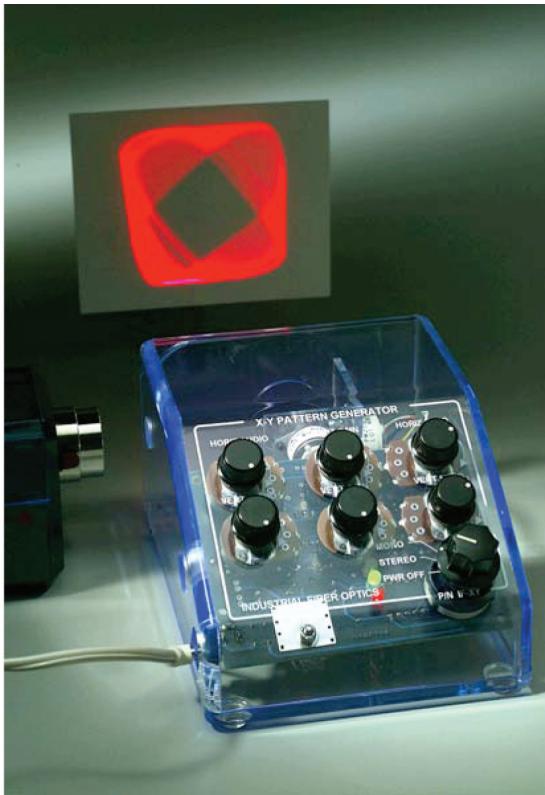


X-Y Pattern Generator

Operator's Manual



Model Number:

IF-XY

INDUSTRIAL FIBER OPTICS

*

Copyright © 2010
Previous Printings 2006, 2001, 1999, 1996
by Industrial Fiber Optics, Inc.
Revision - C

Printed in the United States of America

* * *

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise) without prior written permission from Industrial Fiber Optics.

* * * * *

INTRODUCTION

*This manual provides information about Industrial Fiber Optics' X-Y Pattern Generator Model **IF-XY**. It contains all the information you need to operate this device safely and knowledgeably, even if you are a novice to laser technology. Please read the manual carefully before operating.*

As soon as you receive the X-Y Pattern Generator, inspect it and the shipping container for damage. If any damage is found, immediately refer to the section of this manual entitled "Shipment Damage Claims".

Industrial Fiber Optics makes every effort to incorporate state-of-the-art technology, highest quality, and dependability in its products. We constantly explore new ideas and products to best serve the rapidly expanding needs of industry and education. We encourage comments that you may have about our products, and we welcome the opportunity to discuss new ideas that may better serve your needs. For more information about our company and products refer to <http://www.i-fiberoptics.com> on the Worldwide Web.

Thank you for selecting this Industrial Fiber Optics product. We hope it meets your expectations and provides many hours of productive activity. Good luck and enjoy the fascinating world of laser technology!

Sincerely,

The Industrial Fiber Optics Team

LASER CLASSIFICATIONS

All manufacturers of lasers used in the United States must conform to regulations administered by the Center for Devices and Radiological Health (CDRH), a branch of the U.S. Department of Health and Human Services. CDRH categorizes lasers as follows:

Class	Description
I	A laser or laser system which does not present a hazard to skin or eyes for any wavelength or exposure time. Exposure varies with wavelength. For ultraviolet, .2 to .4 µm exposure must be less than from .8 nW to .8 µW. Acceptable visible light exposure varies from .4 µW to 200 µW, and for near IR, the acceptable exposure is < 200 µW. Consult CDRH regulations for specific information.
II	Any visible laser with an output less than 1 mW of power. Warning label requirements — yellow caution label stating maximum output of 1 mW. Generally used as classroom lab lasers, supermarket scanners and laser pointers.
IIIa	Any visible laser with an output over 1 mW of power with a maximum output of 5 mW of power. Warning label requirements — red danger label stating maximum output of 5 mW. Also used as classroom lab lasers, in holography, laser pointers, leveling instruments, measuring devices and alignment equipment.
IIIb	Any laser with an output over 5 mW of power with a maximum output of 500 mW, and all invisible lasers with an output up to 400 mW. Warning label requirements — red danger label stating maximum output. These lasers also require a key switch for operation and a 3.5-second delay when the laser is turned on. Used in many of the same applications as the Class IIIa when more power is required.
IV	Any laser with an output over 500 mW of power. Warning label requirements — red danger label stating maximum output. These lasers are primarily used in industrial applications such as tooling, machining, cutting and welding. Most medical laser applications also require these high-powered lasers.

