

LASER TECHNIQUE

User Instructions for

DMX GRAPHIC SCAN

250mW Argon Laser System

CE

LASER TECHNIQUE
by
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SAFETY, OPERATING ENVIRONMENT AND USER MAINTENANCE:

1. **Before attempting to use the laser it is important that you read the operating instructions and become familiar with all functions and special considerations when using the laser. Failure to do so may cause a hazard or accident to the operators and the audience. Damage may also occur which will not be covered by the warranty.**
2. These instructions supplied with this product supersede any other versions.
3. The laser energy that is used in this system is powerful. Care must be exercised to avoid direct exposure to the laser beam or its reflections, it is important that the following safety precautions are observed at all times:
 - Do not look directly into a stationary laser beam. Your eye sight may be permanently damaged or lost.
 - Do not operate the laser system when fatigued or under the influence of alcohol.
 - Avoid wearing rings, metallic watchbands, or other metallic and or reflective objects, when near the output of the laser beam.
 - Never leave the laser system unattended while in operation.
 - Limit access to the laser system when in operation.
 - Do not allow persons near the laser system who are not trained in the operation and safety aspects of the laser system when there is no supervision.
 - Any alignment of the optical systems must be carried out with suitable eye protection. Insure that the eye protection is for the proper laser wavelength and optical density.
4. If the laser beam projections are closer than 5m to the audience they must be above head height (guidelines suggest 3m) and exposure to reflected or projected beams must be avoided.
5. When the laser is being used in situations where the distance between the audience and projections is less than 5m, it is important for a mask to be positioned so that the laser projections will be masked off (blocked) should the laser malfunction or the user attempt to scan the audience.
6. Before operation the laser must be connected to a suitable mains plug. **THE UNIT MUST BE EARTHED, AND PROTECTED BY A 13 AMP FUSE.**
7. The laser must only be repaired by qualified personal, any unauthorised modifications or attempts at repair will invalidate the warranty. If there are any problems with the laser contact Nu Light Systems Ltd for advice.
8. The laser cannot be connected to a dimmer system, damage may occur if it is.
9. The laser is designed for inside use. Outside use is permitted providing it is not used in extreme weather conditions and that it is provided with adequate cover from rain and similar precipitation's Failure to do so may cause an electrocution hazard or damage and will invalidate the warranty.
10. The laser must not be operated for more than 5 hours in any one time, after shutting the laser down, the head must be left on for a further 5 minutes for cooling.
11. The laser optics both inside and out must be cleaned frequently (at least once a week if it is used frequently) to remove dust and smoke particles. Ref Figure 1.

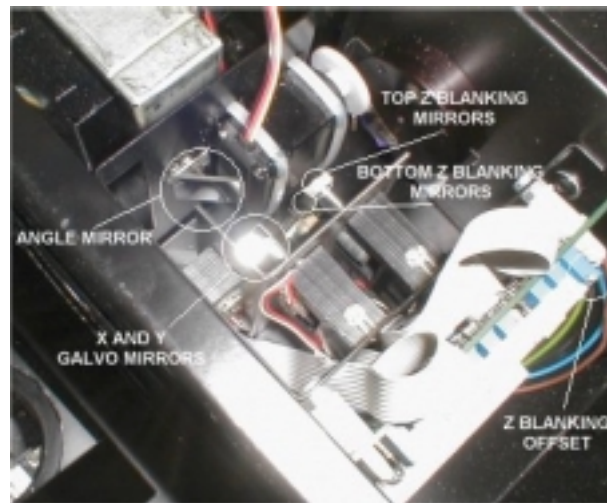
The front laser output window and mirror should be cleaned with lens tissues.

Inside the laser there are 7 mirrors (see diagram below) which may also need cleaning along with the other side of the output window.

