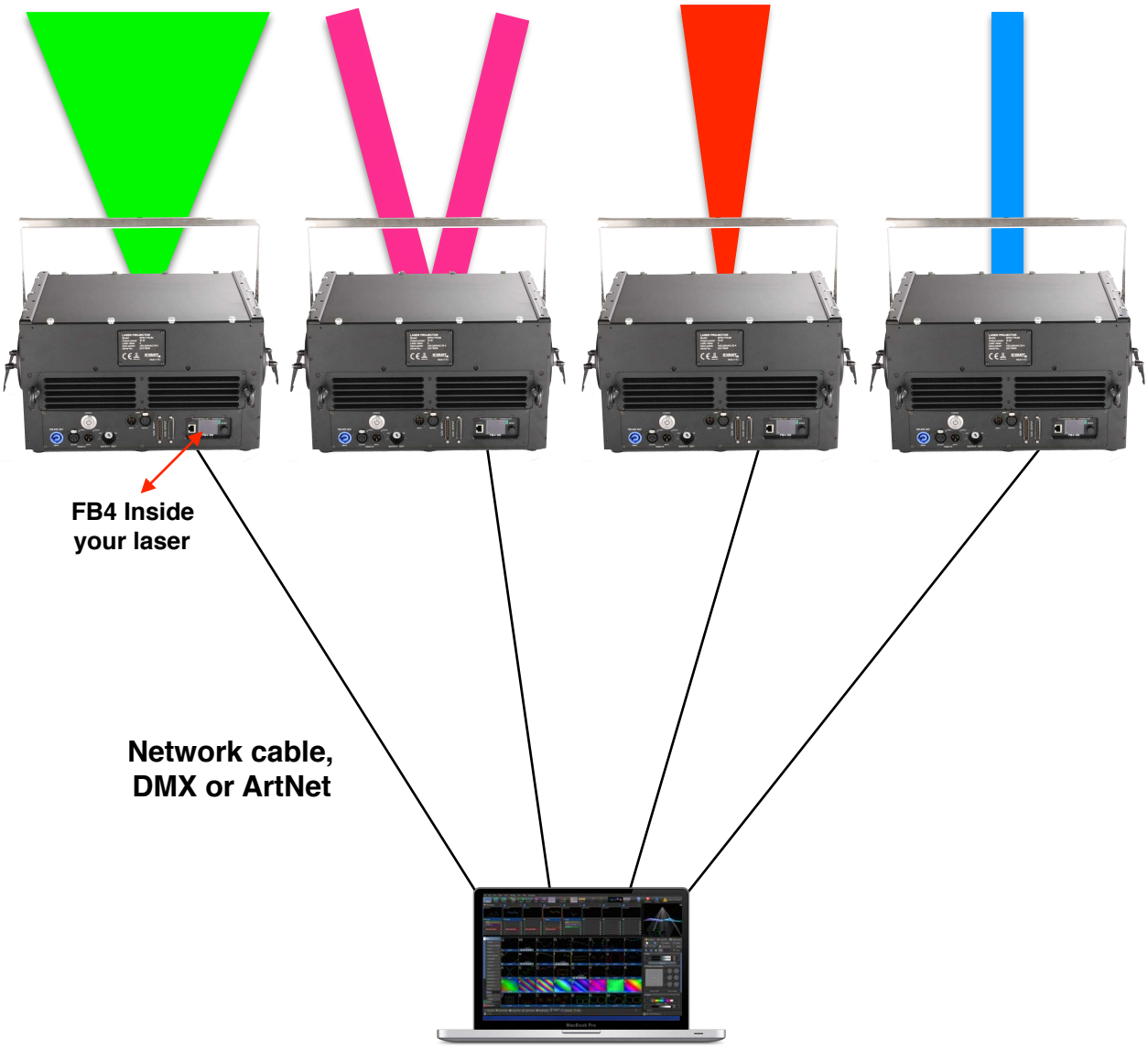


Control Station

This can be a PC, console, etc.

Each laser in this setup has it's own FB4 External controlling it, so each laser can do something different at the same time. When working with FB4 external, you can control the show from a PC, touchscreen, MIDI console, DMX console, or lighting console (with or without a PC, as noted previously). And because FB4 external supports network, DMX, and ArtNet, you can choose which type of control cable you run, depending on your control setup.

FB4 inside your laser - Independent control example



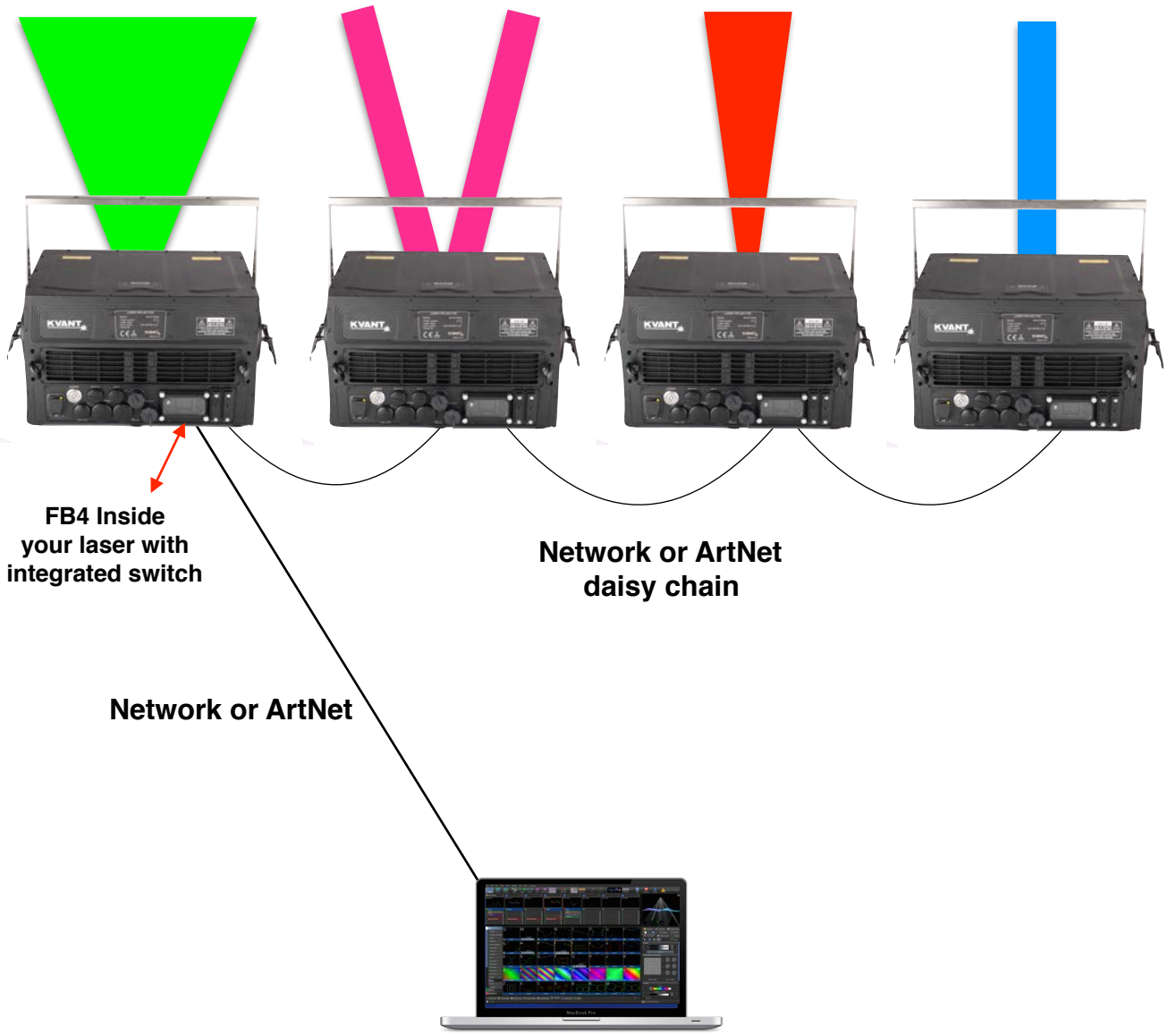
Control Station

This can be a PC, console, etc.

Each laser in this setup has it's own FB4 inside controlling it, so each laser can do something different at the same time. When working with FB4 inside, you can control the show from a PC, touchscreen, MIDI console, DMX console, or lighting console (with or without a PC, as noted previously). And because FB4 inside supports network, DMX, and ArtNet, you can choose which type of control cable you run, depending on your control setup.