TABLE OF CONTENTS

Introduction	i
PREFACE	2
GENERAL	3
Electrical.....	3
Optical.....	8
Product Specifications.....	8
SAFETY	9
GENERAL GUIDELINES FOR USE	10
INITIAL CHECK OUT	11
OPERATING PROCEDURE	12
Using a Laser with the Pattern Generator.....	12
Adding Audio to Your Light Show.....	13
TROUBLESHOOTING	15
SERVICE AND MAINTENANCE	17
WARRANTY	18
SHIPMENT DAMAGE CLAIMS	19

PREFACE

Laser beams! Dazzling, powerful, mysterious pencil-thin shafts of colored light flashing through space. Angels, or demons? Are lasers something straight out of science fiction — the science of the future?

Lasers may seem futuristic, but working laser systems have been part of our world for many years. Today, nearly every business and school has at least one laser in the form of a copier or laser printer. Lasers have truly made a difference in our lives.

Laser technology, powerful though it is, still requires complementary technology to create some of the high-tech “miracles” that you have read about, studied and witnessed in person. A laser is like a raw crude oil. By itself it is only a novelty, but when combined with other parts and process it has become the fuel that created the standard of living for the Twentieth Century. One of the those complementary technologies has been packaged in the product which this manual describes — the X-Y Pattern Generator.

The Pattern Generator is a versatile and economical tool for anyone using lasers for demonstration and practical purposes. Essentially, it is a combination of electronics, mirrors and motors working together to control the direction and movement of a laser beam. First, a laser is aligned so its beam reflects off two mirrors inside the Pattern Generator. When the power supply is connected, the student or experimenter can create wondrous and complex patterns of light simply by adjusting the control knobs.

Examples of using a laser and the X-Y Pattern Generator for specific purposes range from creating optical “Lissajous” patterns in the classroom to producing startling theatrical lighting effects. The Pattern Generator also clearly demonstrates how laser beams can be controlled for applications such as industrial cutting.

GENERAL

Electrical

All control knobs for the Pattern Generator are located on the angled face of the chassis, which we shall call the “Front”. **Figure 1** shows a front view of the Pattern Generator’s control panel. Following are descriptions of each item identified in **Figure 1**. The electrical power and audio jacks for the Pattern Generator are located on the left side of the chassis (when the chassis is viewed from the front). See **Figure 2**.

1. Indicator LEDs

Three indicator LEDs or lights — red, green and yellow — are located in the lower center of the control panel. The position of the selector switch determines which LEDs light up.

2. Selector Switch

The Selector Switch is located in the lower right-hand corner of the control panel. It controls power from the 2.1 mm power jack (see Item 11 on page 6 of this manual) to all the internal electronic and electro-mechanical components. It has three positions — PWR OFF, STEREO and MONO.

When the Selector Switch is in the PWR OFF position the Pattern Generator will also be off, and none of the three indicator LEDs will be lit. With the Selector Switch in the STEREO position, the red and the green LEDs will be on, and the yellow LED off. In the switch’s MONO position, the red and yellow LEDs will be on, and the green LED off.

When the Selector Switch is in either the STEREO or MONO position, the internal electronics for controlling the mirrors and motors are fully operational. (Subsequent sections in this manual contain more information about the control knobs and electronics.)