To access these (with the power turned off) loosen the 4 screws which secure the lid in place and remove the lid, the mirrors are all located just behind the output window. Use camera cleaning

buds with methanol to clean these - **APPLY GENTLE PRESSURE AS IT IS EASILY POSSIBLE TO DAMAGE OR SNAP THE MIRRORS OFF.**

Figure 1.



The mirrors that should be cleaned are: ANGLE MIRROR, X AND Y GALVO MIRRORS, TOP 2 Z BLANKING MIRRORS AND BOTTOM 2 Z BLANKING MIRRORS.

Use camera lens tissues and cleaning buds with pure methanol for cleaning purposes. These are available from all good camera shops.

12. Care must be exercised when handling the laser. It contains fragile components which may be damaged by knocks or excessive force.
13. The laser must always be secured to a stable mounting fixture.
14. The fan intake and output ducts must not be obstructed or placed near any object closer than 150mm. When using the laser in situations that use smoke, such as in a club venue the laser must be supplied with cool clean air to the main input fan (on top the laser), flexible ducting is an ideal low cost method. Failure to this will cause smoke particles to precipitate inside the laser which will cause electrical short circuits and will invalidate the warranty.
15. During the transport of the laser or from drift, there is a small chance that the alignment of the Z BLANKING galvanometer has slightly changed. If this happens the laser may not switch the beam on and off correctly and there also may be power loss.

If this has happened then it will have to be re-aligned. To do this is a simple procedure. Follow the instructions below: (If at any stage you are not sure of what you are doing then contact your dealer or Nu Light Systems directly, as damage may occur if the alignment is carried out incorrectly)

- a) Slightly loosen the 4 screws which hold the cover in place, take the cover off.
- b) Locate where the scanners are, a PCB with "**WARRANTY Void IF BROKEN**" stickers should be visible.
- c) A pre-set resistor should be visible that is labelled "**Z OFFSET**", this is the one that needs to be only slightly adjusted. See part section 10 for location of this pre-set.
- d) Power the laser up as described in the manual.
- e) You will see 3 sets of scanners: One on the very left – this the Y scanner, one in the middle – this is the X scanner, and one on the right with a different mirror to the other scanners – this is Z- BLANK scanner, the one that will be adjusted.
- f) **Select the STAR graphic and turn on the laser beam** via the DMX controller. If the

alignment is OK the laser beam from the Z-Blanking scanner should be in the middle of the X scanner mirror. If it is out alignment the beam maybe on half of the edge and half on the mirror, or the Z Blanking mirrors on the scanner may be glowing brightly form the laser beam.

- g) Slightly turn (anti clockwise or clockwise) the Z OFFSET pre-set until the beam is in the middle of the X mirror or until the Z Blanking mirror is not glowing. The laser path should be visible reflecting of all the mirrors with no bright spots. **Remember that the pre-set will only be needed to be turned a maximum of a 1/6 of a turn. If the alignment is not completed within this segment then contact your dealer or Nu Light Systems directly.**
16. Do not place the laser near the direct output from a smoke machine. Make sure there is a distance of at least 10m from a smoke machine.
17. Make sure the laser is operated from a stable mains power source 230VAC \pm 10%.
18. Every time the laser is to be used all of its functions should be tested before the show.
19. Failure to observe the above may cause damage to the laser and will invalidate the warranty.
20. If you have any suggestions on the operation of this laser or require technical information or support please email: lasersupport@nu-light.co.uk

THE MANUFACTURER NU LIGHT SYSTEMS LTD REPRESENTED BY THE BRAND NAME OF "LASER TECHNIQUE" HOLDS NO LIABILITY FOR THE USE OF THIS PRODUCT OR FOR ANY DAMAGE WHICH MAY RESULT FROM ITS USE, IT IS THE USERS RESPONSIBILITY TO OPERATE THE LASER IN A SAFE MANNER. SPECIFICATIONS MAY CHANGE WITHOUT NOTICE.

