

# HELIUM-CADMIUM LASER MAINTENANCE MANUAL

FOR

LASER HEAD

POWER SUPPLY

CD4123R-F

CD6122C

CD4163R-F

CD6122C

*Please read this instruction manual carefully and thoroughly  
before installing or operating your laser.*

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## Table of Contents

1.	Introduction .....	1
1-1	Laser Safety .....	1
1-2	Labels .....	2
2.	Internal Structure and Parts Name .....	3
2-1	Internal Structure .....	3
2-2	Parts Name .....	4
2-2-1	Laser Head .....	4
2-2-2	Power Supply .....	5
3.	System Outline .....	6
3-1	Structure .....	6
3-2	Principle .....	6
3-3	Control Circuits .....	6
3-4	Laser Characteristics .....	7
4.	Cautions .....	7
4-1	Laser Exposure .....	7
4-2	High Voltage and Temperature Hazard .....	7
5.	Trouble Shooting .....	8
5-1	Diagnostic Flow Chart (No Power Status) .....	8
5-2	Diagnostic Flow Chart (Power lamp "OFF" Status) .....	8
5-3	Diagnostic Flow Chart (Power lamp "ON" Status) .....	9
5-4	Diagnostic Flow Chart (Decreased Laser Output Power) .....	10
5-5	Diagnostic Flow Chart (Increased Noise Level) .....	11
5-6	Diagnostic Flow Chart (Unstable Laser Output Power) .....	12
5-7	Diagnostic Flow Chart (Other Status) .....	12
6.	Maintenance and Adjustment .....	13
6-1	Mirror Alignment .....	13
6-2	Tube Voltage .....	14
6-3	Tube Current .....	15
6-4	AC Frequency (50Hz, 60Hz) .....	16
6-5	Power Supply Revision C1 Procedure .....	16
6-6	Laser System Storage Period .....	16
7.	Laser Specifications .....	17
8.	Laser System Disposal .....	18
9.	Package for Tube Refurbishing and Repairing .....	18
10.	Where to Contact Us .....	18
11.	Drawings .....	19
11-1	Laser Head Model: CD4123R-F .....	19
11-2	Laser Head Model: CD4163R-F .....	20
11-3	Power Supply Model: CD6122C .....	21

## 1. Introduction

This manual is intended for use in the case abnormal conditions are observed. Follow all instructions contained in this manual precisely.

### ATTENTION

This laser equipment is only to use for CANON's STEPPER.  
Do not use other product.

#### 1-1 Laser Safety

Your laser system is classified as "Class III b" laser by the Center for Devices and Radiological Health (CDRH) of US Food and Drug Administration (FDA), and Class III b levels of laser radiation are considered to be an acute hazard to the skin and eyes from direct radiation.

1. Do not look directly into the laser beam.
2. Always use protective glasses for 441.6nm when operating your laser.
3. Set up a restricted access area for laser operation.
4. Post a warning sign near the laser area.

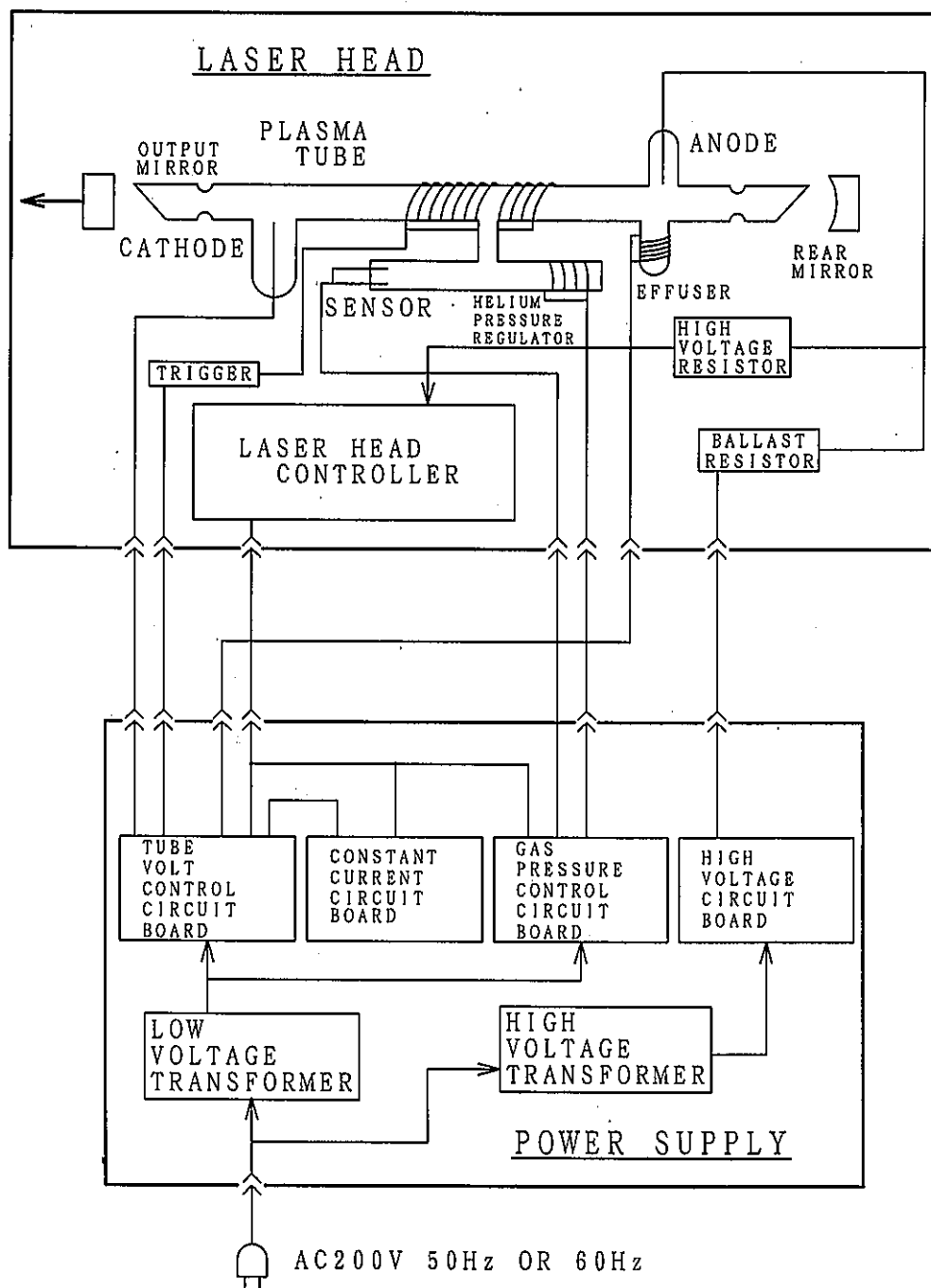
After install the CANNON's STEPPER, it is safety to use to stepper's normal operation.