**** All laser projectors offered by Pangolin, can be setup and configured this way.***

FB4 inside your laser - Independent control example with daisy chain



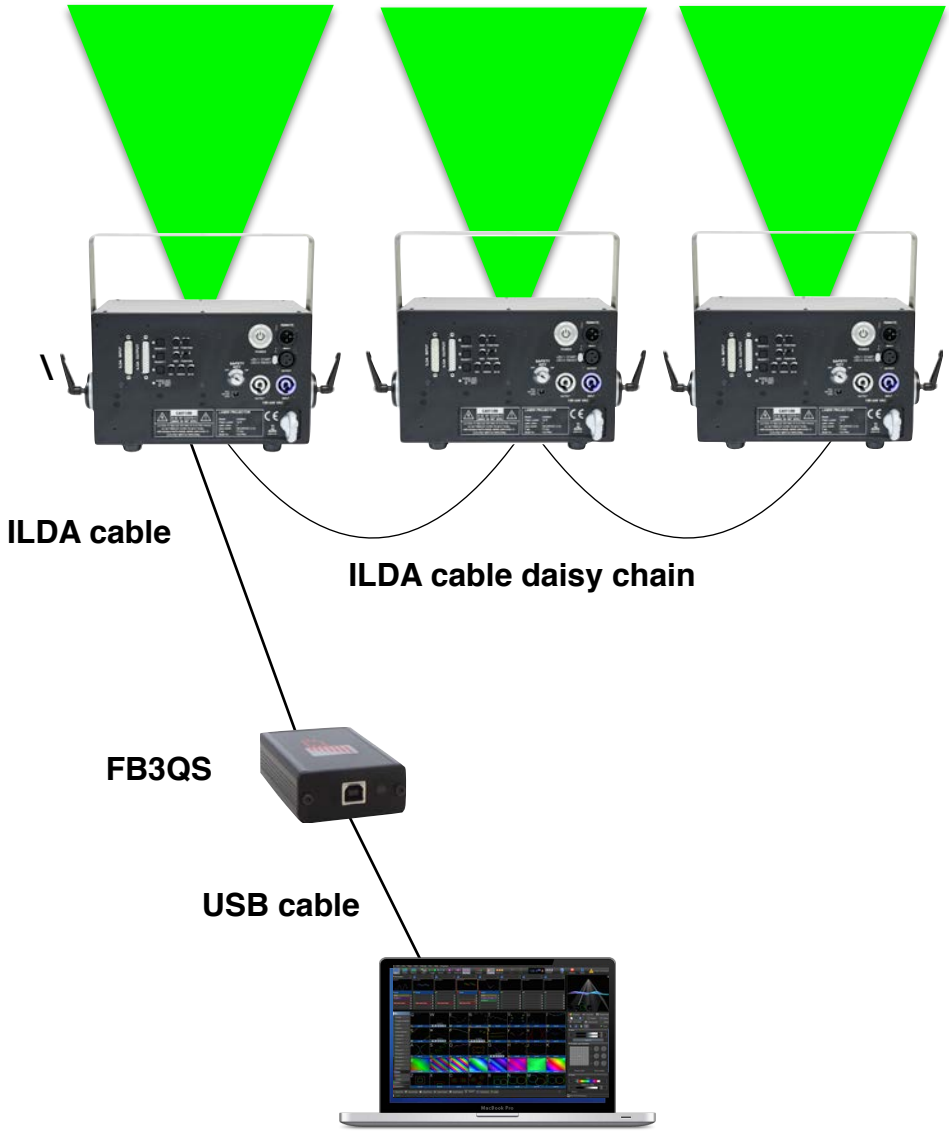
Control Station

This can be a PC, console, etc.

In this example, each laser has FB4 inside, with a built-in switch. This allows you to run a single network or ArtNet control feed, and then daisy chain across each unit. And because each unit has FB4 inside, they are each independently controlled. This is currently the most convenient way to setup a laser show, as it dramatically reduces the amount of cables involved. And your control station can be a PC, or any console of your choice.

**** All laser projectors offered by Pangolin, can be setup and configured this way.***

FB3QS - Shared control example

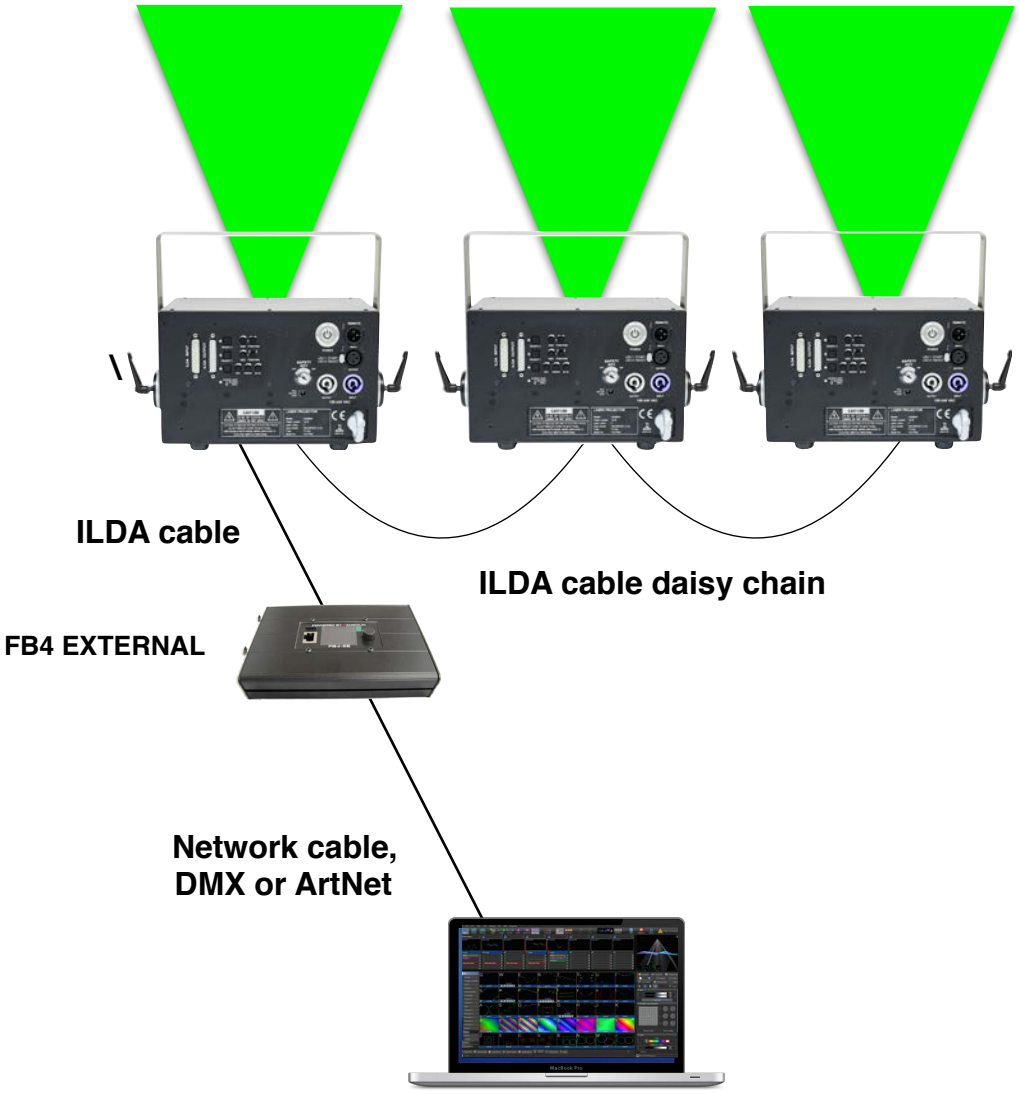


Control Station

This can be a PC, console, etc.

In this setup, we have three lasers, and only one FB3QS. Then, we “share” that signal from the single FB3QS, to the other lasers in the setup, using an “ILDA daisy chain”. So each laser in this setup, will do the same thing, at the same time, as they are sharing the same signal. If you use an advanced projector (like what we offer here at Pangolin) you can invent your axis on X and Y, to make a “mirrored” effect.

FB4 external - Shared control example



Control Station

This can be a PC, console, etc.

In this setup, we have three lasers, and only one FB4 external device. Then, we “share” that signal from the single FB4, to the other lasers in the setup, using an “ILDA daisy chain”. So each laser in this setup, will do the same thing, at the same time, as they are sharing the same signal.

If you use an advanced projector (like what we offer here at Pangolin) each laser will have an ILDA-in and ILDA-out connection, allowing you to do this. In addition, you can invent your axis on X and Y, to make a “mirrored” effect.

LASER SHOW PROJECTORS

An overview of the technology

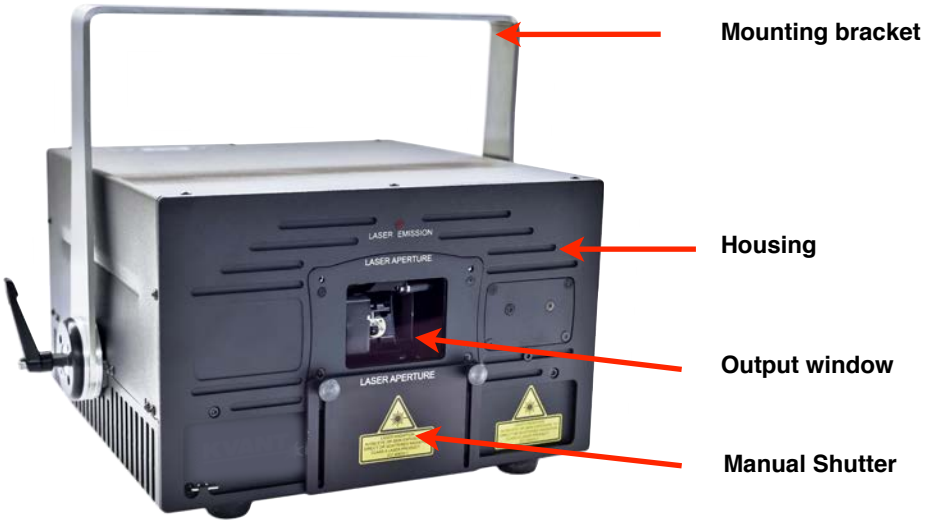
OVERVIEW OF LASER SHOW PROJECTORS

What is a laser projector

To provide a simple definition, a laser projector is any laser system which projects laser output for entertainment purposes. Most entertainment laser projectors generally consists of one or more laser sources (red, green and blue) which are combined together with an optical scanning system and various drive electronics, and then integrated into a laser housing. This allows for the projection of 2D and 3D laser content and objects. Laser projectors (as noted above in the previous sections) can be controlled in a lot of different ways. But most commonly they are controlled from a PC or lighting / DMX console. They can also be controlled in stand-alone or “auto-mode”, if they are used in conjunctions with an FB4 hardware device.