WARRANTY INFORMATION:

This laser system uses the highest quality components for the price / performance ratio. The laser comes with a full 12 month return to base warranty from the original date of purchase which covers all electronics, electromechanical components and enclosures, except for consumables, which carry limited warranties.

The limited warranties apply to the argon laser tube inside the laser unit. The argon laser head comes with a manufacturers 3 month warranty and has a minimum life expectancy of 2000 hours which is equivalent to 2.5 years of heavy use in club situation. The laser tube is of high specification and it can be expected to still be operational after 4000 hours.

Laser Technique reserves the right to repair or replace the faulty product and to substitute any materials which may no longer be available with alternative parts. Charges for shipping the laser to and from Laser Technique must be covered by the customer.

The warranty does not cover defects which may be the result of misuse outside the specified operating conditions. Any non authorised attempts at repairs or service of the product will void the warranty.

GENERAL DESCRIPTION OF LASER SYSTEM:

LASER PHYSICAL FEATURES:

- The DMX GRAPHIC SCAN laser head has the following features: Ref Figure 2.

- Rear Panel:

- IEC Power Input
- Fuse Holder
- Serial Label
- DMX Signal Output
- DMX Signal Input
- Red DMX Error LED
- Green Power LED
- DMX Address Selection Switches



Figure 2.

- Projection window, pan and tilt mirror, where the laser patterns project out from,
- IEC socket lead which must be connected to the respective live, neutral, and earth lines,

DMX CHANNEL SELECTION:

- To select a DMX start address, remove power from the laser and follow the procedure below: (remember the laser takes 8 DMX channels)

- Locate the DMX selector switches on the rear panel, decide what start address you want, and adjust the appropriate switches. The address can be selected with the switches as shown: (1=switch ON, 0=switch OFF)

SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	SW 9	< Binary Value
1	2	4	8	16	32	64	128	256	DMX Start Add
on/off	on/off	on/off	on/off	on/off	on/off	on/off	on/off	on/off	
on	off	off	off	off	off	off	off	off	001
off	off	off	on	off	off	off	off	off	008
on	off	on	off	off	on	off	off	off	036
on	off	on	off	on	off	off	on	off	149
on	on	off	off	off	on	on	on	on	483

- Switch 10 is reserved for future use and must always be in the off position.
- Once the DMX address has been selected with the power turned off, the laser is ready for operation. Plug in the output lead from a DMX controller, then plug the laser into a suitable power outlet. You will see the pan and tilt unit start to calibrate. It is ready for control via DMX.

CHANNEL FUNCTIONS:

- PAN AND TILT CONTROL – Using Channels 1 and 2, the pan and tilt mirror will move from minimum to maximum corresponding with the slider movement on the DMX controller. Note that during the operation of the laser PAN and TILT may slightly lose their locations, if you are using this for location of specific graphics on targets, do not adjust your DMX programming. Instead recalibrate the PAN and TILT by moving channels 1 and 2 from minimum to maximum 3 times.
- GRAPHICS AND TEXT BANK SELECTION – Using Channel 3 the laser will step through all the graphics and the contents of the 6 text banks corresponding with the slider movement on the DMX controller.
- GRAPHIC SIZE SELECTION – Using Channel 4 will size the projected images from the minimum to the maximum corresponding with the slider on the DMX controller.
- MODULATION / TEXT STORING – Using Channel 5 the various modulation effects of the graphics and text can be utilised, also when in text mode this channel is used to store the currently selected character into a text bank.

10. COLOUR CONTROL / TEXT MODE – Using Channel 6 the colours can be controlled. Cyan, blue or green can be selected. Also a colour scroll function is available. This channel is also used to enter text programming mode.
11. BEAM CONTROL – Using Channel 7 various beam effects can be engaged, from BEAM ON and OFF to strobe effects. This channel also starts and shuts the laser head down. To start the laser the channel must be taken from 020 up to or above 231 and back down again. To shut the laser down the channel must be taken from 020 up to or above 231 and back down again. The starting and shutting down is a toggle action. The laser takes approximately 30 seconds to start up.
12. SCAN RATE / TEXT CHARACTER SELECTION – Using Channel 8 will control the scan rate of the graphics and text. When in TEXT PROGRAM MODE this channel will scroll through all the character set for text programming.