### CAUTION

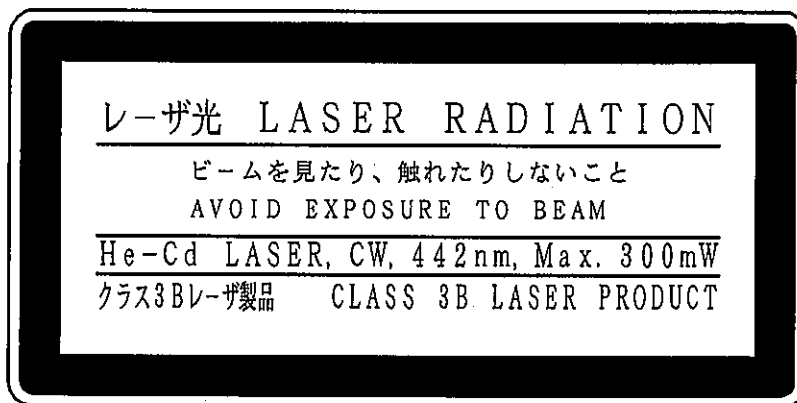
Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## 2. Internal Structure and Parts Name

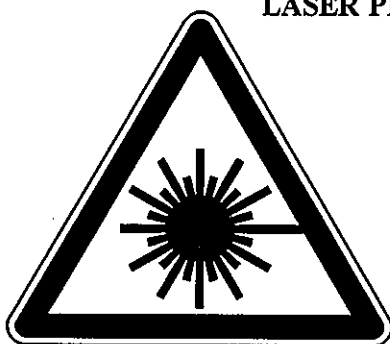
### 2-1 Internal Structure



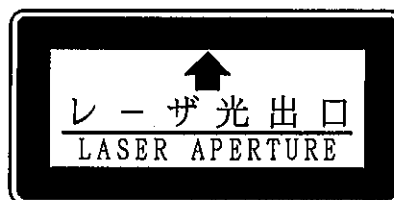
1-2 Labels



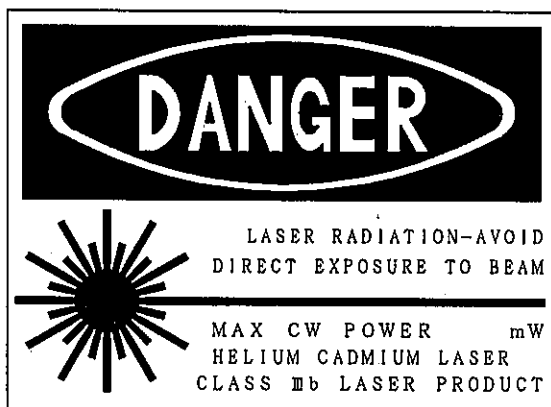
LASER PRODUCTS LABEL



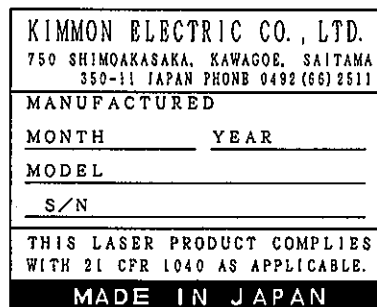
LASER RADIATION WARNING LABEL



LASER APERTURE LABEL



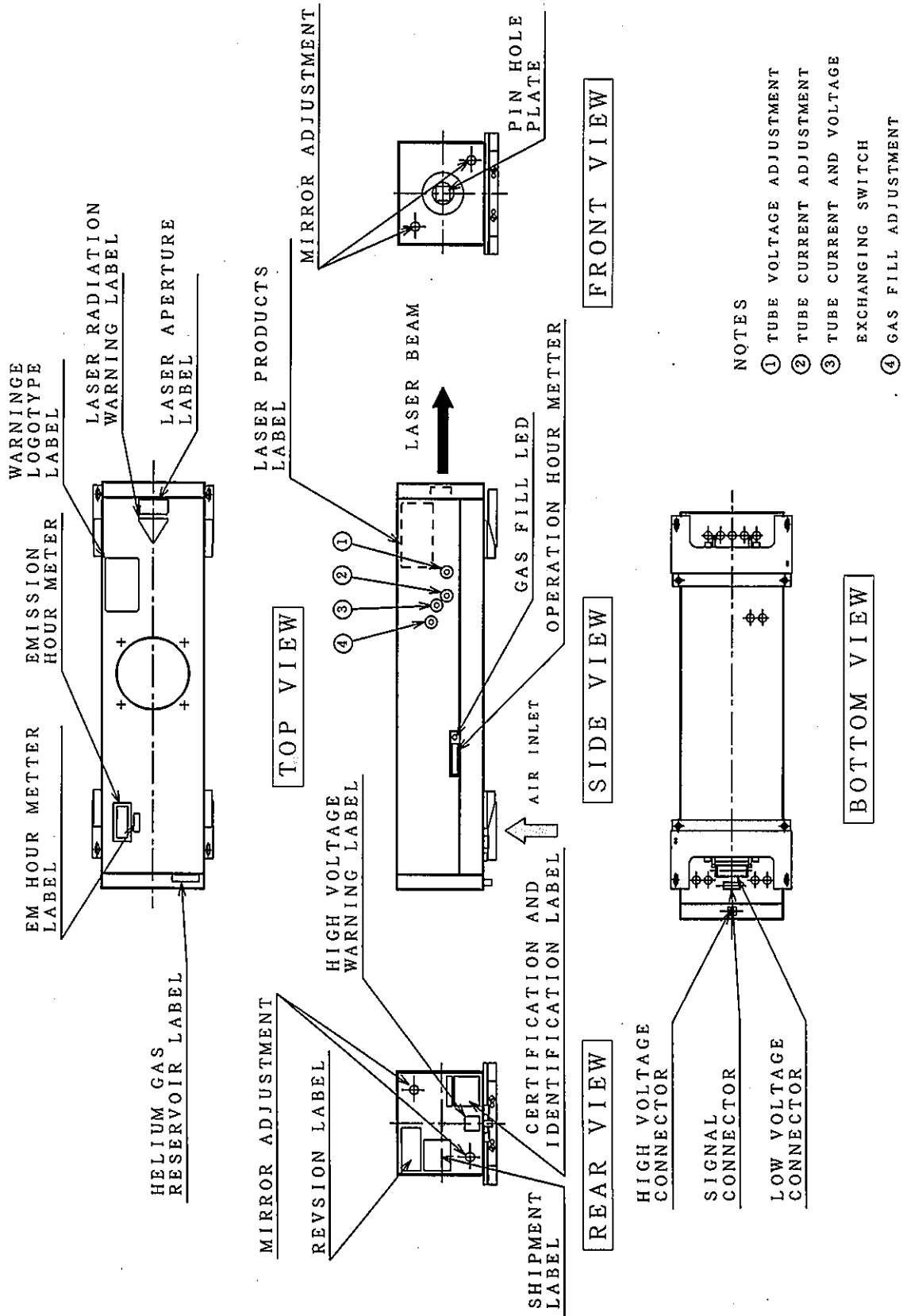
WARNING LOGOTYPE



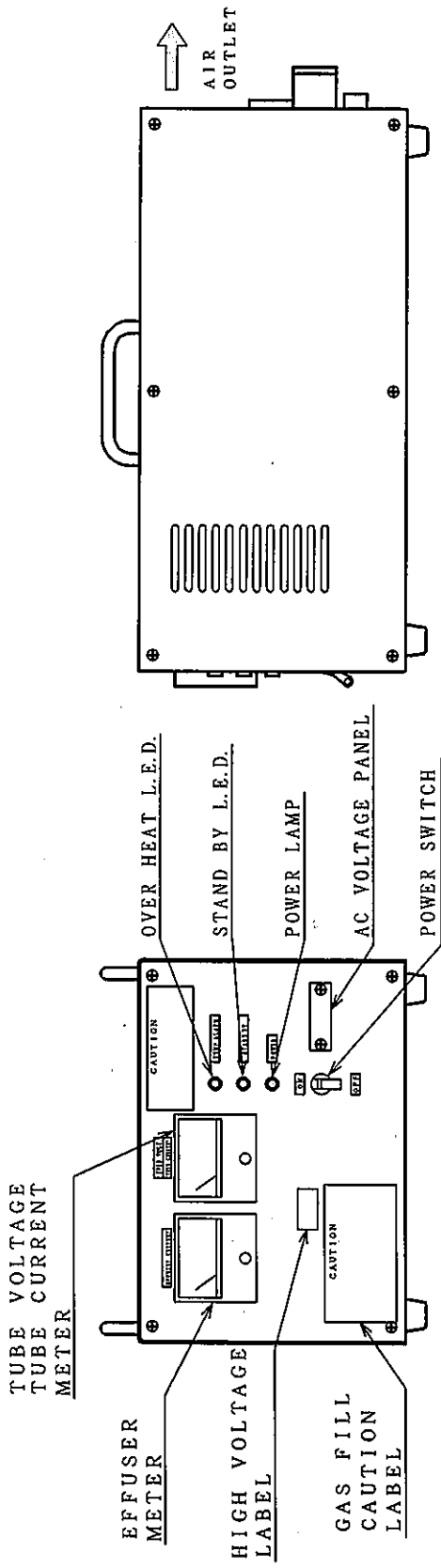
CERTIFICATION AND IDENTIFICATION LABEL

## 2-2 Parts Name

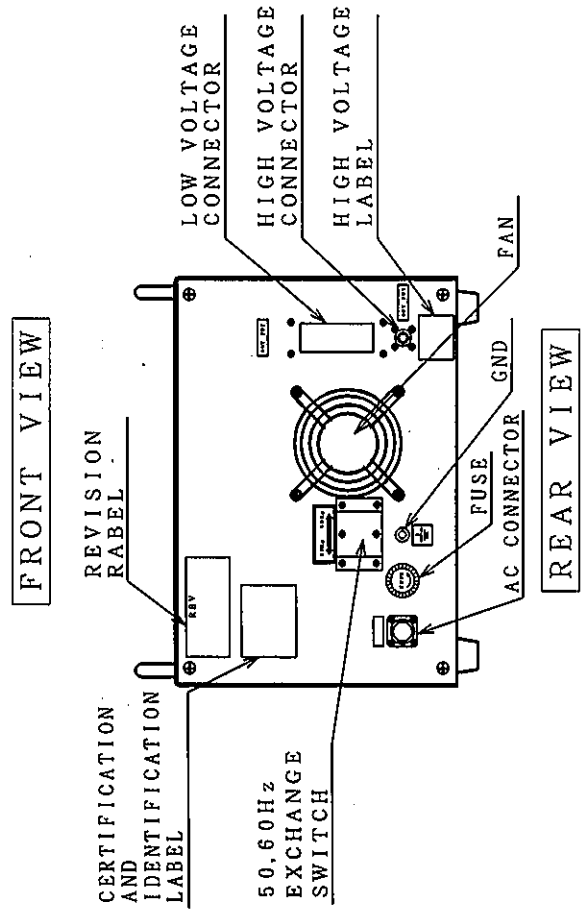
### 2-2-1 Laser Head



2-2-2 Power Supply



SIDE VIEW



FRONT VIEW

REAR VIEW

### 3. System Outline

This laser system continuously emits 441.6nm wavelength of laser, utilizes helium gas and cadmium vapor.

#### 3-1 Structure

This helium-cadmium laser system consists of two major units; one is "laser head" and the other is "power supply." The laser head further consists of a plasma tube where helium and cadmium are sealed, resonator which contains the plasma tube, and laser mirrors which are attached to the resonator.

#### 3-2 Principle

The plasma tube, also called capillary tube is filled with helium gas, and the gas pressure is controlled to be at several Torr at all time. On the other hand, a cadmium metal is sealed in the effuser. The heaters around the effuser heats up the metal to vaporize. The cadmium vapor pressure is also controlled to be at several milli-Torr.

First, a high voltage is impressed between anode and cathode in the plasma tube, where an arc takes place on the helium gas. The effuser is heated up and cadmium is vaporized into the plasma tube. The cadmium vapor is ionized by arc in the tube, and the ions are drawn toward cathode by cataphoresis effect.