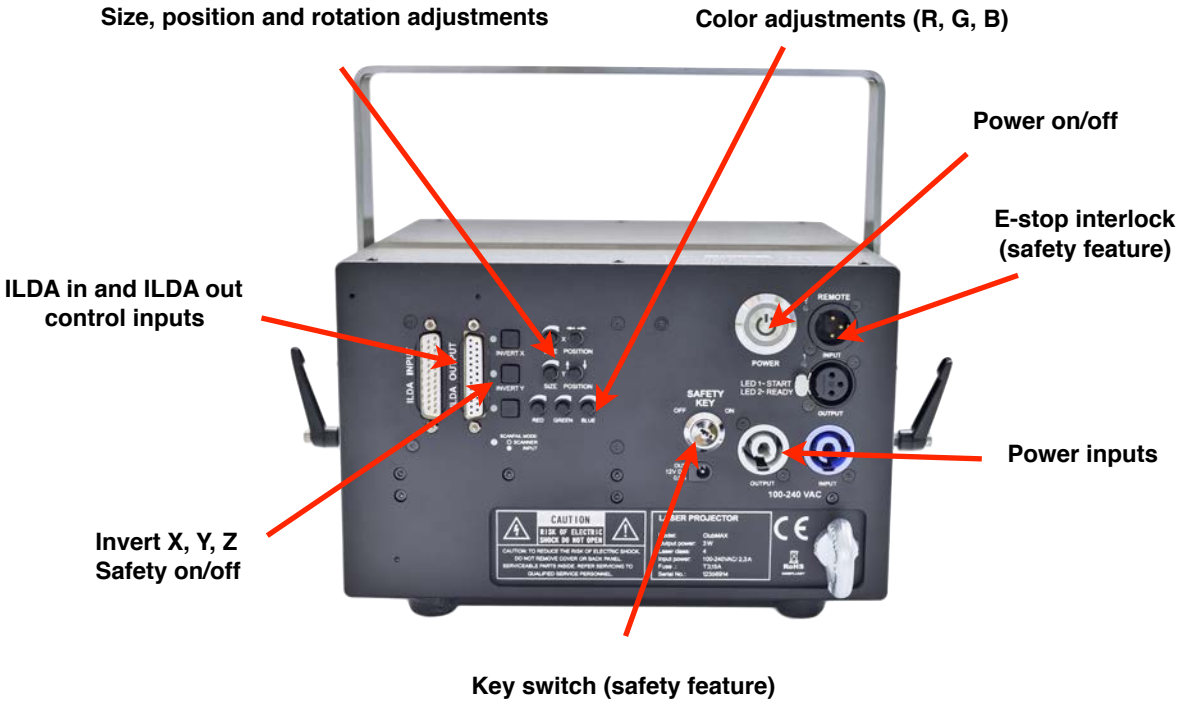
The front and back of a laser projector

Here you can see the general construction of a professional laser projector.



The back of the laser projector

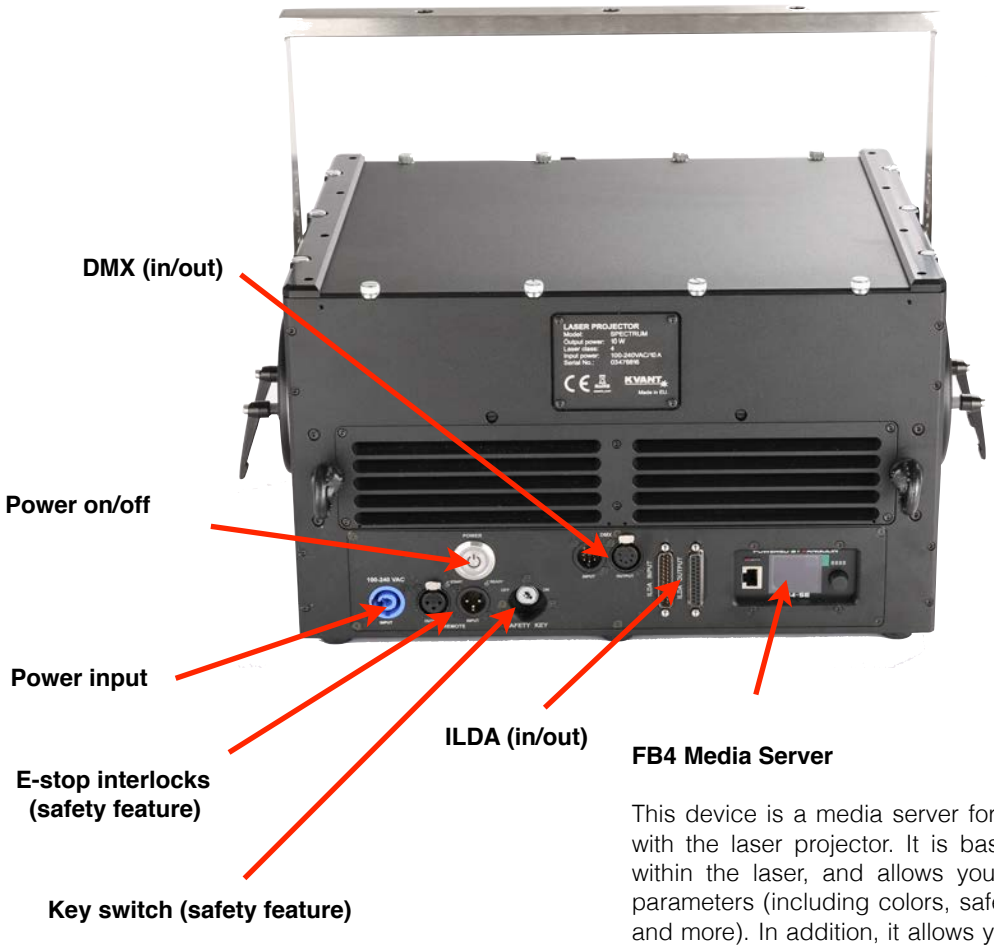
On the back of professional laser projectors, you will see the control inputs, as well as various adjustment and safety options that are commonly available. These are shown below (they may also vary from laser to laser - this is a general overview).



The back of newer, higher end professional laser projectors

Laser technology is constantly evolving, and new higher end professional laser systems are now using network based laser controllers, that get integrated inside of the laser projector. This helps make the setup of a laser show a lot easier, and in addition, makes the control of multiple laser projectors much simpler.

The industry standard network laser control system being integrated, is called “FB4”. FB4 offers a much greater degree of control possibilities. So newer professional lasers on the market, will tend to look more like the laser projector below.

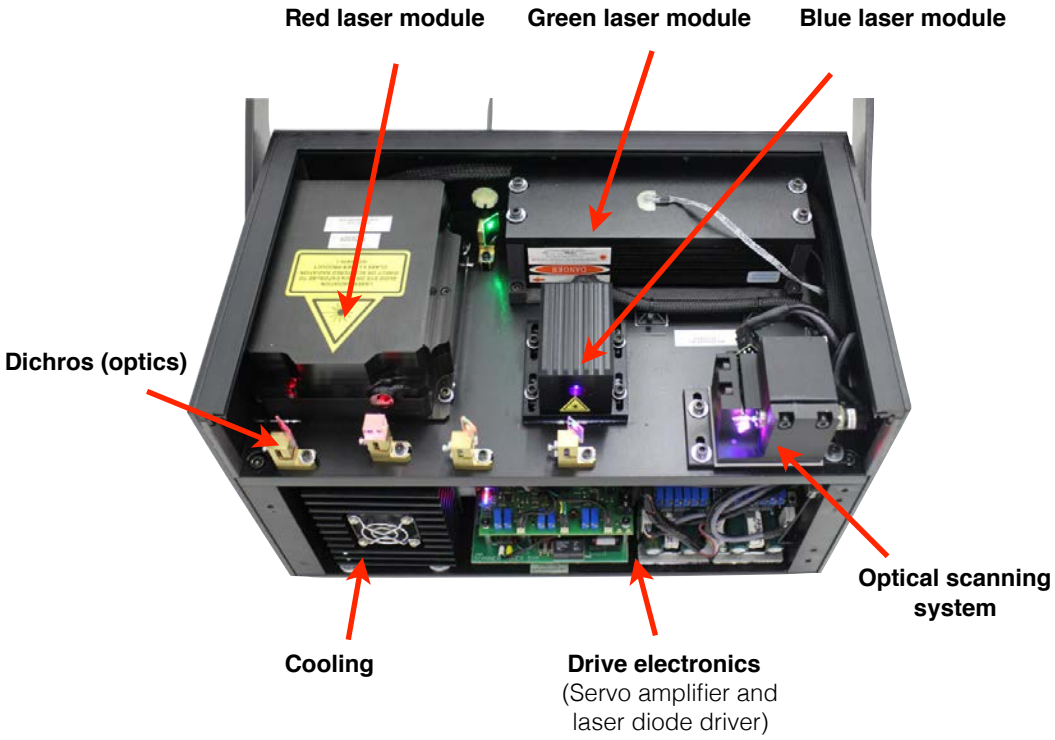


This device is a media server for laser shows, integrated with the laser projector. It is basically a small computer within the laser, and allows you to control all projector parameters (including colors, safety, geometric correction and more). In addition, it allows your lasers to more easily interface with other production equipment. It also features a full color display, and onboard memory systems.