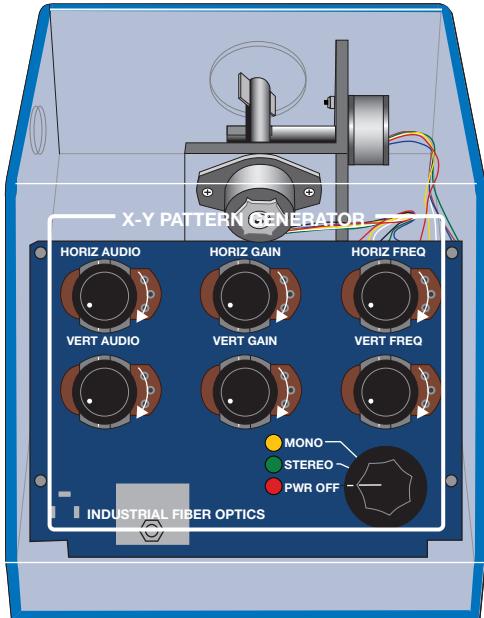


Figure 1. Front View of Pattern Generator Showing Control Panel and Scanning Motors/Mirrors

3. Mirror and Motor for Horizontal Motion

This mirror/motor combination is one of two electro-mechanical assemblies which produce motion inside the Pattern Generator and cause the “x” (horizontal) and “y” (vertical) motions which project the laser beam in variable patterns. In both assemblies the mirror, attached to the motor shaft, reflects the laser beam while the motor causes the mirror to move. The motor generates motion in response to electrical signals from the control panel electronics.

Electrical signals to the motors have two variables — frequency and amplitude. The electrical frequency of the input signal controls the laser beam’s projection *rate*, and the amplitude controls the beam’s projection *angle*.

The mirror/motor assembly which creates horizontal motion is closest to the control panel. Its shaft (central axis) points to the rear of the Pattern Generator.

4. Mirror and Motor for Vertical Motion

This mirror/motor combination is the second of two electro-mechanical assemblies which produce motion inside the Pattern Generator and cause the “x” and “y” motions which project the laser beam in variable patterns.

As with the other mirror/motor assembly, electrical signals to the motors have two variables — frequency and amplitude. The electrical frequency of the input signal controls the laser beam’s projection *rate*, and the amplitude controls the beam’s projection *angle*.

The mirror/motor assembly which creates vertical motion is closest to the rear of the Pattern Generator, and its shaft points toward the right of the Generator (as the chassis is viewed from the front).

5. Horizontal Gain Control (HORIZ GAIN)

The Horizontal Gain control knnob is located at the top center position of the control panel. It controls the **angle** or scan amplitude of the motor/mirror assembly which creates the “x” motion or horizontal projection of the laser beam. It does so by varying the amplitude of the electrical signal to the motor, which then controls the projection angle of the motor shaft and mirror. When this knob is turned fully counterclockwise, the mirror and motor shaft are stationary. As the control knob is rotated clockwise, the mirror/motor projection angle increases from 0 to approximately 10°.

6. Vertical Gain Control (VERT GAIN)

The Vertical Gain control knob is located near the center of the control panel. It controls the angle of the motor/mirror combination which creates the vertical laser beam projection. It does so by varying the amplitude of the electrical signal to the motor, which then controls the angle of the motor shaft and mirror. When the knob is turned fully counterclockwise, this mirror and motor shaft is stationary. As the control knob is rotated clockwise, the mirror and motor's projection angle increases from 0 to approximately 10°.

7. Horizontal Frequency Control (HORIZ FREQ)

The top right-hand knob, labeled **HORIZ FREQ**, controls the frequency of the electrical signal to the motor/mirror assembly which generates the horizontal projection aspects of the Pattern Generator. A typical frequency range is 30 Hz, when the knob is fully counterclockwise, to 150 Hz when it is rotated fully clockwise.

8. Vertical Frequency Control (VERT FREQ)

The center right-hand knob, labeled **VERT FREQ**, controls the frequency of the electrical signal to the motor/mirror assembly which generates the vertical projection aspects of the Pattern Generator. A typical frequency range is 30 Hz, when the knob is fully counter-clockwise, to 150 Hz when it is rotated fully clockwise.

9. Horizontal Audio Control (HORIZ AUDIO)

The top left-hand knob, labeled **HORIZ AUDIO**, controls the amplitude of audio signals from the audio jack to the mirror/motor which controls horizontal projection of the laser beam. When the knob is fully counterclockwise, this mirror and motor shaft are stationary, regardless of audio signal. As the control knob is rotated clockwise, the mirror and motor's scan angle increases from 0 to a maximum of approximately 10°. Following are the horizontal projection patterns for Selector Switch positions and stereo and mono audio inputs.