The ionized cadmium is semi-stable in the tube, and it forms a reverse distribution to raise the gain of light of 441.6nm wavelength.

The light reflects between mirrors through the tube, and the gain is raised every reflection. Thus, the laser oscillation takes place in the tube, and the amplified beam is emitted through the mirror which has a little lower than 100% reflectivity.

#### 3-3 Control Circuits

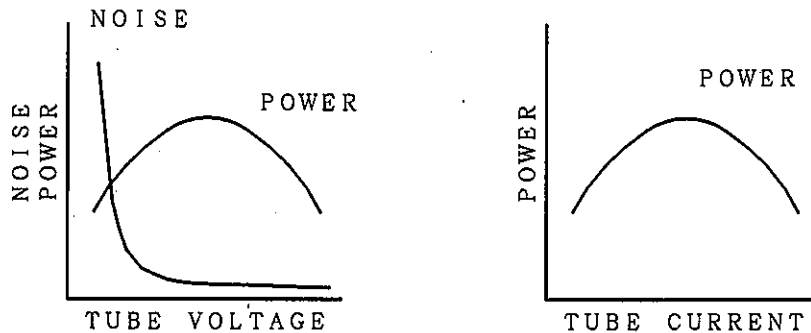
The laser performance is impaired by the fluctuation of such parameters as tube current, helium gas pressure, and cadmium vapor pressure. To offset the fluctuation and keep the parameters constant, controllers are built in the power supply :

Tube current -----Constant current circuit  
Helium gas pressure -----Gas pressure control circuit  
Cadmium vapor pressure -----Tube voltage control circuit



### 3-4 Laser Characteristics

The laser power and noise are closely related to the tube voltage and current.



#### TUBE VOLTAGE AND TUBE CURRENT VS. LASER POWER AND NOISE

Every laser tube has a different optimum point in terms of tube voltage and current. To get the optimum, two potentiometers (pot) - "TUBE CURRENT ADJ." and "TUBE EFFUSER ADJ." are provided inside the laser head.

The laser mirrors are attached to the resonator. The mirrors are kept in parallel with the resonator's rigid framework so that the parallelism is more insured against temperature change.

## 4. Cautions

### 4-1 Laser Exposure

The laser system is a "Class III b laser". With this system, there is no possibility of exposure to a stronger laser radiation than this class. However, if eyes are exposed to this class of laser beam not only direct beam from source but beam reflected on mirrors, they may be injured. Keep all reflective tools and materials away from beam path to prevent unexpected reflection and exposure. During maintenance work, all persons in the designated laser system area must wear protection glasses of that wavelength.

### 4-2 High Voltage and Temperature Hazard

A high voltage is supplied to the electrical circuits of laser head and power supply. Do not remove protective housing of laser head or power supply in any event. Whenever replacement of the laser head or power supply is necessary, first shut down the system by turning the key lock switch counter-clockwise and wait for 10 minutes before unplugging cables.

During operation and even after shut down of the laser system, the temperature of the capillary tube exceeds 200 °C. Never open the protective housing to avoid burning.

## 5. Trouble Shooting

### 5-1 Diagnostic Flow Chart (No Power Status)

Status	Check Points	Measures
<p>Turn on the Power switch.</p> <p>YES</p> <p>Is the power ON?</p> <p>NO</p>	<p>① Check if AC200V is supplied to wall receptacles.</p> <p>② Check ambient temperature.</p>	<p>① Use a receptacle where AC200V is supplied.</p> <p>② Set the temperature between 10 ~ 40 °C .</p>

### 5-2 Diagnostic Flow Chart (Power lamp "OFF" Status)

Status	Check Points	Measures
<p>Turn on the Power switch.</p> <p>System does not start. Power lamp is off.</p> <p>YES</p> <p>Is AC200V supplied?</p> <p>NO</p> <p>YES</p> <p>Is signal controlled ON?</p> <p>NO</p> <p>YES</p> <p>Is power switch on?</p> <p>NO</p> <p>YES</p> <p>Contact us immediately.</p>	<p>Is the power supply's fan operating? Check the stepper.</p> <p>① Check if AC200V is supplied to wall receptacles.</p> <p>② Check connection of power supply cables and the receptacles.</p> <p>③ Power switch off and disconnect the power cable and check the fuse.</p> <p>Stepper's laser power control signal make on. Check this control connector tighten ups.</p> <p>Check if the Power switch is tripped.</p>	<p>① Use a receptacle where AC200V is supplied.</p> <p>② Connect cables properly.</p> <p>③ If blow the fuse, please change new fuse. More blow a fuse, please contact us.</p> <p>Check the stepper and control signal cable.</p> <p>Pushing the button resumes operation. However, first check the followings :</p> <p>① Supplied voltage is AC200V</p> <p>② Ambient temperature does not exceed 40 °C . If it is tripped again even after the reset procedure contact us immediately.</p>

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

5-3 Diagnostic Flow Chart (Power lamp "ON" Status)

Status	Check points	Measures
Turn on the Power switch.		
Is Power lamp ON?		
YES		
NO	The metal vapor laser needs 10 minutes to get stable.	
Have 10 min. passed?		
YES		
NO	① Check if AC200V is supplied to AC receptacle. ② Check connection of power cable and the receptacle.	① Use a receptacle of AC200V. ② Connect cables properly.
Is AC200V supplied properly?		
YES		
NO	Look through fan port of laser head, and check glow inside.	If no glow, contact us.
Is the laser tube discharged?		
YES		
YES	Hear the sound of spark?	If such sound is heard, contact us. (may be a trigger leak.)
Is the sound heard?		
NO		
NO	Compare the voltage with those listed in final inspection report. (TEST DATA)	Contact us if the reading is far from value given in final inspection report.
Is the tube voltage correct?		
YES		
NO	Read the meter. (0.9A ± 0.3A)	If the pointer does not come down from a peak, which means that cadmium is exhausted and the laser tube ceased its function.
Is the effuser current correct?		
YES		
Contact us immediately.		