** Ethercon available*
** Network and ArtNet in/out also available*

Inside the laser projector

A laser show projector generally consists of red, green and blue laser sources which are combined together with an optical scanning system, dichros (optics), and various drive electronics, and then integrated into a protective housing.



What are laser modules, and laser diodes

A laser module is the light source, inside of a laser projector. Think of this like the lightbulb inside of a lamp, the same principle applies. Inside of a laser module you have various laser diodes and optics / crystals. A laser diode is the component that emits laser light within the module itself.

To offer a bit of history… Laser modules were first gas laser tubes holding a specific gas, argon, or mixture of gases or helium-neon, and a large amount of power was used to excite the gas and create a laser beam. This technology later evolved to DPSS, which stands for Diode-Pumped Solid State. DPSS lasers used a very high powered infrared light source which was then focused onto a specific crystal (Nd:Yag) to create

various lasers wavelengths (colors). Most recently, diode laser technology has become the standard for laser show laser modules. This technology uses an electrical current applied to a laser diode, which is then passed through a laser crystal, to create laser light. This has become the standard type of laser module in the laser light show industry, due to the reliability and longevity it offers.

Here is a quick photo of what a professional pure diode laser module looks like (showing both the external housing, and inside the module).

Professional laser modules are completely sealed, so that nothing can get inside and potentially damage or harm the laser diodes, and optics.

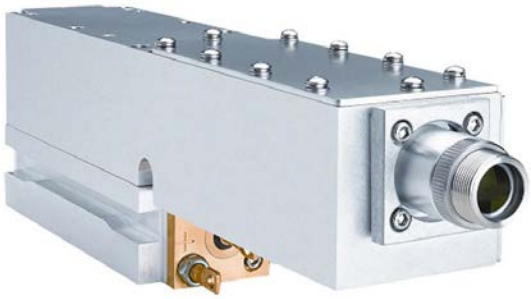
You will notice that inside of the laser module, we have the laser diodes, and various optics used to create the laser beam.

IMPORTANT: You will also see a component called LASORB, connected to each laser diode. LASORB is a protection device used on professional laser projectors, that protects the diodes inside from ESD (electro static discharge) as well as power surges. ESD and power surges are two of the biggest causes of premature laser failure, and LASORB guarantees your laser module and laser diodes, will not be harmed from these elements.

* You can see why you want to have LASORB inside of your module, by watching this video: https://www.youtube.com/watch?v=Bow7pL4n3Ak

Another type of laser light source which is common only in very high end laser show projectors, is OPSL technology. OPSL stands for Optical Pumped Solid State, and to

put it simply, it offers a very low beam divergence (meaning the laser beam is tighter, and thus, appears brighter). OPSL laser modules are mostly integrated into high end laser show projectors, used for large scale outdoor applications, and stadium sized shows. A picture of an OPSL module and what it looks like inside of its housing, are provided below. Lasers offered by Pangolin integrate OPSL laser sources into nearly all of our high power laser projectors. Helping clients get a much brighter laser system, but still at a cost effective price point.



What is an optical scanning system (galvos, scanners, servo amplifier)

An optical scanning system is really the heart and soul of a laser show projector. It consists of two small electronic motors placed inside of a mount on an X and Y axis. Each of the motors has a mirror connected to it, to reflect laser light. And on the bottom of the motor there is a position detector, to receive a control signal from a laser control system. These motors are driven by a servo amplifier.

When the scanners receive the signal from your laser show control system, they move back and forth at very rapid speeds, reflecting the laser light off of them and allowing you to project 2D and 3D laser show images and displays.

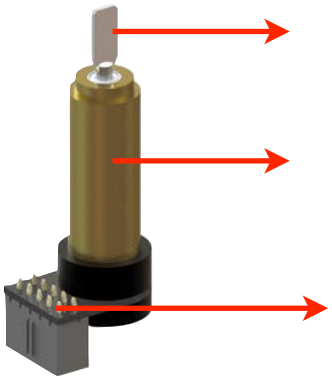
- A “Galvo” is another name for an optical scanner. Galvo is the scientific term used when discussing the motor itself.

- A “Scanner” is just another name for a “Galvo”. The name derived as people saw the “Galvo” scanning the laser beam off of it.

- The “servo amplifier” (or amplifier for short) is the drive electronic, used to send the signal to the optical scanning system.

Optical Scanning System inside a laser projector

Galvo or Scanner



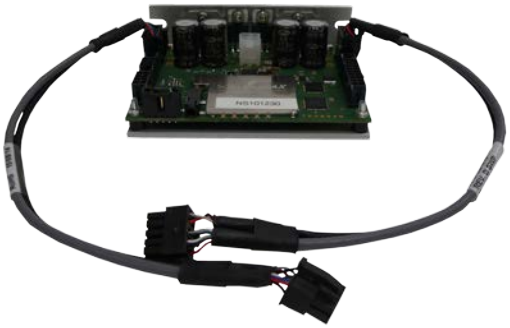
Mirror

Body

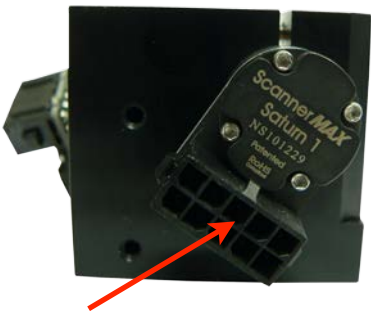
Position detector

Scanners inside of their mount

Servo Amplifier (driver)



Position Detector



The servo amplifier's cable's, connect to the back of the position detector on the optical scanner (galvo)

Understanding laser projectors and specifications

There are a lot of laser projectors on the market today, and not all lasers are created equal. The configuration of your laser projector and the quality of the components used inside, have a direct impact on the type of laser shows and content you can create. Here will will provide some basic guidance to help you understand what to look for when buying or comparing laser show projectors.

Laser powers and how to interpret them

Lasers come in a wide variety of power levels, and the power of the laser is important to understand when choosing the right laser for your desired application. Laser powers are generally specified in terms of “watts (W)” or “mili-watts (mw)”.

- 1W = 1,000mw
- Take note of this, as it is important when understanding the power of your laser.

You also need to be careful when looking at laser powers as different manufacturers use clever terms to specify the actual power of their lasers, which in some cases inadvertently makes a laser projector look more powerful than it actually is.

When you are looking at different laser systems, it is important to know the exact output power of the laser, at the output window. As that is the real amount of power you will have to work with, when performing shows. This is also very important for various laser safety aspects, especially if you are performing an Audience Scanning laser show.

You want to know the amount of laser power you get here… Not necessarily what is produced inside of the laser.

Some clever laser projector suppliers use various “marketing and sales” terminology, to inadvertently try and make their laser projectors look more powerful than they actually are. So when comparing different lasers, be weary if you see terms like:

- **Minimum / Maximum output power -** The maximum laser power is what is produced inside of the laser projector. ***It is NOT what you will get, at the output window***. As every time a laser hits an optic, it has a small loss of power.

- **Apparent brightness -** This is a generalized term, and seeks to make someone believe a laser’s power, is brighter than it is in reality. ***You might see certain suppliers say their laser has an “apparent brightness of 1W”… THIS DOES NOT MEAN YOU HAVE A ONE WATT LASER.*** It only means they are claiming that the output power looks like 1W… If you were to put a laser with an apparent brightness of 1W, side by side with a real 1W laser, in most cases, you will see a noticeable difference. So make sure that if your supplier uses the apparent brightness technique for specifying their laser’s power, that you ask them for the real output power of the laser projector, at the output window.

*** All laser projectors offered by Pangolin have their specification for power listed at the output window. So you will get the exact laser power specified - and sometimes even more :)*

Choosing the right laser power, for your needs

Deciding what power of laser to get can also be confusing at times, as there are a lot of laser powers available. A basic guide of what power is right for a given application, is noted below.