Table 1. Horizontal Scan of Selector Switch and Audio Inputs.

Selector Switch/ Audio Input (across)	Stereo	Mono
STEREO	Left channel audio signal to horizontal motion axis	Audio frequencies below 1 kHz will be added with the internal signals driving the horizontal axis
MONO	Left channel audio frequencies will be added with the internal signals driving the horizontal axis	Audio frequencies below 1 kHz will be added with the internal signals driving the horizontal axis

10. Vertical Audio Control (VERT AUDIO)

The bottom left-hand knob, labeled **VERT AUDIO**, controls the amplitude of audio signals from the audio jack to the mirror/motor which controls vertical projection of the laser beam. When the knob is fully counterclockwise, this mirror and motor shaft are stationary, regardless of audio signal. As the control knob is rotated clockwise, the mirror and motor's scan angle increases from 0 to a maximum of approximately 10°. Following are the vertical projection patterns for Selector Switch positions and stereo and mono audio inputs.

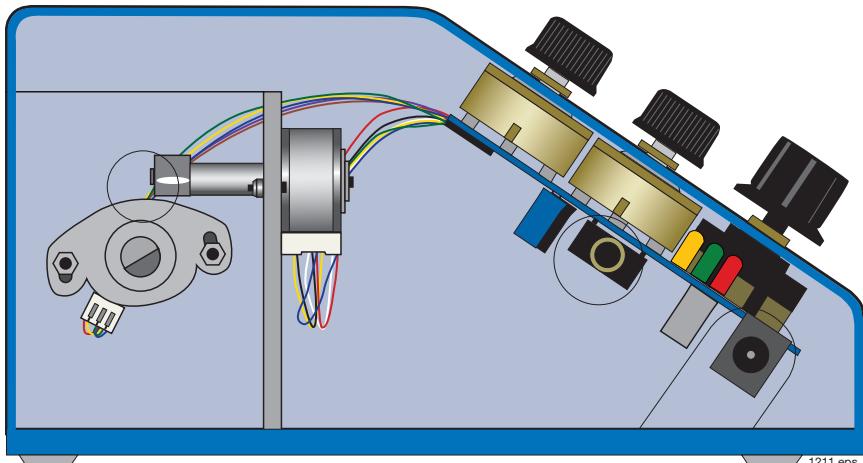
Table 2. Vertical Scan of Selector Switch and Audio Inputs.

Selector Switch/ Audio Input (across)	Stereo	Mono
STEREO	Right channel audio signal to vertical motion axis	Vertical axis will not be affected by any audio frequency
MONO	Right channel audio frequencies will be added with the internal signals driving the vertical axis	Audio frequencies above 1 kHz will be added with the internal signals driving the vertical axis

11. Power Jack

All Industrial Fiber Optics pattern generators obtain electrical power through a standard 2.1 mm DC power jack. (The Selector Switch controls the power from the jack to the electronic circuitry and motors.)

Electrical power to the Pattern Generator must be applied from a low-voltage DC power source with an output from 14 to 20 volts, such as supplied with this Pattern Generator. See Item 13 in this section for more information about the Power Adapter.



1211.eps

Figure 2. Left-hand view of the Pattern Generator.

12. 3.5 mm Audio Jack

The 3.5 mm Audio Jack is industry-standard. It is compatible with many remote microphones and patch cords from cassette and CD players. The jack is used to electrically connect stereo and mono audio signals to the Pattern Generator's internal circuitry.

The audio input for the Pattern Generator is intended primarily to patch in the output from a radio or CD player. Although microphones (many of which have similar-sized plugs) can often be connected to the Pattern Generator, this practice is not recommended. Signals from microphones are too small to drive the electronics and motors to produce scan patterns of any significant size.

If your audio signal has only a "mono" sound output, set the selector switch to MONO.

It is recommended that signals into the 3.5 mm audio jack be 1.0 volts AC or less.