TEXT BANK PROGRAMMING:

13. To program any of the TEXT banks with a scrolling message follow the procedure detailed below:
 - a) Select the TEXT bank that needs to be programmed or changed with CHANNEL 3.
 - b) Move CHANNEL 5 to the minimum DMX setting (000).
 - c) Move CHANNEL 6 to the maximum DMX setting (255), placing the laser into TEXT PROGRAMMING MODE.
 - d) With CHANNEL 8 scroll through the character set until the letter, number or symbol you require is reached on the laser projection.
 - e) To store the character that was selected in step d), move CHANNEL 5 from the minimum to maximum to minimum DMX value (000 to 255 to 000).
 - f) Repeat steps d) and e) until your text message has been completed. Remember that each text bank stores a maximum of 256 characters including spaces.
 - g) To store the text message and to exit TEXT PROGRAMMING MODE slide CHANNEL 6 to 000.
 - h) The selected text bank will now be programmed with your message.
 - i) Note that if you enter TEXT PROGRAMMING MODE and then exit without storing any characters the TEXT bank will be empty. Also if you have entered a sentence and you have some letters which are incorrect, you do not have to enter the whole sentence in again, when you enter text programming mode, you can use CHANNEL 5 slider to enter the existing characters again until you reach the incorrect character. Then you may select the correct one with CHANNEL 8. You must then continue to use the CHANNEL 5 slider to repeat enter the rest of the sentence until it is finished. Save and exit as in section g).

GETTING THE MOST FROM YOUR LASER:

14. Before installation, operate the laser in a dark room with a little smoke so that you can become familiar with the various effects it can generate.
15. A good idea is to step through each graphic one at a time and to apply all the modulation, sizing and strobe effects so that they can be clearly seen individually on each graphic projection.
16. Remember the graphics are designed for volumetric effects in smoke and for striking visual projections on surfaces. Some will look better than others depending on how they are being used. Experiment and try to get familiar with the effects generated in smoke and without smoke.

Graphics which are complex in design and have many features in them and look less impressive in smoke than graphics that are hollow and volumetric. Graphics for projection are: eye triangle, musical note, lightening bolt, leaf, dollar, diamond star, cross hairs, heart, star. Graphics that are good for effects in smoke are: square, circle, sine wave, flat lines, slow square, box cross, 3 circles, array squares, splash, arrow, girder, slats, beam points.

Adding modulations to the volumetric graphics will add an extra dimension to the effect in smoke.

17. Custom graphics can be programmed by us. If you have a special set of logos or theme that you require either contact your dealer or Nu Light Systems directly.

LASER OPERATION:

SETTING UP AND TURNING THE LASER SYSTEM ON:

1. Position the laser head in a suitable position.
2. Connect a DMX control cable to the 3 pin male XLR connector on the back of the laser and the other end to the DMX controller. Make sure the controller is off.
3. Connect the IEC mains input lead to the laser at the back.
4. The pan and tilt mechanism will start to calibrate, this takes approximately 10 seconds. When this finishes the laser is ready for operation.
5. Switch the DMX controller on. **MAKE SURE THAT THE LASER BEAM CONTROL IS OFF** (channel 7 set to 000, the minimum position).
6. To start the laser head take channel 7 from 000 to 231 or above and back down again, a click should be heard from the laser head indicating that the laser source has started to warm up. The laser head should be ready in approximately 30 seconds.
7. Wait approximately 2 minutes before using the modulations on channel 5 as it takes time for the oscillator to start up. If the modulations do not work, shut the laser down (see below), turn power off, wait 20 seconds and restart.
8. Control the laser via the DMX controller.