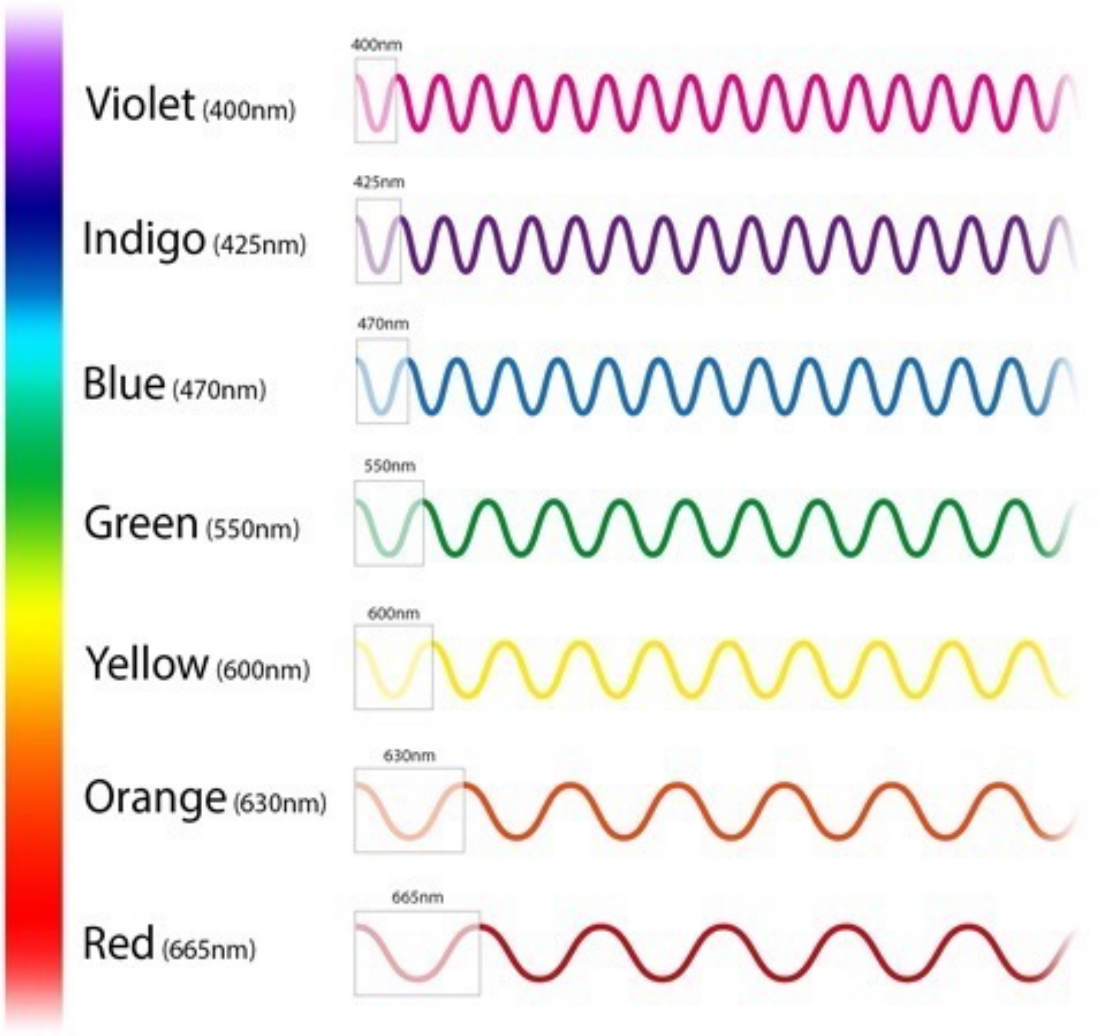
- **Low Power Lasers (500mw - 3W)** - Well suited for indoor shows, such as small to medium size clubs. Also great for home use.

- **Medium Power Lasers (3w+ - 12W)** - Well suited for medium to large scale indoor venues, as well as certain types of outdoor laser shows (think small festivals). These are also well suited for graphic projections outdoors (during nighttime hours).

- **High Power Lasers (12w+ - 40W)** - Well suited for large scale indoor venues (think stadium sized shows) as well as large outdoor shows (festivals, stadiums, long distance arial projection, sky projections, etc.).

Laser colors (and laser modulation)

Most laser projectors have one to three laser modules (red, green, and blue) but the international standard provides for up to 6 color channels to control up to 6 different color laser modules. A laser module's color is determined by its wavelength which is measured in nanometers (nM). All 6 international standard colors, are noted below.



With that being said, the vast majority of laser show projectors on the market, use three color sources (Red, Green and Blue). We call these "RGB" laser projectors. And with RGB based laser projectors, you can create nearly any color in the spectrum.

When working with RGB laser projectors, it is very important to have a system with an even balance of red, green and blue laser sources inside, as this is a critical element that allows you to create a wider variety of colors from the laser projector.

A good ratio of red, green and blue is about 20-30% red, 30-40% green, and around 40-50% blue. Green is the most visible color for lasers. Blue is also the cheapest laser source. So it is common for some budget manufacturers to advertise high power lasers, that use a lot of blue. This is generally not good, because even though you have more power, you have unbalanced colors. And in reality, an evenly balanced laser with good color combination and divergence, will appear brighter to the human eye, than even a higher power system with an uneven balance of red, green and blue. So when comparing brightness, it is not just about “power” ... Color balance, divergence, quality optics, and internal components, are all equally and if not more important overall.

** NOTE - Divergence is the width of the laser beam. Meaning how large is the “spot size”… The lower the divergence, the better looking the laser beam is. Generally a system with <1mrad (full angle) is a good starting point.*

Analog and TTL modulation

There are two types of lasers when it comes to the type of modulation they have. These include “analog” and “TTL” based systems. Without getting too technical, if you use an analog laser projector with good linear modulation, you can create millions of different color combinations, and evenly fade in, and fade out those colors when creating different laser effects.

If you have a TTL based laser, you are limited to only seven colors in total, and you cannot fade in, and fade out across different colors. Generally speaking, budget level lasers or those which are lower in price ($1,000 or less), are TTL based. While more professional lasers tend to be analog modulated.

Modulation and Blanking

This is an externally caused change in laser power, which turns the laser on/off and also allows for the fading of colors. Blanking, or tuning a laser module all the way off, is used in drawing laser animations to separate image components so they are not connected by a low power line.

For example, if the word “TEXT” is projected, a properly blanked laser with analog response and a good linear balance, would turn off (0% power) between each letter of the word, allowing you to clearly see each letter in the projected image.

Whereas in less lower-end laser systems, you will see a line or tail going through the word “TEXT” as illustrated below.

This is good (analog modulation, linear balance)

This is bad (poor modulation, blanking lines visible)

Understanding optical scanning specifications

Most laser projector manufacturers use the term “KPPS” or kilo points per second, when defining optical scanning speeds. So you might see specifications like “20K, 30K, 40K, 60K, etc.. When looking at the optical scanning speeds.

But what is just as important as the speed of the optical scanning system, is the angle which it can perform at. All optical scanning specifications inside of laser projectors should be done at 8°. This is the standard set by the International Laser Display Association, which oversees most laser specifications on the market currently. We use 8°, because this is really the smallest scan angle you would ever really use in a real world scenario.

So for example, you might see “30K @ 8°” or “40K @ 8°”, etc... Again, make sure you are closely watching the angle at which the speed is defined, because you do not want to get taken advantage of, by some of the manufacturers on the market who fudge this specification, to make their laser appear better than it actually is.

- **Caution...** Some people will say “30K @ 4°”... Well, this is really 15K @ 8°. So in reality, you did not get a real “30K” laser projector, you actually got a 15K laser, accordingly to the international standard. We cannot stress how important this is to take note of. Because the optical scanning system plays a huge part, in the overall quality of your laser, and the type of effects it can create.

Another important thing to consider when looking at optical scanning systems on your laser projector, is the optical degrees it can project at, on an X and Y axis. For example, some people will say +/- 60° optical on the X and Y axis. You want to take note of this, because the angle you can project at, on the X and Y axis, directly effects how large of a projection area you can cover with a single laser. Better lasers on the market will start at +/- 60° optical on the X and Y axis.

So here is an overview of optical scanning specifications, and how they related to the effects you can create...

- **30K @ 8° (+/- 60+° optical on the X and Y axis) -** This will be well suited for laser beam effects, and it can also be used for basic laser graphics, text and logo projections. The +/- 60° optical is a pretty large scan angle, and will allow you to cover a relatively wide projection area.

- **40K @ 8° (+/- 60+° optical on the X and Y axis) -** This will be well suited for laser beam effects, and it will also can also give you a big sharper looking laser graphics,

text, and logo projections. The +/- 60° optical is a pretty large scan angle, and will allow you to cover a relatively wide projection area.

- **50K @ 8° (+/- 60+° optical on the X and Y axis) -** This will be well suited for laser beam effects, and it will also can also give you very sharp looking laser graphics, text, and logo projections. The +/- 60° optical is a pretty large scan angle, and will allow you to cover a relatively wide projection area.

- **60K @ 8° (+/- 60+° optical on the X and Y axis) -** This will be well suited for nearly any type of laser display you might wish to create. However, there are only a few optical scanning which can really achieve this speed.

*** Just because a manufacture lists a specification on a website or marketing material, does not mean it is true. Unfortunately, because not many people really understand these specifications, you will find a lot of companies grossly exaggerating this specification - especially on more budget based systems. Ask friends, read reviews, and if you can, get a demo unit to try yourself before buying a laser. This is really the only sure way, to know if you are getting a quality optical scanning system. Anyone can put numbers on paper.*

Below is a list of today's best quality optical scanning systems, available inside of various laser projectors on the market.