13. Power Adapter (not shown)

All of our pattern generators sold in the United States come complete with a power adapter suitable for 60 Hz 110 VAC-to-DC conversion. All others come with 50 Hz 220 VAC-to-DC power adapters. It is strongly recommended that you use only the power adapter furnished with the Pattern Generator. If you use another power supply, it must be one with an output of 14 to 20 volts DC, and minimum current capability of 150 milliamperes. *Do not use a power supply which may generate spikes exceeding 36 volts.*

OPTICAL

The Industrial Fiber Optics X-Y Pattern Generator was designed to create special indoor displays and demonstrations when used in conjunction with any visible light laser. Applications of the Pattern Generator include special lighting requirements for small theaters and educational demonstrations such as showing Lissajous patterns, controlling laser beams in machining applications, and demonstrating the actual mechanics of how sophisticated light shows are created.

Lasers suitable for use with this X-Y Pattern Generator include diode or semiconductor lasers, laser pointers and Helium Neon (HeNe) lasers which produce a beam of visible light. Suggested output power is 5 milliwatts or less. Lasers of this power are classified by CDRH regulations as Class II or Class IIIa. Several other types of lasers will work equally well with this Pattern Generator, but please — for your welfare and that of others — think SAFETY. If in question about safety see the sources listed in the section entitled **SAFETY**.

This Pattern Generator was designed so its exit beam angles upward at approximately 10 degrees. The design permits easy viewing of the laser projections without having to place the laser and Pattern Generator on a raised platform.

Product Specifications

Table 3. Pattern Generator Specifications.

Parameter	Stereo
Operating	
Input voltage	14 to 20 volts DC
Input current	150 milliamperes
Temperature	0 to 40° C
Optical	
Inclination angle	$10 \pm 2^\circ$
Scan angle	$\pm 5^\circ$
Storage	
Dimensions	12.8 x 15.5 x 8.1 cm
Weight	653 grams
Temperature	-20 to 50° C

SAFETY

Optical

Do not poke fingers or any other objects through the holes on the back and side of the Pattern Generator during operation. If the mirrors need cleaning, see the section entitled “**SERVICE AND MAINTENANCE**”.

Any laser should be used with caution, because the beam can be focused to an extremely powerful pinpoint of radiant energy. When aligning the laser with the Pattern Generator **never** look directly into the laser beam or stare at its bright reflections — just as you should avoid staring at the sun or other very bright light sources. Stand over or back from the laser when aligning it, keeping at least 15 inches between your body and the equipment.

If this is your first experience using a laser, review the **Rules for Laser Safety** on the back cover of this booklet.

If in question about the safety of using your laser with this Pattern Generator, contact the laser manufacturer; your local U.S. Department of Health, Education and Welfare office; or write to the agency's headquarters at 1390 Piccard Dr., Rockville, MD 20850.

Electrical

Included with this X-Y Pattern Generator is a UL-approved AC-to-DC adapter for VAC operation. The adapter converts common lab/household voltage to low DC voltage suitable for Pattern Generator operation. Always plug the adapter into a grounded circuit.

This device is particularly safe because it operates at low voltage and low current levels. However, as when using any electrical device, you must take certain safety precautions:

- Do not touch (or short-circuit) the connection points of the power adapter plug.
- Do not open the Pattern Generator housing under any circumstances, as this will expose you to unshielded electrical connections, and void the product warranty.

GENERAL GUIDELINES FOR USE

- Use this Pattern Generator with only low-power diode or semiconductor lasers, laser pointers, or Helium Neon (HeNe) lasers. Before using this equipment with a laser see the preceding section entitled Safety.
- Position the laser and Pattern Generator so the laser beams are not projected toward people, hallways or doors.
- Always use the power adapter shipped with this Pattern Generator.

IMPORTANT: If you must use a power adapter other than the one supplied with this Pattern Generator, check the section entitled *Operational Information* in this manual to ensure the power adapter's voltage and current levels are within recommended specifications.

- When finished using the Pattern Generator, return it to the plastic bag in which it came, to minimize dust collecting on the mirrors.
- Store the Pattern Generator in a clean, dry environment.

