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DUO-220/221 DYE LASER

337220-00, 01
337221-00, 01

SERVICE MANUAL

DUO-220/221 Manual Part Number: 999220 (2 of 2) Rev. A (12/99)

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The **DUO-220/221** is a Class IIIb laser device.

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Chapter 1 - Precautions

1.1 Safety Precautions

All persons who use the laser, or will be in the area where the laser is in use, should be aware of potential hazards associated with the equipment and the precautions to avoid injury.

Observe the following precautions when operating or servicing the laser:

- Before turning on the laser, don safety glasses or goggles appropriate for protection from laser radiation at 337 nm as well as the visible laser wavelength selected.
- This device can be configured to produce visible and invisible laser radiation. To prevent injury to your eyes, **never** look directly into the laser beam or directly at any specular reflections of the laser beam.
- Post warning signs at entrances and in prominent locations near the laser work area.
- Limit access to the work area to trained personnel.
- When possible, enclose all laser beam paths.
- Set up work stations so that the laser beam is not at eye level. (Set up a beam dump.)
- Be sure the beam attenuator on the **VSL-337ND-S** Nitrogen pump laser is closed at all times when the laser is not operating.
- Maintenance and servicing of the laser should be done by trained personnel only.

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Chapter 2 - Attachment

2.1 Attaching the DUO-220/221 Dye Laser to the VSL-337ND-S Nitrogen Pump Laser

The **DUO-220/221** dye laser module should be attached to the **VSL-337ND-S** Nitrogen laser for a stable laser configuration. Before attaching the module to the Nitrogen laser, the Nitrogen laser must be "OFF" and the **DUO-220/221** stir motor control should be "OFF." Pull off the metal cap that covers the dye cuvette. Remove the dye stir motor connection. Unscrew the two hold-down cover screws, one on each side of the dye laser module near the base. The cover can now be lifted off the dye module. Working from inside the dye module, insert the two laser attachment screws provided with the **DUO-220/221** through the back plate of the dye module and screw them into the matching tapped holes of the **VSL-337ND-S** laser front plate. (See Figure 1.) Care should be taken to avoid touching the turning mirrors or the laser optics. Replace the cover of the **DUO-220/221** laser module, the cover screws, and the cuvette metal cap before operating the dye laser.

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Chapter 3 - Alignment

3.1 Alignment Adjustments

The **DUO-220** dye laser cavity has been optimized at the factory for the Coumarin 500 green line (500 nm). The **DUO-221** has been optimized for 800 nm output. In ordinary use of the laser, the only adjustment the user will need to perform will be the lens translation adjustment as described in the **DUO-220/221** User Manual, Section 2.6. There are some applications where further improvements in beam quality or output energy are desired. Also, with time or laser use, the original cavity alignment may degrade. In these cases, we recommend that the user first attempt to improve the output energy or beam quality by small adjustments to the output coupler mirror **(M2)** tilt (see Figure 1). To do this, follow steps 1- 8 of the alignment procedure below. Then, using a viewing card (such as a business card) at the laser output port, determine whether adjustments to the output mirror tilt are sufficient to optimize the laser alignment. If these adjustments do not produce the desired effect, then steps 9 - 21 of the alignment procedure should be followed to optimize the laser output. For the **DUO-221** the same procedure using a viewing card for evaluating the laser cavity alignment can be used with the visible output from DCM dye. The cavity alignment obtained will hold for the IR dyes as well. If only IR dye is used, a power meter must replace the card and only steps 1 - 7 and 15 should be attempted.

3.2 Alignment of the laser cavity

WARNING: Laser protective eyewear is recommended whenever the pump laser or the dye laser is "ON."

1. Make certain that the Nitrogen pump laser and the stir motor driver are in the "OFF" position at the start of the alignment procedure. The laser output level will be affected by the position and tilt of the impact pump beam. For this reason, it is recommended that the dye laser module be attached to the Nitrogen pump laser before proceeding with the alignment.

2. Remove the dye laser module cover by first pulling off the metal cap that covers the dye cuvette. Remove the stir motor driver connection from the side of the dye laser module. Unscrew the two hold-down cover screws, one on each side of the dye laser module near the base. The cover can now be lifted off the dye module.

3. With the cover off the dye laser module, the Laser Interlock Shutter **(LIS)** is free to swing into place at the entrance port to the module, blocking the path of the nitrogen laser pump beam. Defeat this interlock by pressing down on the shutter lever or by releasing the shutter spring. Care should be taken not to touch the surface of the turning mirrors or the laser optics.