- **Compact-506 -** A high quality and affordably priced optical scanning system, suitable for all types of laser beam effects, as well as good quality laser text, graphics, and logos. These are generally used in lasers ranging from 500mw in power, up to around 7watts, due to the size of the mirror they can support.

- **ScannerMAX Saturn 1** - A high end optical scanning system, which performs high quality laser beam effects, and exceptionally crisp laser graphics, text and logos. This is currently the fastest optical scanning system in the world. If you need precise laser graphics, on a low power to medium power laser projector, this is the best optical scanning system to use. But, it is a bit expensive. If you do not need this precision, the Compact-506 is generally well suited for most standard applications.

- **ScannerMAX Saturn 5 -** A high end optical scanning system, which performs high quality laser beam effects, and exceptionally crisp laser graphics, text and logos. If you need precise laser graphics, on a low high power laser system, this is the best optical scanning system to use.

- **Cambridge CT6215 -** This is another great optical scanning system, and commonly used across the industry because it was one of the first optical scanning systems integrated into a laser show projector. You will mostly find these integrated into high power lasers, starting at around 9W in power, up to 40W.

- **ScannerMAX Saturn 9 -** A high end optical scanning system, which performs high quality laser beam effects, and exceptionally crisp laser graphics, text and logos. These are generally integrated into lasers, that have a large beam diameter and thus require a larger mirror to hold the beam.

FREE Resources for laser show projectors

NEED HELP FINDING THE RIGHT LASER? WE CAN ASSIST…

Our team here at Pangolin has over 30-years of international experience in the development and application of laser light show technology. If you have questions about finding the right laser projector, let us know.

We work with all of the world's leading laser projector manufacturers, and have also visited nearly every single factory worldwide, making laser show systems. As such, we can provide great insight on what laser show projector would be right for your needs, and desired application.

You can learn more about this service, by visiting www.LaserShowProjector.com.

Or reach out directly… 24 hours a day, 7 days a week.

- **Office telephone:** +1(407) 299-2088
- **24-hour hotline:** +1(407) 421-5542
- **Email:** (contact@Pangolin.com)

A great resource to understanding optical scanning technology

William R. Benner Jr., President and CTO of Pangolin Laser Systems, Inc. holds over 30-international patents, for laser related technologies he has developed. Benner is considered by many, to be the world's premier expert on optical scanning technology, and in addition to his role at Pangolin, he has consulted with many of the world's largest optical scanning and laser technology related companies, about how to improve and integrate optical scanning technology. In addition, Mr. Benner has

published books and various articles, discussing optical scanning, the technology behind it, and how it can be used in real world scenarios.

Mr. Benner wrote an entire book about optical scanning technology, which you can download for FREE, by going to this website:

http://www.pangolin.com/_Files/LASER_SCANNERS_Book.pdf

* Password is “hello”

LASER SHOW RESOURCES

Helpful information for you

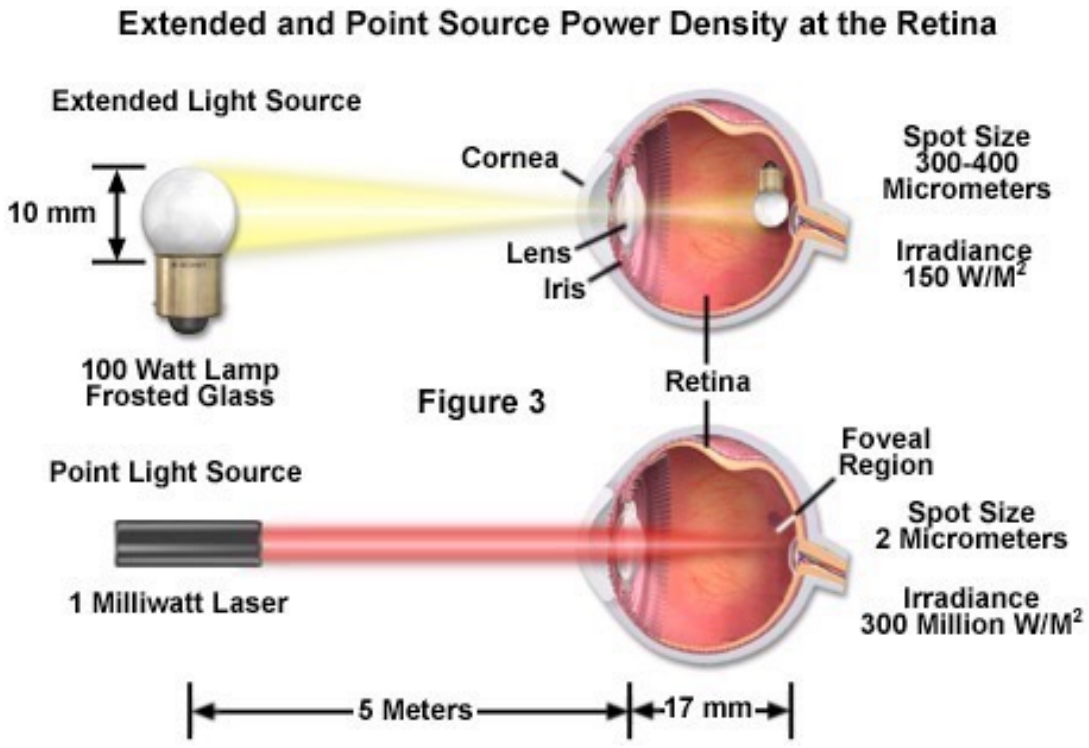
LASER SHOW RESOURCES

Laser Safety Information

Laser light shows have been taking place for more than forty years. In all of this time, a very small number of incidents have been reported, claiming that an audience member was injured or harmed as a result of a laser light show. Frankly speaking, laser shows are one of the safest special effects that can be produced, especially when the operator employs the required laser safety precautions and procedures. However, certain laser effects carry an increased potential of an unsafe exposure, and as such, an understanding of the hazard potential of each type of effect, and how to perform these effects safely, is imperative for any laser operator. Typically, the only laser effects that are potentially hazardous, are those effects that come in direct contact with the audience. Why? We will explain the answer to this question here, without getting too technical.

Why laser effects are potentially more hazardous than typical light sources

The following diagram provides a great illustration and starting point, to help explain why directly viewing a laser beam can be potentially hazardous.



As the diagram above helps illustrate, the human eye is able to focus laser light much more efficiently than it can other types of light (such as sunlight or light from an incandescent light bulb). The better focusing action leads to greater concentration of the light. And, just like when holding a magnifying glass to focus a beam of sunlight into a given area, the human eye will focus laser light into a very small spot. At very high levels, the concentrated energy could become hazardous.

This is a major reason why there are regulations surrounding the use of Audience Scanning-type laser effects, especially in the United States, but also in Europe and some other countries. And, it is also why we at Pangolin strongly urge anyone performing Audience Scanning, to first understand these laser effects, understand what makes the effect potentially hazardous, and to learn how to perform Audience Scanning shows safely and correctly, before presenting this type of effect in a live show scenario.

As a world leader in laser show safety, our team here at Pangolin has compiled a wealth of great articles that discuss the various laser safety aspects touched on in this book; including Audience Scanning safety and the use of lasers in airspace. You can access these articles, using the links below:

Audience Scanning Safety Article - Making laser shows safe and enjoyable, by William R. Benner Jr.
http://www.pangolin.com/resguide09a.htm

Laser Safety Thesis
A Risk Assessment Methodology for the Use of Lasers in the Entertainment Industry, by John O'Hagan
http://www.pangolin.com/resguide09b.htm

Handy Laser Safety Document - A Generic Safety Policy, Risk Assessment, and Contract, by Jeremy Turner
http://www.pangolin.com/_Files/GenericLaserSafetyPolicy.pdf