INITIAL CHECK-OUT

1. Unpack the Pattern Generator from its shipping container and remove it from the plastic bag.
2. Check the Pattern Generator for any damage that may have occurred during shipping.
3. Plug one end of the AC adapter (provided with the Pattern Generator) into a 120 VAC wall outlet and the other end into the power jack on the left side of the Pattern Generator.
4. Turn the Selector Switch on the Pattern Generator to the position marked “STEREO”.
5. At this point the red and green LEDs on the X-Y Pattern Generator’s Control Panel should light up.
6. Turn the Selector Switch to the “MONO” position and verify that the red and yellow LEDs now are lit.
7. Gradually turn the **HORIZ GAIN** and **VERT GAIN** control knobs clockwise and observe the mirrors moving slightly.
8. Set the **HORIZ GAIN** and **VERT GAIN** knobs at the 12 o’clock position, then turn the **HORIZ FREQ** and **VERT FREQ** knobs clockwise and observe the increased rate at which the mirrors move.
9. At this point you have verified that the Pattern Generator is fully functional. Proceed to the next section now — and let’s put a laser to work!

OPERATING PROCEDURES

Using a Laser with the Pattern Generator

1. Review the laser safety rules on the back cover of this manual if this is your first time operating a laser.
2. Make sure the laser's ON/OFF switch is in its OFF position.
3. Push the laser beam stop or beam shutter to its closed position.
4. Rotate all the knobs on the Pattern Generator (including the Selector Switch) to their full counter-clockwise position.
5. Plug one end of the AC adapter (provided with the laser) into a 120-VAC electrical outlet and the adapter's other end into the power jack on the laser.
6. Plug one end of the 120-VAC to DC power adapter into the X-Y Pattern Generator, and the other end into a 120-VAC electrical outlet.
7. Switch the X-Y Pattern Generator on, using the knob in the lower right of the control panel. The green and red indicators just to the left of the switch should be on, and the yellow indicator off.
8. Point the laser toward a wall or other dull surface.
9. Turn on the laser's power switch.
10. The laser now should be on, as indicated by its indicator/pilot light.
11. Open the laser beam stop.
12. Observe the spot on the wall where the laser is pointed.
13. Align the laser beam with the Pattern Generator so the beam strikes the center of the upper mirror at right angles, as shown in **Figure 3**. (Books or paper may have to be placed under the laser or Pattern Generator to accurately align the laser beam with the Pattern Generator's upper mirror.)
14. The laser beam should now appear as a dot on the wall or backstop, at right angles and slightly elevated above the original direction of the beam.
15. Adjust the **HORIZ GAIN** and **VERT GAIN** control knobs of the X-Y Pattern Generator to the 12 o'clock position.

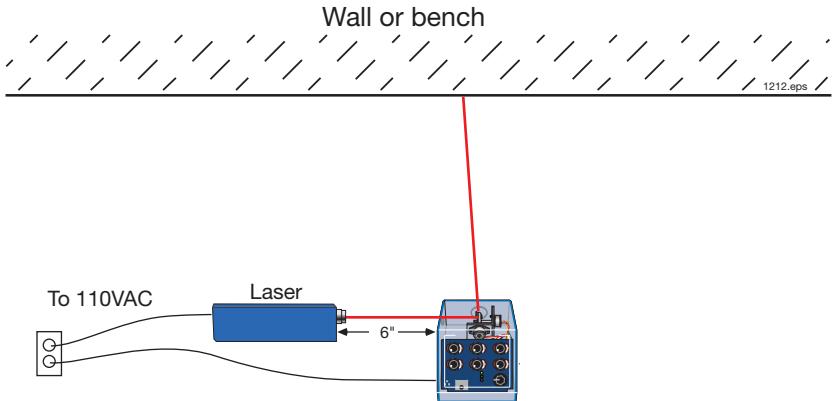


Figure 3. Laser aligned with the Pattern Generator and ready for use.

16. At this point you should see a light pattern projected onto the wall.
17. Try adjusting the knobs — individually, then in various combinations. You'll find there is no limit to the number of laser light combinations you can create!
18. If and when you've exhausted your creativity (for a while, at least) close the laser shutter, then turn the laser off.