3

4. The optical layout of the **DUO-220/221** appears in Figure 2. The laser selection wheel, **SW**, should be set for clear throughput of the Nitrogen laser beam to the focusing lens. (Position 1 on the wheel.) The micrometer should be set to 0 for 0-order reflection from the grating. Check the optical train for a clear path of the Nitrogen laser beam up to the focusing lens **(L)** before turning on the Nitrogen pump laser.

WARNING: Laser protective eyewear is recommended before turning on the Nitrogen pump laser.

5. Turn on the nitrogen laser and set the pulse repetition rate to about ten pulses per second. Use a beam-sensing card, such as a white business card, to check that the Nitrogen laser beam is centered on the turning mirror, **M1**. The base of the turning mirror holder has slotted screw holes so that it can be adjusted to center the pump beam.

6. Next check whether the pump beam clears the selection wheel aperture, and is centered on the focusing lens **(L)**. If necessary, correct both vertical and horizontal tilts on the turning mirror for optimum input to the center of the focusing lens.

7. Insert a dye cuvette with dye and stir bar into the cuvette holder **(H)**.

8. Use the beam sensing card to check the output laser beam. A few inches from the laser output port, the spot should appear as a single small bright spot about 2mm wide and 1mm high. A few small vertical and horizontal diffraction lines close to the spot are normal. This is a well-aligned laser. If more than a single spot appears, or if it appears to be spread out in the vertical or horizontal direction, then some tuning of the laser cavity is indicated.

9. For a less than ideal laser alignment, the appearance of the spot can indicate what corrective measures to take. The tilts on the output mirror (**M2** in Figure 1) should be adjusted first. The top screw close to the laser side plate controls the horizontal tilt of the mirror. If the laser spot appears spread out in the horizontal direction, adjust the horizontal tilt while using the viewing card for feedback. If the laser spot appears spread out in the vertical direction, adjust the bottom screw on the output mirror holder. These screws can be adjusted from the top, with a narrow screw driver.

10. If adjustments to the tilt of the output mirror do not result in an optimal spot outline, then it may be necessary to adjust the grating assembly tilt. First remove the output mirror holder (**M2**) with the output mirror in it. The mirror holder is attached to the base with a single socket head screw. Care should be taken not to touch the mirror itself when holding the mirror holder. If the mirror is left in its holder, it has some protection from accidental scratches or fingerprints. Place the holder in a safe place with the mirror facing up.

11. Slip a card (such as a business card) between the grating assembly **(GA)** and the cuvette holder as shown in Figure 1. The output on a viewing screen or card placed at a few inches from the output plate will be a fuzzy spot.

12. Positioning the lens: Use the Lens Adjustment Screw **(LAS)** accessible through the side of the laser module (see Figure 3). Translate the lens just until the fuzzy spot becomes a horizontal streak. This streak should be level with the center of the output aperture of the laser. It is useful to have a card set several inches from the aperture with the correct height marked for reference. If the horizontal streak is not level with the reference mark, loosen the locking set screw on the top of the lens holder and slightly **rotate** the lens in its holder until the streak lines up with the reference. Tighten the lens lock-down screw.

13. Remove the card blocking the grating assembly. Find the grating assembly tilt adjustment screw **(GAA)**. Use this screw to adjust the horizontal tilt for a single bright spot output. The spot will have fine line vertical and horizontal streaks, but only a single central bright spot should appear.

14. Replace the viewing card at the laser output with an energy meter and optimize the lens translation while monitoring the output energy. (If an energy meter is not available, skip to Step 16.)

15. Use the energy meter reading to fine tune the mirror tilt adjustments for optimum output. It is useful to take a quick average reading of 10-20 shots for this purpose to avoid large shot-to-shot energy variations from giving confusing readings.

16. Replace the output mirror holder (with the output mirror still in place) and attach it to the laser cavity base.

17. Using the viewing card again, adjust the output mirror tilts for a single small bright spot. Do not change the grating tilt at this point.

18. Optimize the tilt on the output mirror while monitoring the energy with the energy meter. (If an energy meter is not available, skip to Step 20.)

19. Optimize the focusing lens position: Translate the focusing lens by turning the Lens Adjustment Screw **(LAS)** in small increments while monitoring the output power.

20. Replace or unlatch the Laser Interlock Shutter **(LIS)**.

21. Replace the cover and secure in place. Replace the metal cuvette cover cap in the unit cover.

The laser should now be optimized for the dye and cuvette used. When changing dyes be sure to optimize the laser output by translating the focusing lens using the Lens Adjustment Screw **(LAS)** as described in the **DUO-220/221 User Manual**. In most applications no further adjustments will be needed.