TURNING THE LASER SYSTEM OFF:

9. Shut the laser down by taking channel 7 up to or above 231 on the DMX controller. A click will be heard and the laser glow extinguish.
10. Wait for 5 minutes so that the laser can cool down.
11. Turn the DMX controller off.
12. Switch the main power to the laser head off.
13. Disconnect the IEC power lead.

DMX CHANNEL SPECIFICATIONS:

DMX XLR PINOUTS-

PIN1 - GROUND
PIN2 - NEGATIVE
PIN3 - POSITIVE

DMX CHANNEL ASSIGNMENTS-

CHANNEL 1: PAN POSITION 000 - 255

CHANNEL 2: TILT POSITION 000 - 255

CHANNEL 3: GRAPHICS AND TEXT BANK SELECTION

000 - 007	1: STAR	128 - 135	17: LIGHTENING BOLT
008 - 015	2: SQUARE	136 - 143	18: 4 SQUARE ARRAY
016 - 023	3: HORIZONTAL FLAT	144 - 151	19: LEAF
024 - 031	4: VERTICAL FLAT	152 - 159	20: DIAMOND STAR
032 - 039	5: CIRCLE	160 - 167	21: EYE TRIANGLE
040 - 047	6: BOXED CROSS	168 - 175	22: MUSICAL NOTE
048 - 055	7: WAVE	176 - 183	23: DOLLAR
056 - 063	8: SOLID ARROW	184 - 191	24: SPLASH
064 - 071	9: TRIANGLE	192 - 199	25: 4 SLATS
072 - 079	10: 3 CIRCLES	200 - 207	26: SLOW GIRDER PROFILE
080 - 087	11: HEART	208 - 215	TEXT BANK 1
088 - 095	12: CROSS HAIRS	216 - 223	TEXT BANK 2
096 - 103	13: 3 PETALS	224 - 231	TEXT BANK 3
104 - 111	14: BEAM	232 - 239	TEXT BANK 4
118 - 119	15: BROKEN SQUARE	240 - 247	TEXT BANK 5
126 - 127	16: METEOR SHOWER	248 - 255	TEXT BANK 6

CHANNEL 4: GRAPHIC SIZE SELECTION

000 - 031	SIZE 1	128 - 159	SIZE 5
032 - 063	SIZE 2	160 - 191	SIZE 6
064 - 095	SIZE 3	192 - 223	SIZE 7
096 - 127	SIZE 4	224 - 255	SIZE 8

CHANNEL 5: GRAPHIC MODULATION SELECTION / TEXT STORING

MODULATION MODE:

000 - 032	NO MODULATION	128 - 159	SHRINK AND GROW
033 - 063	HORIZONTAL SPIN	160 - 191	ROTATE AND SHRINK
064 - 095	VERTICAL SPIN	192 - 223	ROTATE AND SHRINK
096 - 127	ROTATION	224 - 255	NO MODULATION

TEXT MODE:

000 - 255 - 000 STORE CHARACTER

CHANNEL 6: COLOUR CONTROL / TEXT ENTRY MODE

000 - 059	CYAN (FULL POWER)	180 - 239	3 sec COLOUR SCROLL
060 - 119	GREEN	240 - 255	TEXT MODE
120 - 179	BLUE		

CHANNEL 7: BEAM CONTROL / REMOTE START

BEAM CONTROL:

000 - 020	BEAM OFF	041 - 199	STROBE EFFECTS
021 - 040	BEAM ON	200 - 230	BEAM ON

REMOTE START:

020 - 231 - 020 REMOTE START TOGGLE

CHANNEL 8: SCAN RATE / TEXT CHARACTER SELECTION

SCAN RATES:

000 - 005 DEFAULT SCAN RATE 006 - 255 SCAN RATE EFFECTS (006 SLOWEST)

TEXT CHARACTER SELECTION:

000 - 005	A	120 - 125	U
006 - 011	B	126 - 131	V
012 - 017	C	132 - 137	W
018 - 023	D	138 - 143	X
024 - 029	E	144 - 149	Y
030 - 035	F	150 - 155	Z
036 - 041	G	156 - 161	. (full stop)
042 - 047	H	162 - 167	_ (space)
048 - 053	I	168 - 173	0
054 - 059	J	174 - 179	1
060 - 065	K	180 - 185	2
066 - 071	L	186 - 191	3
072 - 077	M	192 - 197	4
078 - 083	N	198 - 203	5
084 - 089	O	204 - 209	6
090 - 095	P	210 - 215	7
096 - 101	Q	216 - 221	8
102 - 107	R	222 - 227	9
108 - 113	S	228 - 233	£ (pound sign)
114 - 119	T		

DMX GRAPHIC SCAN HEAD SPECIFICATIONS:

OPTICAL:

Laser Source : Argon Ion,
Maximum Optical Power: 300mW,
Classification : 3B,
Wavelength : 547 - 514nm,
Beam Divergence : 2mrad,
Beam Diameter : 1.5mm,
Estimated Laser Life : 2000 Hrs,
Optics : Front surface enhanced aluminium mirrors with Anti Reflective coated output window, dichroic filters for colour selection.
Shutter : Galvanometer,
Maximum Scan Time : 30mS Exposure.

EFFECTS:

- 26 Pre-set Graphics,
- 6 x 250 Character Text banks,
- 150° Pan and 45° Tilt projection,
- 6 Modulations effects,
- Variable Strobe,
- Variable Scan Rate,
- Variable Pattern divergence angle,
- 2 Galvanometer Scanners.

POWER SUPPLY:

- Linear power supply for electronics and switch mode for laser,
- 230 VAC \pm 10% Operation,
- 1600 Watt power consumption.

CONFORMITY / SAFETY FEATURES:

- CE Conformity to : EN 55011:1991 CLASS B (conducted and radiated),
EN 61000-4-2:1995,
EN 61000-4-3:1995,
EN 61000-4-8:1994,
LOW VOLTAGE DIRECTIVE,
- *Pulse Train MPE=1.092J/m², Energy density: 0.963J/m² at 5m assuming a scan time of 30mS and exposure to 2 pulses in medium density smoke.
- *Minimum viewing distance for stationary beams is 5m, based on single pulse exposure and 250mS exposure (eye blink reflex time) in medium density smoke.

*Note that these energy densities are approximate calculations based on the information provided in the HS(G)95 guide book. For further details on the calculation process please see LASER MPE LEVEL CALCULATIONS section in this manual.

PHYSICAL:

System Dimensions : 720(l) x 386(w) x 235(h)mm,
Weight : 15.0Kg
Operating Temperature : 5-35°C
Relative Humidity : 0-95%, non condensing,
Packaging Size : 940(l) x 540(w) x 415(h)mm,
Packaged Weight : 20.0Kg

LASER MPE LEVEL CALCULATIONS:

DURING SCANNING:

Whilst scanning the 250mW Argon laser has the following parameters:

Power after Optics	: 167.81mW (8 x FS mirrors and 1 x Window)
Divergence	: 2mrad
Beam Diameter	: 1.5mm
Scan time	: 30mS
Number of Exposures	: 2
Wavelength	: 457-514nm

Firstly the appropriate MPE from the table on page 29 of HS(G)95 laser safety guide is selected. For the above scan time and system this is:

$$\text{Single Pulse MPE} = 18 t^{0.75} C_6 \text{ J/m}^2$$

C_6 can be made to =1, for display lasers:

$$\begin{aligned} &= 18 (30 \times 10^{-3})^{0.75} \text{ J/m}^2 \\ &= 1.298 \text{ J/m}^2 \end{aligned}$$

This means that a laser pulse lasting 30ms cannot exceed 1.298 J/m².