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

5-4 Diagnostic Flow Chart (Decreased Laser Output Power)

Status	Check points	Measures
<p>Laser output is decreased.</p>		
<p>YES NO</p>		
<p>Mirrors aligned?</p>	<p>Check if mirrors are aligned.</p>	<p>Please refer to Section 6-1.</p>
<p>YES NO</p>		
<p>Cooling fan operating</p>	<p>Check if cooling fan is working.</p>	<p>If not, contact to stepper service immediately.</p>
<p>YES NO</p>		
<p>Head ventilation ports</p>	<p>Check if any interference at inlet and outlet ventilation ports. A poor ventilation may cause misalignment of mirror.</p>	<p>Keep enough room at both inlet and outlet ventilation ports.</p>
<p>YES</p>		
<p>Tube voltage setting</p>	<p>Confirm if the tube voltage is same as the value given in the final inspection report.</p>	<p>① Please refer to Section 6-2. ② After 5000 hours usage, it may be the laser tube's life end.</p>
<p>NO</p>		
<p>YES</p>		
<p>Tube current setting</p>	<p>Confirm if the tube current is same as the value given in the final inspection report.</p>	<p>Please refer to Section 6-3.</p>
<p>NO</p>		
<p>YES</p>		
<p>Ambient temperature</p>	<p>Check if ambient temperature is between 10 °C and 40 °C .</p>	<p>Use under the specified temperature range.</p>
<p>NO</p>		
<p>YES</p>		
<p>Contact us immediately.</p>		

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

5-5 Diagnostic Flow Chart (Increased Noise Level)

Status	Check points	Measures
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Laser noise is increased.</div> <div style="text-align: center; margin-bottom: 5px;">YES</div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Tube voltage setting</div> <div style="margin-left: 10px;">NO</div> </div> <div style="text-align: center; margin-bottom: 5px;">YES</div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Tube current setting</div> <div style="margin-left: 10px;">NO</div> </div> <div style="text-align: center; margin-bottom: 5px;">YES</div> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Ambient temperature</div> <div style="margin-left: 10px;">NO</div> </div> <div style="text-align: center; margin-bottom: 5px;">YES</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Contact us immediately.</div>	<p>Confirm if the tube voltage is same as the value given in the final inspection report.</p> <hr style="border-top: 1px dashed black;"/> <p>Confirm if the tube current is same as the value given in the final inspection report.</p> <hr style="border-top: 1px dashed black;"/> <p>Check if ambient temperature is between 10 °C and 40 °C .</p>	<p>Please refer to Section 6-2.</p> <hr style="border-top: 1px dashed black;"/> <p>Please refer to Section 6-3.</p> <hr style="border-top: 1px dashed black;"/> <p>Use under the specified temperature range.</p>

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

5-6 Diagnostic Flow Chart (Unstable Laser Output Power)

Status	Check points	Measures
<p>Laser output power fluctuates.</p> <p>YES YES</p> <p>Fluctuation with less than 1 minute periodicity.</p> <p>NO</p> <p>YES</p> <p>Fluctuation with more than 1 hour periodicity.</p> <p>NO</p> <p>Contact us immediately.</p>	<p>① Check the effuser current meter and see if pointer stays still or fluctuates within 0.1A range. More than 0.1A fluctuation is directly reflected to tube voltage.</p> <p>② Turn meter switch to the position of tube current, and check pointer behavior.</p> <p>① Check if ambient temperature fluctuation is more than 10 °C .</p> <p>② Check if air from air conditioner directly hit the laser head, or check any other factors which might be affecting the ambient temperature.</p>	<p>① Keep running for 1 hour and check again. If still fluctuates more than 0.1A, refer to Section 6-2 for adjustment.</p> <p>② If not improved, refer to Section 6-3 for adjustment.</p> <p>Keep from use under the condition where ambient temperature considerably fluctuates.</p>

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

5-7 Diagnostic Flow Chart (Other Status)

Status	Check points	Measures
<p>TEMP. ALARM on.</p>	<p>Check ambient temperature and cooling fan working.</p>	<p>Contact us immediately.</p>
<p>STAND. BY alarm on.</p>	<p>Confirm if the stepper controlled make standby mode.</p>	<p>This is standby mode.</p>

If you do not see improvements after the suggested measures, please contact the nearest representative or KIMMON immediately.

## 6. Maintenance and Adjustment

### 6-1 Mirror Alignment

Mirrors misalignment is one of the most common reasons for laser power reduction. The misalignment is caused by external factors such as ambient temperature change. To recover the laser power, re-align the mirror to optimum condition.

**Tools :** Protective glasses for 441.6nm  
Power monitor  
7mm hexagonal box driver for M4 nuts

#### Preparation

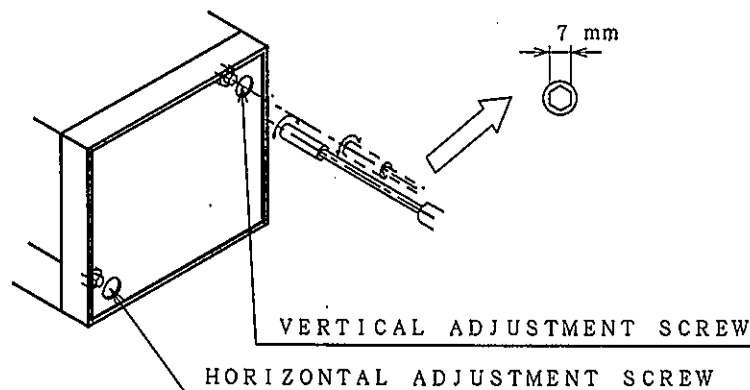
- (1) Use the protective eye glasses.
- (2) Turn on the laser system for 20 minutes to allow temperature of oscillator to be stable.
- (3) Check if the tube voltage and current are set at an optimum points. (Refer to the final inspection report.) If the tube voltage and current are off, first adjust the voltage and current before attempting mirror adjustment.

#### Adjustment

- (1) Monitor the laser power with the power monitor.
- (2) An adjusting screw is provided on the rear panel of the laser head to move the mirror in vertical direction. Turn the screw with the hexagonal box driver clockwise or counter-clockwise very slightly watching the power to reach the maximum power.
- (3) For mirror adjustment in horizontal direction, another screw is provided. Turn and stop the screw in the same manner as the adjustment in the vertical direction.
- (4) Repeat the steps (2) and (3) for a fine adjustment.
- (5) In most cases, adjusting the screws on the rear panel improves the power to the maximum. If not, try to turn the screws on the front panel.