Adding audio to your Light Show

To use the audio functions of this Pattern Generator, you will need:

- External audio source (radio, cassette player, CD, etc.)
- 3.5 mm stereo patch cord (available in stereo and electronic stores)

In the following steps we will assume that you have already completed the previous procedure; power is applied to the Pattern Generator and laser; and the Pattern Generator and laser are aligned.

1. Rotate all the knobs on the Pattern Generator to their full counter-clockwise position, including the Selector Switch.
2. Verify that your audio source (radio, cassette player or CD) is working.
3. Turn the audio source off and turn its volume knob to the lowest sound level.
4. Insert one end of the audio patch cord into your radio, cassette, or CD player and the other end into the audio jack on the Pattern Generator.

5. Turn on the power to the audio source and adjust its volume to a comfortable listening level. (If the room starts vibrating, and adults slap their hands over their ears, your volume is *way* too high.)
6. Turn the Selector Switch of the Pattern Generator to the **STEREO** position. (Turn the Selector Switch to **MONO** if your audio source has only mono output or if you are using a mono patch cord.)
7. Turn the **HORIZ AUDIO** and **VERT AUDIO** control knobs slowly clockwise while observing the red laser light movements responding to the music.

Do not attempt “maximum light pattern” by increasing the volume on your audio source or turning the audio control knobs all the way clockwise. Damage to the pattern generator may occur under such conditions and this is **not covered by the warranty.**

8. Change the settings on your audio source from AM to FM (or vice versa) to view the light patterns. Do the same by varying the position of the Pattern Generator's Selector Switch.
9. You can add more size to the light pattern by turning the **HORIZ GAIN** and **VERT GAIN** control knobs slowly clockwise.
10. Experiment with setting the Selector Switch to **MONO** and **STEREO** settings; or even add some aerosols such as incense, chalk dust, or room freshener and dim the room lights. (*This will simulate the effect commonly seen during indoor rock concerts.*)
11. When you've had enough fun for a while, turn off the power to all electrical components and disconnect their power cords.
12. Return the Pattern Generator to the plastic bag in which it came, to minimize dust collecting on the mirrors. Return other items to their proper storage containers and locations.

TROUBLESHOOTING

No “On” Indicator (All Leds Off)

- Is the ON/OFF selector switch in the “**MONO**” or “**STEREO**” position?
- Is the 120-VAC power adapter plugged into both the X-Y Pattern Generator and an appropriate wall outlet?
- Is power reaching the wall outlet?
- Are you using the power adapter shipped with the Pattern Generator to power the device?

No Projected Light Patterns

- Is the laser turned on?
- Is the laser’s mechanical beam stop in its open position?
- Is the laser positioned properly so its beam strikes the center of the reflective mirrors inside the Pattern Generator?
- Are the **HORIZ GAIN** and **VERT GAIN** knobs on the X-Y Pattern Generator control panel set at their 12 o’clock positions?

No Projected Patterns With Audio Input

- Is the audio patch cord plugged into the X-Y Pattern Generator?
- Is the audio patch cord plugged into the audio source — (cassette, CD player, etc.)?
- Is the audio source turned ON?
- Is the audio source volume turned high enough?
- Are the **HORIZ AUDIO** and **VERT AUDIO** controls on the X-Y Pattern Generator adjusted to their 12 o’clock positions?
- Is the patch cord making good connection, or does it have broken wires?
- Check the Pattern Generator’s function by turning the **HORIZ GAIN** and **VERT GAIN** control knobs to their 12 o’clock positions. If a red light pattern is projected on the wall, the problem lies with the audio output of the audio source or the patch cord.

Only a Horizontal Line Projected

- This will occur if the Pattern Generator has a mono audio input, but the Selector Switch is set at **STEREO**. The “fix” is simple: Turn the Selector Switch to its **MONO** position.

Partial or Half Images

- Is the laser aligned properly so its beam strikes the center of the scanning mirror inside the X-Y Pattern Generator?
- The laser beam diameter may be too large for the Pattern Generator's mirrors. We suggest trying a different laser or adding a lens to focus the laser beam on the internal mirrors.

Blurry Output Images

- Is the laser aligned properly so its beam strikes the center of the scanning mirrors in the Pattern Generator?
- Is the diameter of the laser beam you are using larger than the mirrors in the Pattern Generator?
- Are the Pattern Generator mirrors dirty?
- Is there moisture or other liquid on the Pattern Generator mirrors?