For multiple pulse exposure, in this case 2 (because of people moving and the pan and tilt movements of the laser), the Single pulse MPE must be multiplied by:

$$\begin{aligned} &n(\text{number of pulses})^{-0.25} \\ &= 2^{-0.25} \times 1.298 \\ \text{Pulse Train MPE} &= 1.092 \text{ J/m}^2 \end{aligned}$$

This means that a laser pulse of 30ms, repeated 2 times cannot exceed 1.092 J/m².

To work out the energy density 5m with a power loss of 98% due to medium density smoke / haze, the energy in the pulse is divided by the cross sectional area of the beam at that distance.

Beam Diameter at Distance d = (d x Divergence) + Beam Diameter

$$= (5 \times 2) + 1.5 = 11.5 \text{mm} \quad (r = 5.75 \text{mm})$$

$$\begin{aligned} \text{Energy Density} &= (\text{Laser Power} \times t) / \pi r^2 \\ &= (3.356 \times 10^{-3}) (30 \times 10^{-3}) / \pi 5.75^2 \\ &= 0.1 \times 10^{-3} / 103.86 \times 10^{-6} \\ &= 0.963 \text{ J/m}^2 \end{aligned}$$

The energy density at 5m is 0.963 J/m², which is under the pulse train MPE. The laser at this distance may be scanned at audiences. Providing the scan speed is not lower or higher than 30mS.

DURING STATIONARY BEAMS:

With stationary beams the 250mW Argon laser has the following the following parameters:

Power after Optics : 167.81mW (8 x FS mirrors and 1 x Window)
Divergence : 2mrad
Beam Diameter : 1.5mm
Scan time : 250mS
Number of Exposures : 1
Wavelength : 457-514nm

Firstly the appropriate MPE from the table on page 29 of HS(G)95 laser safety guide is selected. For the above scan time and system this is:

$$\text{Single Pulse MPE} = 18 t^{0.75} C_6 \text{ J/m}^2$$

C_6 can be made to =1, for display lasers:

$$\begin{aligned} &= 18 (250 \times 10^{-3})^{0.75} \text{ J/m}^2 \\ &= 6.364 \text{ J/m}^2 \end{aligned}$$

This means that a laser pulse lasting 250ms cannot exceed 6.364 J/m².

For multiple pulse exposure, in this case 1 accounting for the eyes reflex, the Single pulse MPE must be multiplied by:

$$\begin{aligned} &n(\text{number of pulses})^{-0.25} \\ &= 1^{-0.25} \times 6.364 \\ \text{Pulse Train MPE} &= 6.364 \text{ J/m}^2 \end{aligned}$$

This means that a laser pulse of 250ms, cannot exceed 6.364 J/m². The time of 250mS is the time it takes for the eyes reflex function to operate.

To work out the energy density at 5.05m, with a power loss of 98.5% due to medium density smoke / haze the energy in the pulse is divided by the cross sectional area of the beam at that distance.

$$\begin{aligned} \text{Beam Diameter at Distance } d &= (d \times \text{Divergence}) + \text{Beam Diameter} \\ &= (5.05 \times 2) + 1.5 = 11.6\text{mm} \quad (r = 5.8\text{mm}) \end{aligned}$$

$$\begin{aligned} \text{Energy Density} &= (\text{Laser Power} \times t) / \pi r^2 \\ &= (2.517 \times 10^{-3}) (250 \times 10^{-3}) / \pi 5.8^2 \\ &= 0.629 \times 10^{-3} / 105.68 \times 10^{-6} \\ &= 5.952 \text{ J/m}^2 \end{aligned}$$

The energy density at 5.05m in the stationary beam in this case is 5.952 J/m², which is again under the pulse train MPE. The laser beam at this distance may be projected at audiences. Providing the exposure duration is not higher than 250mS. So if stationary beams are directed into the audience the laser must be programmed for rapid movement so that no beam stays in one place for more than 250mS (1/4 second).