#### Cautions

When turning the screws, turn the screws very slightly at one time and repeat the action. If screws are turned too much at one time, the oscillation may stop. Should it stop, just turn the screw back slowly; and the oscillation will be resumed. If there is a difficulty in getting access to the screws on the rear panel, you may alternatively adjust it with the screws on the front panel.



## 6-2 Tube Voltage

When you see the laser power is decreased or unstable or increasing in noise level, it may be recovered by adjusting the tube voltage.

Tools : Power monitor

Oscilloscope (for simplified noise check)

Slotted screwdriver

Protective glasses for 441.6nm

### Preparation

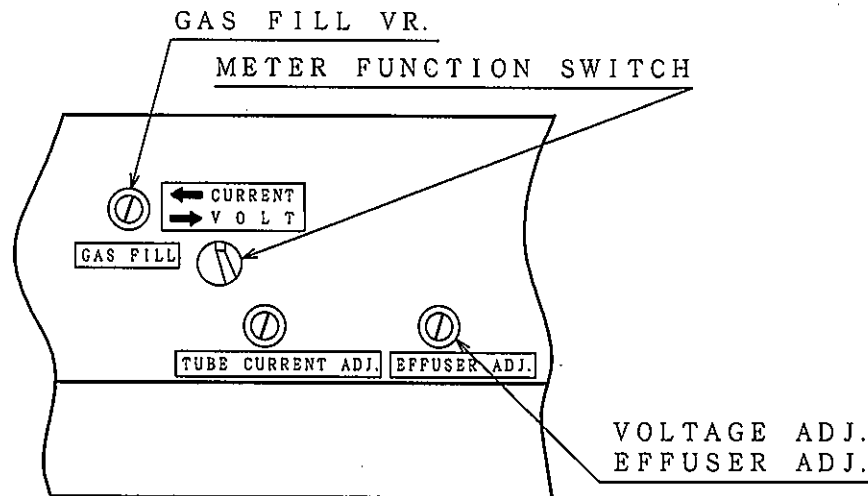
- (1) Turn on the laser system for 20 minutes before starting the adjustment.
- (2) Switch "CURRENT/VOLT" to Volt side on the side panel of the laser head. Make sure to monitor the power and the noise level.

### Adjustment

First, turn the knob only by 5 degrees, and monitor the laser with the voltmeter (TUBE VOLT), power monitor, and oscilloscope. Wait for at least 5 minutes before turning the knob for another 5 degrees. Repeat these steps to look for an optimum laser power and noise. When coming close to an optimum point, turn the knob just a little for a fine adjustment.

Keep the voltage adjustment range within  $\pm 100V$  of the value given in the final inspection report.

- (a) If the knob is turned counter-clockwise, the tube voltage is increased.  
(The effuser current dip briefly before the tube voltage increases.)
- (b) If turned clockwise, the tube voltage is decreased.  
(The effuser current increases briefly before the tube voltage decreases.)





### 6-3 Tube Current

When you see the laser power is decreased or unstable or increasing in noise level, it may be recovered by adjusting the tube current.

**ONLY ADJUST TUBE CURRENT AFTER ADJUSTING TUBE VOLTAGE.**

Tools : Power monitor

Oscilloscope (for simplified noise check)

Protective glasses for 441.6nm

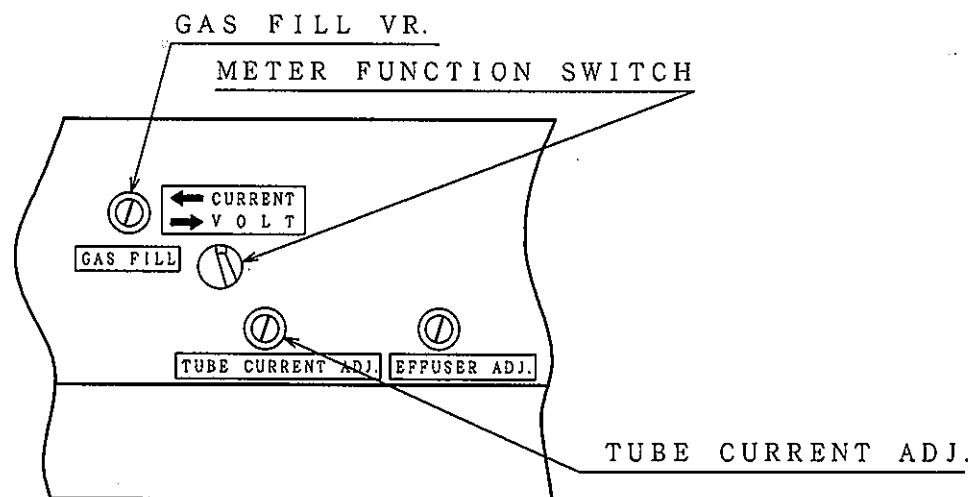
#### Preparation

- (1) Turn on the laser system for 20 minutes before starting the adjustment.
- (2) Switch "CURRENT/VOLT" to Current side on the side panel of the laser head. Make sure to monitor the power and the noise level.
- (3) Attempt the tube voltage adjustment before the current adjustment.

#### Adjustment

First, turn the knob to change the current for up to 5mA and monitor the laser with the voltmeter (TUBE CURRENT), power monitor and oscilloscope. Wait for at least 10 minutes before turning the knob for another 5mA. Repeat these steps to look for an optimum laser power and noise. When it comes close to an optimum, turn the knob just a little for a fine adjustment.

- (a) If the knob is turned counter-clockwise, the tube current is decreased.
- (b) If turned clockwise, the tube current is increased.



#### 6-4 AC Frequency (50Hz, 60Hz)

This laser system can be used with either 50Hz or 60Hz frequency of AC power. The frequency is selected by changing the position of a switch at rear panel of the power supply.

**warning :** Before practicing the switch position change, first shut down the system, and leave it for at least 10 minutes.

##### Frequency Change Procedure

- (1) Turn off the main switch and wait 10 minutes.
- (2) Remove the switch cover using a Phillips screwdriver and select switch.  
Turn right to 50Hz  
Turn left to 60Hz
- (3) Reinstall the panel.

#### 6-5 Power Supply Revision C1 Procedure

To use the CD4123R-F and CD6122C, check the CD6122C's revision label number C2 was not erased. If erased the C2, please change the transformers tap.

**warning :** Before practicing the connector position change, first shut down the system, and leave it for at least 10 minutes.

- (1) Remove the right side panel using a Phillips screwdriver.
- (2) Change the tap connector at T570 high voltage transformer.  
  