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Chapter 4 – Selector Wheel

4.1 Inserting Optics in the Selector wheel

The selector wheel is located inside the **DUO-220/221** dye laser module. Part of the wheel extends outside the module cover for thumb control to select the output laser line or lines. Position 1 on the wheel dial corresponds to a clear aperture in the wheel. With the selection wheel in this position, the full-scale Nitrogen pump beam is delivered to the dye laser cell and the full-scale dye laser line is output from the laser. The **DUO-220/221** also comes with a nominal 100% reflective turning mirror in position 2 of the selector wheel for full-scale Nitrogen laser output at 337 nm. Additional one inch diameter optics or mounted optics can be inserted in the selector wheel slots for customized laser operation. For example, an optional 50/50 beam splitter is available from optical component suppliers which allows approximately 50% of the Nitrogen laser beam to be output simultaneously with approximately 45% of the full scale dye laser output.

To insert optics in the selection wheel slots, first remove the wheel from the **DUO-220/221** dye laser module by removing the module cover (see 3.2) and loosening the two tie-down socket head screws in the wheel base. Care must be taken to protect optics already in the wheel slots during this operation. Note that the wheel number which appears above an optical element slot is not the wheel position number for that slot. The position number appears at the top of the wheel is visible when the laser cover is on. It corresponds to the slot, which is in line with the pump laser beam.

New optics should be inserted with the reflective surface set against the slot "ledge." Using lens tissue to protect the optical surface, the optics should be gently pressed against the ledge while the holding set screw is tightened. Very thin optical elements may need a protective edging added in order to catch the holding set screw. Once the optics are in place, the wheel is screwed into the module base again. The position of reflective optics should be checked for angular accuracy with the Nitrogen pump laser before the module cover is replaced.

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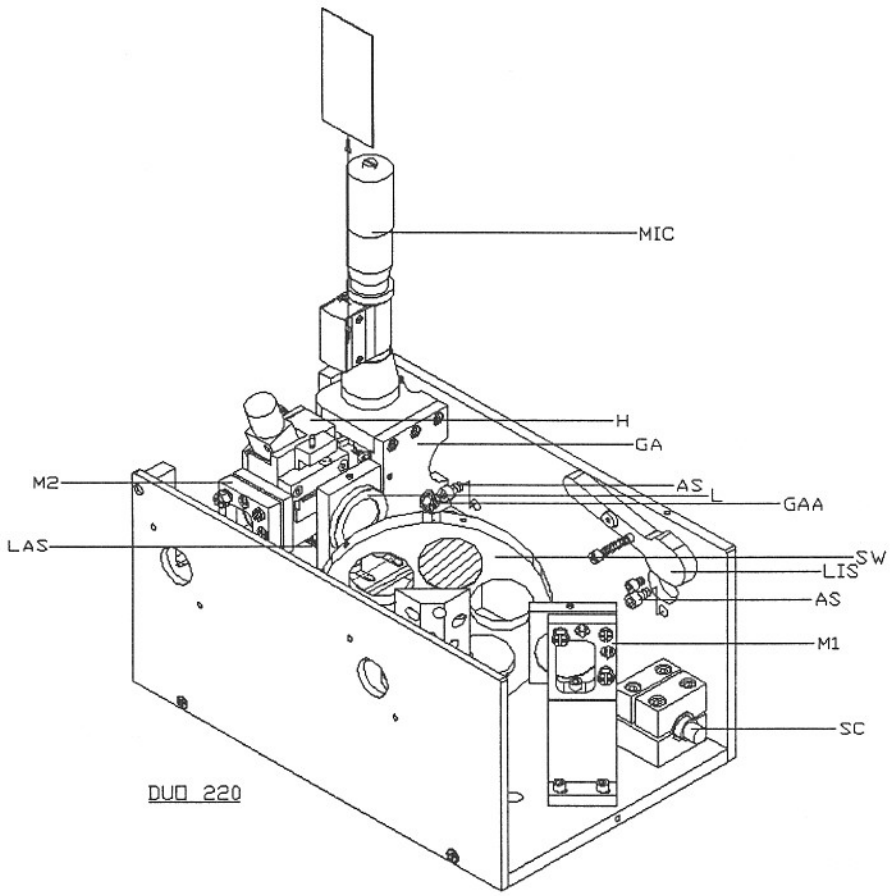
Figure 1



KEY:

AS - Attachment screw
GA - Grating Assembly
GAA - Grating Assembly Adjustment
H - Cuvette Holder
L - Focusing Lens
LAS - Lens Adjustment Screw
LIS - Laser interlock shutter
M1 - Turning mirror
M2 - Laser cavity output mirror
SC - Stirrer motor connect
SW - Selection wheel

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Figure 2

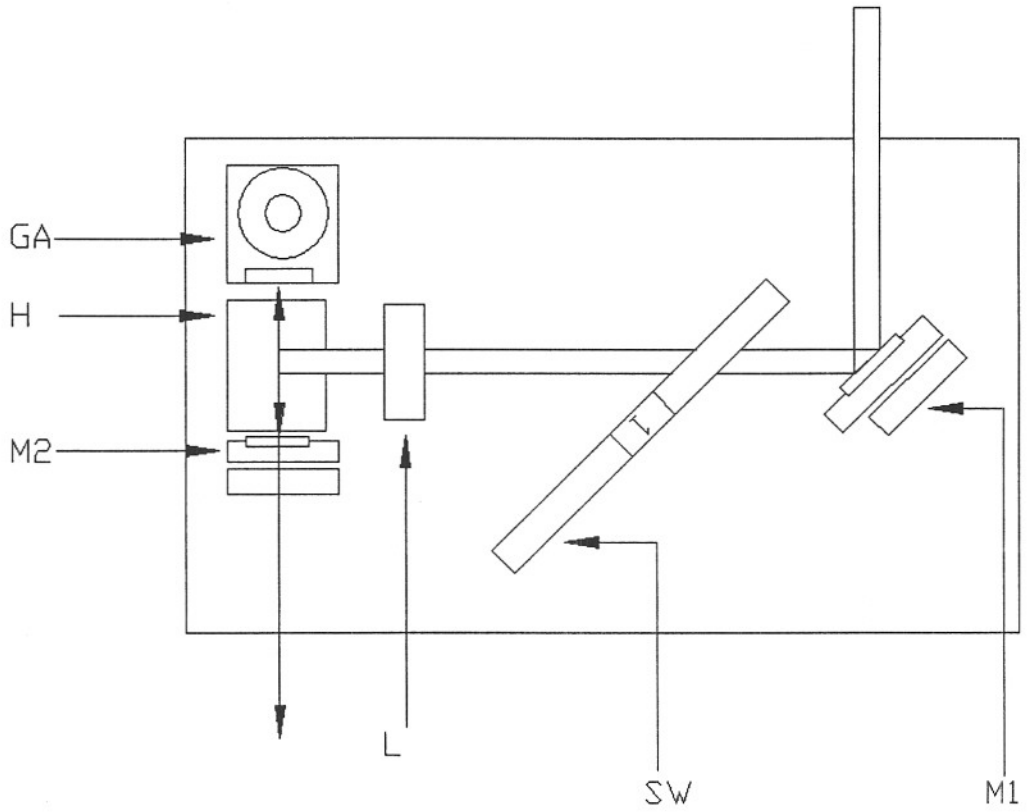

Figure 2. Optical Layout of the DUO-220/221

KEY:

GA - Grating Assembly
H - Cuvette holder
L - Focusing lens
M1 - Turning mirror
M2 - Laser cavity output mirror
SW - Laser selector wheel

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Figure 3

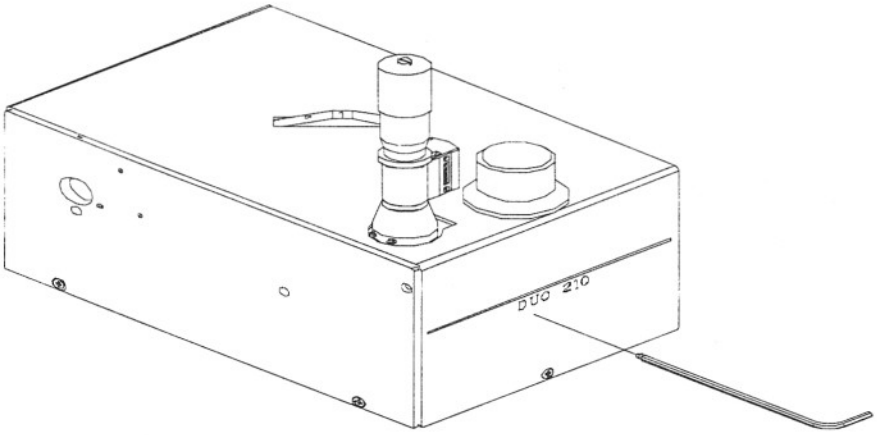

Figure 3.

Allen wrench adjustment of the DUO-220/221 focusing lens