Do **not** attempt to troubleshoot the X-Y Pattern Generator beyond the steps listed above. If you believe that a problem exists within the Pattern Generator, please either contact the factory or return it for appropriate servicing to Industrial Fiber Optics, as described in the section on **SERVICE AND MAINTENANCE**.

SERVICE AND MAINTENANCE

The only maintenance or service that the X-Y Pattern Generator may require is cleaning of its internal mirrors. Use cotton swabs dipped in distilled water, isopropyl alcohol or commercial glass cleaner. Reach through the aperture holes with the cotton swabs and gently wipe the surface of the mirrors until clean. ***Do not open the housing or remove the screws as the product warranty will be voided if entry has been made to the Pattern Generator.***

In the unlikely event the Pattern Generator malfunctions, you may have it repaired by doing the following:

- In writing, describe the problem, person to contact, phone number, and return address.
- Carefully pack the Pattern Generator, power adapter, manual, and problem description in a stout box with sufficient packing material to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS

1725 WEST 1ST STREET
TEMPE, AZ 85281-7622
USA

WARRANTY

Industrial Fiber Optics products are warranted against defects in materials and workmanship for 90 days. The warranty will be voided if internal components have been damaged or mishandled by the buyer, including entry to the Pattern Generator housing and/or removal of screws.

Warranty liability is limited to repair or replacement of any defective unit at the company's facilities, and does not include attendant or consequential damages. Repair or replacement can be made only after failure analysis at the factory. Authorized warranty repairs are made at no charge, and are guaranteed for the balance of the original warranty.

Industrial Fiber Optics will pay the return freight and insurance charges for warranty repair within the continental United States, by United Parcel Service or Parcel Post. Any other delivery means must be paid for by the customer.

The costs of return shipments for a Pattern Generator no longer under warranty must be paid by the customer. If an item is not under warranty, repairs will not be undertaken until the cost of such repairs has been approved, in writing, by the customer. Typical repair costs range from \$25 -125, and completion times from two to three weeks.

When returning items for analysis and possible repair, please do the following:

- In a letter, describe the problem, person to contact, phone number, and return address.
- Pack the Pattern Generator, power adapter, manual, and your letter carefully in a strong box with adequate packing material, to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS

1725 WEST 1ST STREET
TEMPE, AZ 85281-7622
USA

SHIPMENT DAMAGE CLAIMS

If damage to an Industrial Fiber Optics product should occur during shipping, it is imperative that it be reported immediately, both to the carrier and the distributor or salesperson from whom the item was purchased. DO NOT CONTACT INDUSTRIAL FIBER OPTICS.

Time is of the essence because damage claims submitted more than five days after delivery may not be honored. If shipping damage has occurred during shipment, please do the following:

- Make a note of the carrier company; the name of the carrier employee who delivered the damaged product; the date; and the time of the delivery.
- Keep all packing material.
- In writing, describe the nature of damage to the product.
- In cases of severe damage, do not attempt to use the product (including attaching it to a power source).
- Notify the carrier immediately of any damaged product.
- Notify the distributor from whom the purchase was made.

Rules for Laser Safety

- Lasers produce a very intense beam of light. Treat them with respect. Most educational lasers have an output of less than 3 milliwatts, and will not harm the skin.
- Never look into the laser aperture while the laser is turned on! **PERMANENT EYE DAMAGE COULD RESULT.**
- Never stare into the oncoming beam. Never use magnifiers (such as binoculars or telescopes) to look at the beam as it travels – or when it strikes a surface.
- Never point a laser at anyone's eyes or face, no matter how far away they are.
- When using a laser in the classroom or laboratory, always use a beam stop, or project the beam to areas, which people won't enter or pass through.
- Never leave a laser unattended while it is turned on – and always unplug it when it's not actually being used.
- Remove all shiny objects from the area in which you will be working. This includes rings, watches, metal bands, tools, and glass. Reflections from the beam can be nearly as intense as the beam itself.
- Never disassemble or try to adjust the laser's internal components. Electric shock could result.