CD4123R-F and CD6122C : Connect 200V tap connector  
CD4163R-F and CD6122C : Connect 190V tap connector
- (3) Reinstall the panel.

#### 6-6 Laser System Storage Period

The tube voltage (cadmium vapor pressure), tube current and helium gas pressure all contributes to the laser power and noise level. The helium gas pressure changes gradually during storage. For storage over a period of 2 month, it is recommended that the laser system be run for 48 hours at least once every 2 month to maintain the helium gas pressure at optimum level.

## 7. Laser Specifications

I T E M		CD4123R-F	CD4163R-F
WAVELENGTH	(nm)	441.6	441.6
INITIAL POWER	(mW)	> 16	> 20
TRANSVERSE MODE		TEM <sub>00</sub>	TEM <sub>00</sub>
BEAM DIAMETER (1/e <sup>2</sup> )	(mm)	0.7 ± 0.15	0.8 ± 0.1
BEAM DIVERGENCE	(mrad)	< 0.6	< 0.6
POLARIZATION		Linear	Linear
POLARIZATION ANGLE (VERTICAL)		< ± 5°	< ± 5°
NOISE(P-P)	(%)	< 5	< 6
WARM UP TIME TO 90% POWER	(min.)	< 10	< 10
BEAM POINTING STABILITY (μ rad)		90	80
POWER STABILITY (@25 °C)	(%)	< ± 2	< ± 2
POWER STABILITY (@10 ~ 40 °C)	(%)	< 20	< 20
LENGTH	(mm)	680	750
WEIGHT	(Kg)	17.0	18.5

I T E M		CD6122C	CD6122C
INPUT VOLTAGE	(V)	AC200 ± 10%	AC200 ± 10%
INPUT CURRENT	(A)	3.3 ± 20%	3.3 ± 20%
POWER CONSUMPTION	(W)	500 ± 20%	500 ± 20%
FREQUENCY	(Hz)	50/60	50/60
LINE CABLE LENGTH	(m)	3	3
WEIGHT	(Kg)	23.5	23.5

The beam diameter is measured at 100mm from output mirror.

Laser system environmental conditions (No condensation).

Operation : Temperature 10 °C ~ 40 °C : Relative Humidity 20% ~ 80%  
 Non Operation : Temperature -10 °C ~ 50 °C : Relative Humidity 5% ~ 95%

**8. Laser System Disposal**

The heavy metal, cadmium, is sealed in the tube. Such heavy metal must be disposed according to the government's regulations. Contact your government or its agencies for further details, or contact us for disposal for fee under consignment basis.

**9. Package for Tube Refurbishing and Repairing**

When you ship your laser system back for tube refurbishing and repairing, use the package provided when the laser system was delivered to you.