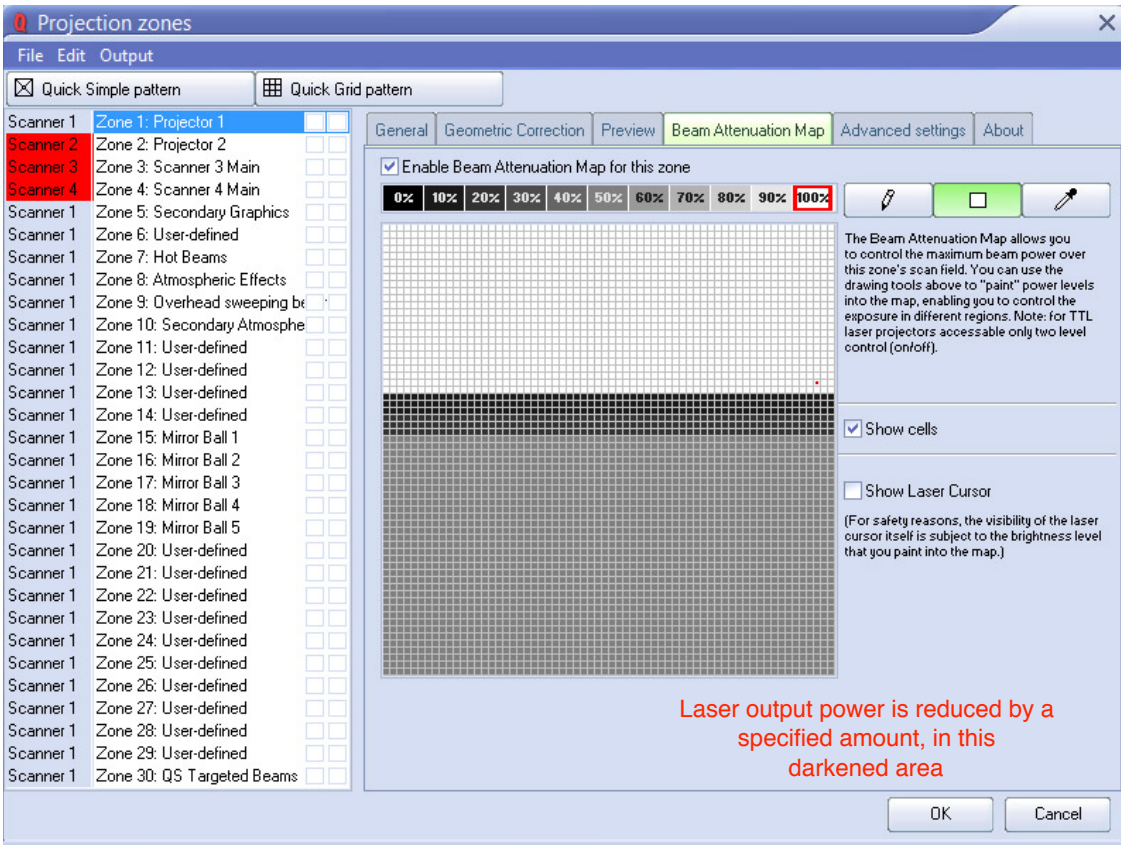
Lasers and aviation safety - Overview and FAQ
http://www.pangolin.com/resguide09c.htm

Laser Safety Technologies available from Pangolin

At Pangolin, we don't just talk about laser safety, we live by it. As such, we've developed a variety of laser safety technologies over the years, that help make laser safety easier for operators to understand, incorporate and handle. A brief overview of these technologies, as well as information on how they help make shows safer, is presented below.

The Beam Attenuation Map - Pangolin's patented Beam Attenuation Map (or BAM for short) is a safety feature inside of all Pangolin software. The Beam Attenuation Map allows the laser operator to define safe areas within your projection space. Using the BAM, you can reduce the laser output power by a predefined amount when projected into areas that might be deemed more sensitive. For example, if you will be projecting laser into an audience area (i.e. Audience Scanning), you can reduce the laser output by a given amount (say 50, 60, or 70%), when it is projected into that audience area. However, the laser power will not be reduced when projected into other "safe" areas (for example above the heads of the audience or into predefined termination areas). You can easily control the amount of exposure using a simple grid inside of the BAM, as you can see below.

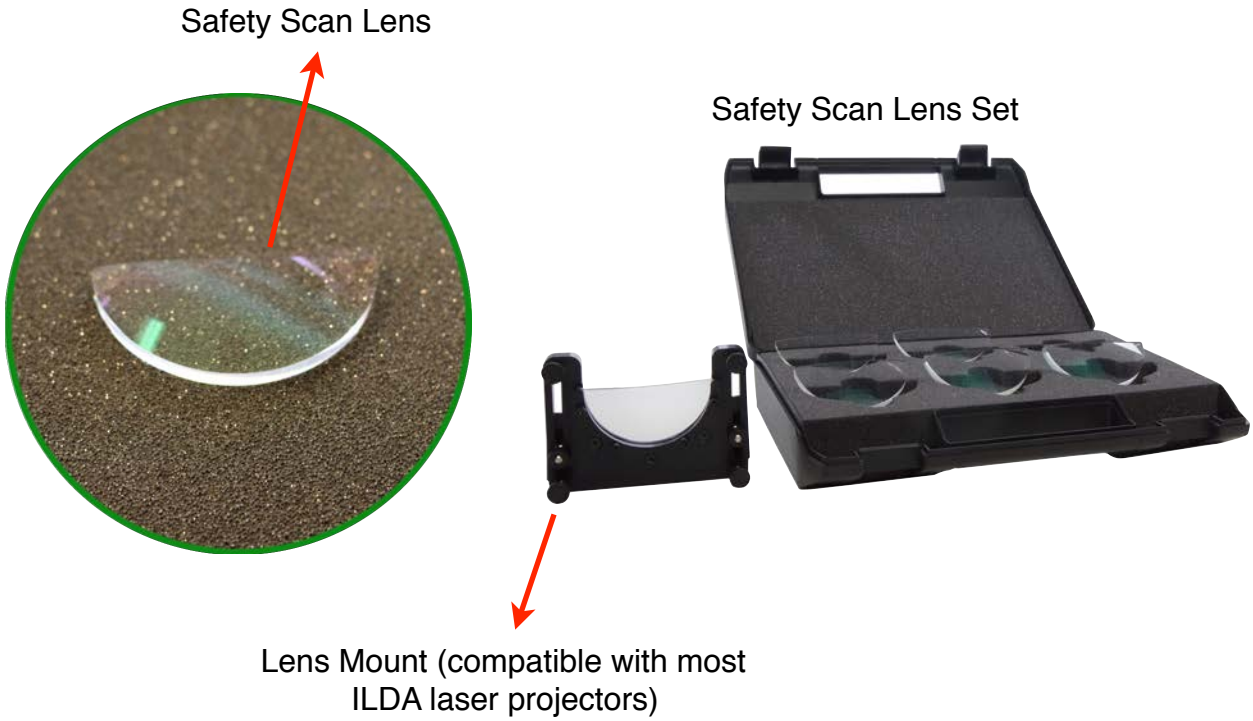
QuickShow



The BAM functionality is available in all Pangolin software, including QuickShow, BEYOND, and LD2000. It also works for all types of laser shows, including graphics, beams, etc.

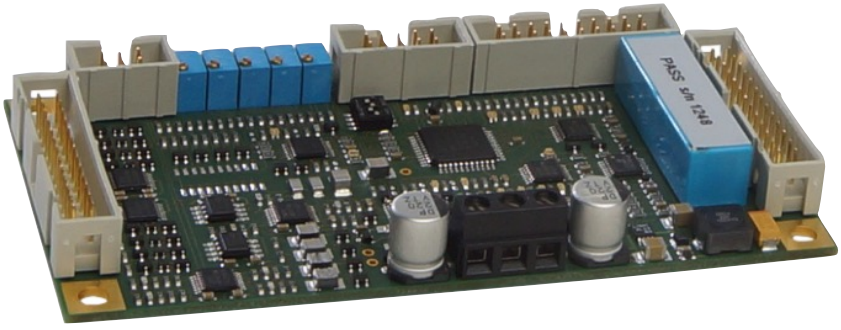
The SafetyScan Lens - Pangolin's patented SafetyScan lenses provide an incredibly easy and affordable way to increase the safety of your laser light shows. Pangolin has created a uniquely-designed series of "half lenses" which are coated with a special anti-reflective coating on both the front and rear surfaces. When properly installed, lenses increase the divergence of the laser beam when scanning downward into the audience, but not when projecting outside the audience area. This allows you to create a beautiful laser light show, and keep the beams which project on the audience at a safe an enjoyable level while not affecting the overhead beams at all. The lenses are available as a complete kit (which includes all six lenses, and a carrying case) or you can purchase only the specific lens you need. Using Pangolin's universal lens mount, any lenses can easily be incorporated onto nearly any type of laser projector, from nearly any manufacturer. The end result, is a visually-impactful and powerful show, which is both safe and enjoyable for the audience to view. You can also watch our Safety Scan Lens Tutorial Video, which further explains this technology, and provides great insight on how to choose the best lens, for your given application.

You can access this video, using the following link:
https://www.youtube.com/watch?v=s9-iKF-iiOw



P.A.S.S. - The Professional Audience Safety System is another patented Pangolin technology that is used to help ensure the safety of Audience Scanning style laser shows. PASS is a highly specialized circuit that monitors the health of all critical systems in a laser projector. PASS performs real-time monitoring of all key projector subsystems, and it is able to instantly terminate laser emissions if PASS detects any unsafe condition. All of the circuits within PASS were designed with a high level of redundancy, which means that there are always at least two circuits monitoring any condition (power supply, light level, scanner dynamics, and system logic). For maximum reliability, each of these “at least two circuits” are implemented in different ways, thus, making it extraordinarily unlikely that both circuits would fail in exactly the same way at exactly the same time. And the output of these circuits are polled, such that all circuits must agree that there is a safe condition in order for PASS to allow light to emanate from the projector. If any parameter is unsafe, or if a monitoring circuit within PASS fails, it will go into a mode where laser light ceases. In fact, PASS will maintain safety even in the face of five simultaneous system failures. Due to strict enforcement of laser safety regulations in the United States, PASS has become the industry-standard solution for those who wish to perform Audience Scanning laser light shows in America. And because of its success in the USA, it is also becoming a standard in many other parts of the world, including the United Kingdom, Europe and Australia. PASS can be integrated into most laser projectors, by those companies which Pangolin has trained to integrate PASS.

For more information on PASS certified integrators, and how to get a laser projector with PASS inside, please contact at Pangolin.



Additional Steps you can take, to learn about laser safety

This report is not the "end all, be all" guide to laser safety. It is merely a guide, providing you with additional information and resources, which you can use to help ensure you are performing shows in a safe manner.

In addition to this report, we would strongly urge anyone performing laser light shows, to take a laser safety operator course. Contact us here at Pangolin and we can help you find the appropriate courses to take, to become a laser safety officer.

We would also like to note, that if you have any questions about laser safety, Pangolin Safety Products, or the industry in general, please feel free to contact us at anytime. We value the relationships we have with our clients, and will always be happy to help you.

An additional video that covers the topics presented in this report can be found here: https://www.youtube.com/watch?v=pohPyDRsCRk.

Laser Compliance Information

Laser classifications

There are different classes of laser projectors, and those classes have different rules and regulations associated with them in different parts of the world. In the laser light show and laser entertainment industry, we generally deal with "Class 4" laser projectors, which are the most powerful type of systems available.

A general breakdown of laser classifications is provided below (information from Laser Institute of America):

- **Class 1 -** A Class 1 laser is considered safe based upon current medical knowledge. This class includes all lasers or laser systems which cannot emit levels of optical radiation above the exposure limits for the eye under any exposure conditions inherent in the design of the laser product. There may be a more hazardous laser embedded in the enclosure of a Class 1 product, but no harmful radiation can escape the enclosure.

- **Class 2 -** A Class 2 laser or laser system must emit a visible laser beam. Because of its brightness, Class 2 laser light will be too dazzling to stare into for extended periods. Momentary viewing is not considered hazardous since the

upper radiant power limit on this type of device is less than the MPE (Maximum Permissible Exposure) for momentary exposure of 0.25 second or less. Intentional extended viewing, however, is considered hazardous.

- **Class 3 -** A Class 3 laser or laser system can emit any wavelength, but it cannot produce a diffuse (not mirror-like) reflection hazard unless focused or viewed for extended periods at close range. It is also not considered a fire hazard or serious skin hazard. Any continuous wave (CW) laser that is not Class 1 or Class 2 is a Class 3 device if its output power is 0.5 W (500mw) or less. Since the output beam of such a laser is definitely hazardous for intra-beam viewing, control measures center on eliminating this possibility.

- **Class 4** - A Class 4 laser or laser system is any that exceeds the output limits (Accessible Emission Limits, AEL's) of a Class 3 device. As would be expected, these lasers may be either a fire or skin hazard or a diffuse reflection hazard. Very stringent control measures are required for a Class 4 laser or laser system.

Laser regulations (mostly relating to the USA)

In the United States, as well as many other countries (including Germany, the UK, Australia, France and Singapore), regulations are in place to ensure the safe operation of laser shows and those viewing them.

We'll focus mostly on US regulations here, as they tend to be the most stringent. We also notice that some other countries follow the United State's lead when it comes to laser show safety.

In the United States, laser show projectors (and lasers in general) are regulated by a division of the FDA called the CDRH (Center for Devices and Radiological Health). CDRH has been chartered by Congress to standardize the performance safety of all manufactured laser products entering into US commerce. All laser products that have been manufactured and entered into commerce, after August 2, 1976, must comply with their regulations.

For the laser light show industry, this means that in order to use a laser show projector in the United States having Class 3b or higher, the system must be certified with the CDRH. That certification usually includes a manufacturer's variance, and in order to receive that certification and variance, the laser must have the following basic safety system integrated:

- **Interlock -** A small device that needs to be connected, in order for the laser to turn on - Most professional lasers use a 3-pin XLR Emergency-stop safety system.

- **Key Switch -** Just like it sounds… A key that is used to turn the laser on. Without the key, the laser will not start.

- **Mechanical Shutter -** This is a device inside the laser, which will block laser output if the content being projected is deemed to be unsafe. It's normally positioned inside the laser, near the optical scanning system.

- **Emission delay -** This is a setting that prevents laser output from being projected upon the start of the system, for a few seconds. Intended to prevent a targeted laser beam, from accidentally hitting someone nearby.

In addition, the operator of the laser projector must also have a "license" to run his show. This is called an "operators variance" and just think of it like your license, to legally operate a laser show, in the United States.

When performing laser shows in the USA, you want to follow some basic guidelines as well, these include:

- **Use compliant equipment -** Make sure you are using a laser show projector, that is certified and compliant in the United States. Some unprofessional companies out there might claim they are selling you a laser that is certified and that has a variance. We have seen a lot of customers have issues by using non-compliant laser equipment. You can check to see if a laser projector is certified, by going to **www.regulations.gov**. You can look up that manufacturer's variance, and then see if they are, in fact, selling compliant laser show projectors.

- **Have a variance -** You need to make sure when performing laser shows, that you have a valid laser show variance. This is separate from the "manufacturer's variance" on the laser projector itself, and is like your "license" of sorts, to run a laser show in public, in the United States.

- **The 3 Meter rule -** When projecting at an audience, keep the laser content 3 meters above people's head. ***DO NOT PROJECT LASERS INTO THE AUDIENCE, UNLESS YOU HAVE BEEN PROPERLY TRAINED, AND HAVE THE PROPER VARIANCES, CERTIFICATIONS AND EQUIPMENT TO DO SO.***

- **Outdoor shows -** When doing an outdoor show, you must make sure your laser beams “terminate” (meaning they do not project on into airspace, and are physically blocked by some kind of object - such as a wall, building, etc.).

- **Outdoor shows/Non-terminate beams -** If you do an outdoor laser show, and you do not have your beams terminated onto some surface, you must get prior approval from the FAA. This serves to protect pilots flying aircraft from unintended laser beams being protected at or towards them while flying.

Audience Scanning regulations in the USA

Performing Audience Scanning in the United States can be done, but it is a sophisticated process, which requires special certifications (variances) as well as special training, and equipment. Currently, there are relatively few people in the USA, who are properly certified to perform this type of effect. The basic steps to becoming Audience Scanning certified, are as follows:

1. Your laser show projector generally must have Pangolin’s PASS hardware integrated properly by a certified laser projector manufacturer who has been approved and trained on how to integrate PASS, by Pangolin.

2. Next, you will need to hire laser safety consultant to work with you to file the appropriate paperwork, to certify your laser show projector with PASS, as well as to file your show report - which is a document detailing how you will setup and operate an Audience Scanning laser show, to ensure you are operating within whats called “MPE” or maximum permissible exposure. This process is quite complex, and that is why most everyone hires a laser safety consultant, to assist with the process.

3. Finally, you need to take and pass an laser safety officer course, and then purchase the necessary laser safety test equipment, that is used during the course of setting up an Audience Scanning show.

For more information about laser compliance, and laser compliance related information, you can visit the FDA / CDRH’s website here: www.regulations.gov.

Where to get FREE laser shows

The Pangolin Cloud

The Pangolin Cloud is a new and innovative feature inside Pangolin software, that provides clients with hundreds of FREE laser shows, and thousands of laser frames and pieces of content. In addition, you can create your own profile to upload laser shows and content to share with others around the world.

The Pangolin Cloud is directly integrated inside of QuickShow and BEYOND (versions 3.0 and higher).

Watch this video, that shows how to use and work with the Pangolin Cloud: https://www.youtube.com/watch?v=T191ofwnxeA.

Join Pangolin on Social Media

Another great way to get laser shows and content, is to join our Facebook communities. In our Facebook groups, you can connect with thousands of laser artists from around the world, many of whom specialize in creating custom shows and content for clients. You can join us on Facebook and social media, using the links below:

Friend us on Facebook: www.Facebook.com/PangolinSystems.
Join our Facebook Group: https://www.facebook.com/groups/PoweredbyPangolin/.
Follow us on Twitter: www.Twitter.com/PangolinSystems.

Links to laser training videos

QuickShow Tutorial Videos

- Overview of QuickShow software
- Creating laser text (QuickText)
- Creating laser beam effects (QuickShape)
- Creating laser logos (QuickTrace)
- Creating timeline laser show (QuickTimeline)

- Combining laser images (QuickCapture)
- Creating laser effects (QuickFX)
- Using DMX (QuickDMX)
- Creating targeted laser effects (QuickTargets)
- Overview of new features in QuickShow 3.0

BEYOND Tutorial Videos

- Overview of BEYOND software
- How to run “live” laser shows
- Live control tutorials
- Creating advanced effects
- Show creation tutorials
- Using BEYOND with DMX
- Using BEYOND with ArtNet
- Designing custom software interfaces in BEYOND
- Mapping out MIDI, DMX and ArtNet devices
- Working with lighting consoles and BEYOND
- Using BEYOND and timecode
- BEYOND 3D - Creating 3D animations and content

Laser safety video

- Overview of laser safety technologies

Optical scanning technology

- Overview of ScannerMAX optical scanners

Other helpful videos

- How to use FB4
- How control multiple lasers, in Pangolin software

Laser show projectors

- Get inspired, and watch a bunch of great videos showing our lasers

All Pangolin related videos

- Visit our YouTube channel, and see more videos all related to laser shows

THANK YOU FOR READING!

From all of us here at Team Pangolin, we hope that you enjoyed reading this E-Book on how to create shows. And again, please know that if you have any questions about laser light shows, the technology or the industry in general, you can always contact us. We pride ourselves on the service and support we provide to our clients. If there is ever anything we can do to help, let us know!

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