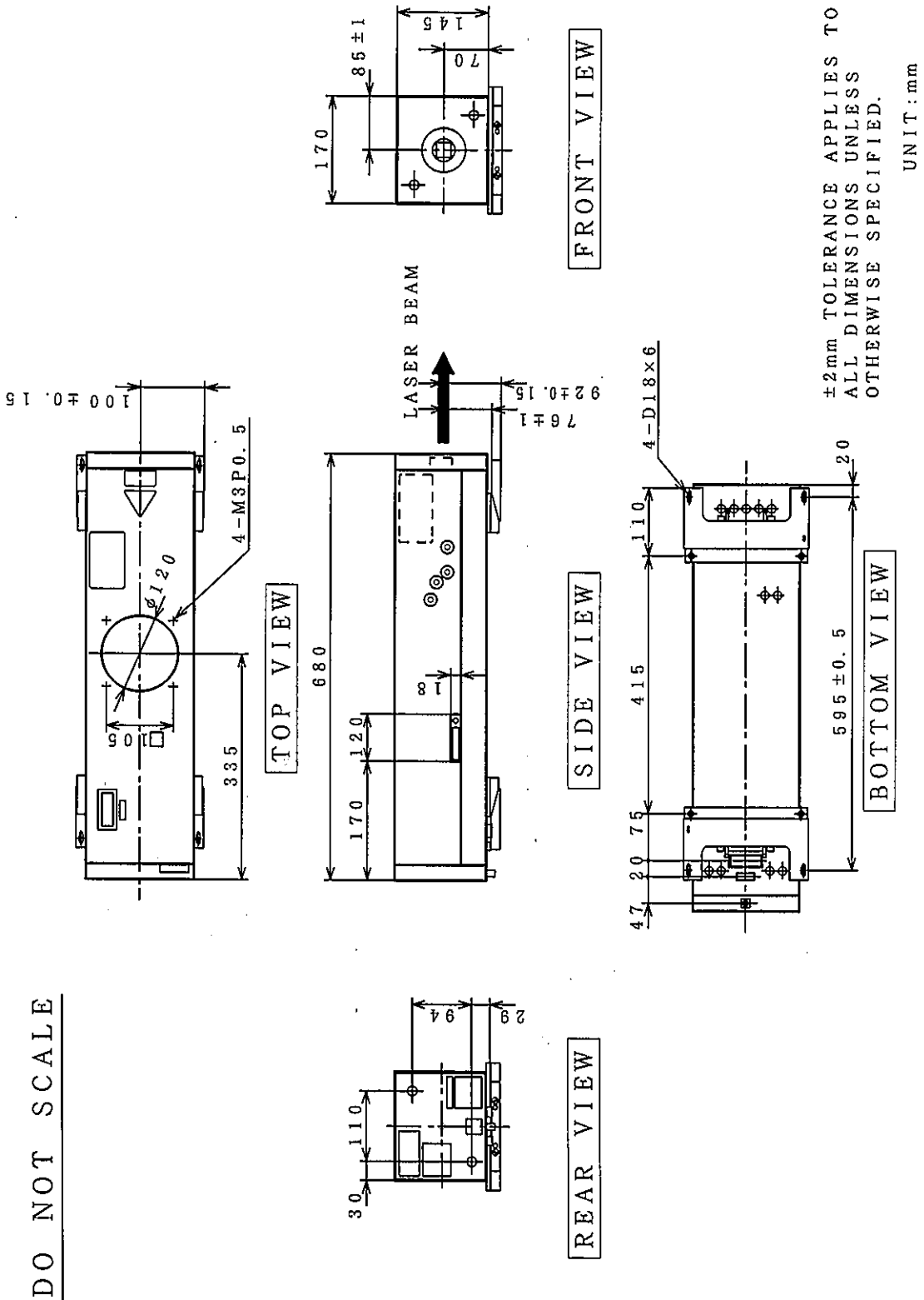
**10. Where to Contact Us**

**TOKYO HEAD OFFICE**  
1-53-2 ITABASHI, ITABASHI-KU, TOKYO, 173 JAPAN  
PHONE 81-3-5248-4811 FAX 81-3-5248-0021

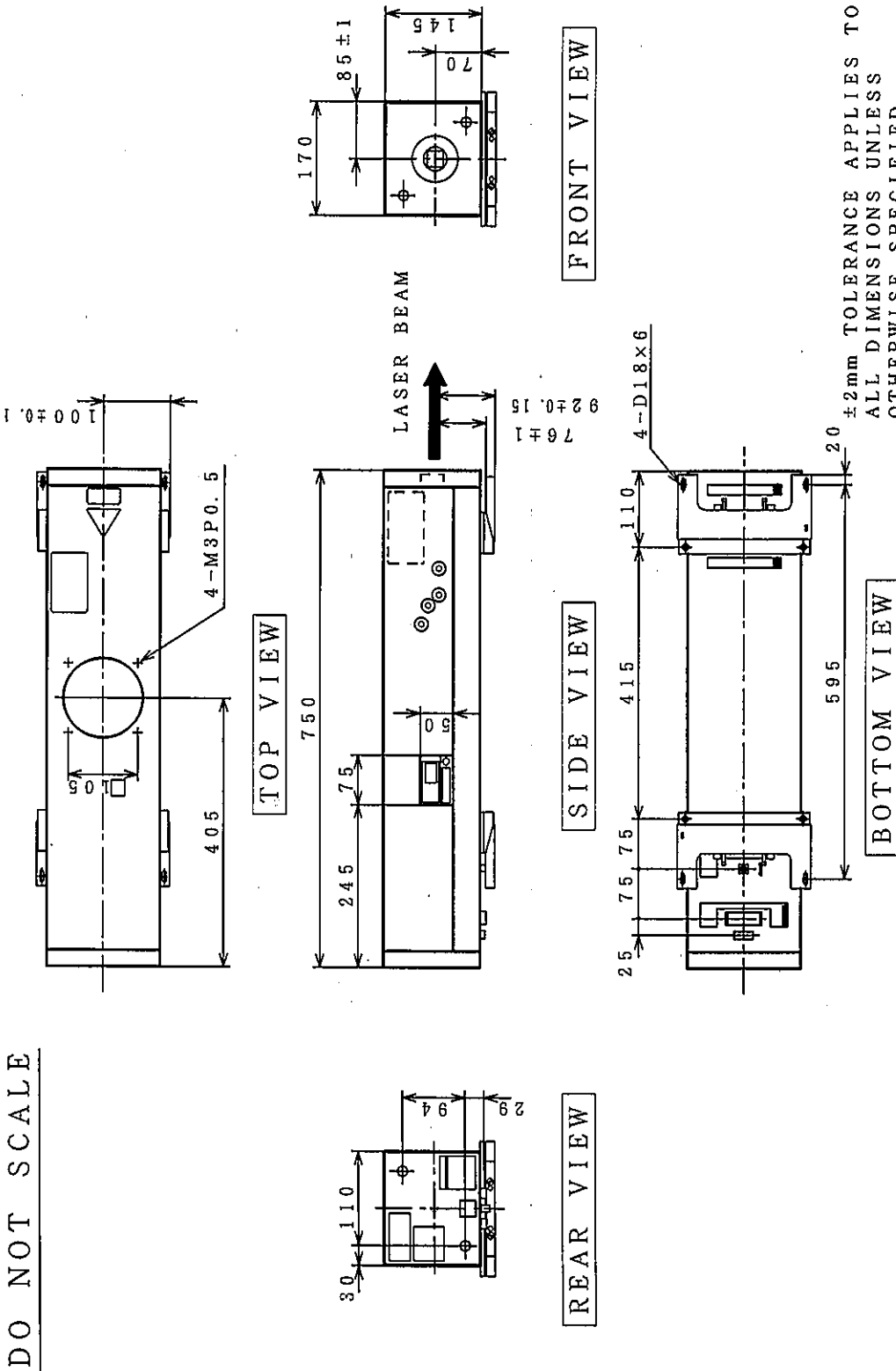
**KAWAGOE FACTORY**  
750 SHIMOAKASAKA, KAWAGOE-CITY, SAITAMA, 350-11 JAPAN  
PHONE 81-492-66-2511 FAX 81-492-66-2061

11. Drawings

11-1 Laser head Model : CD4123R-F



11-2 Laser head Model : CD4163R-F



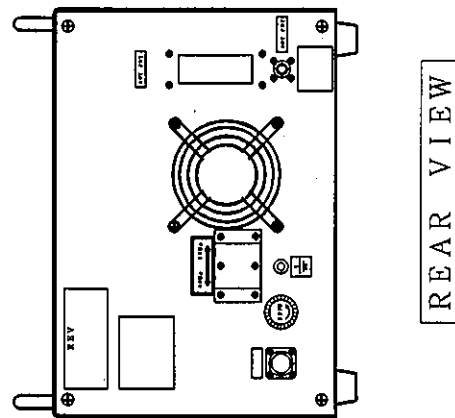
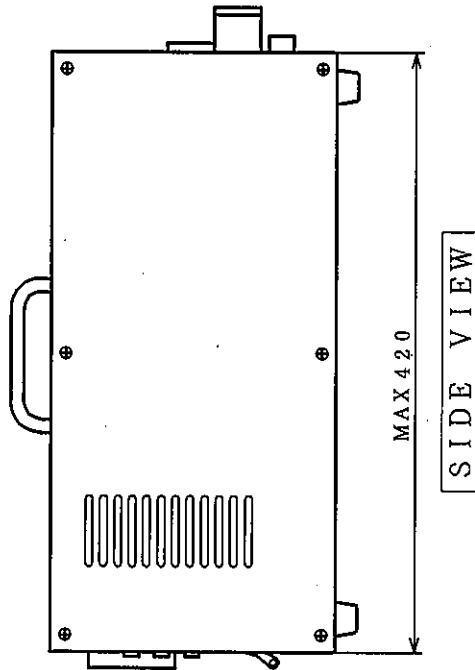
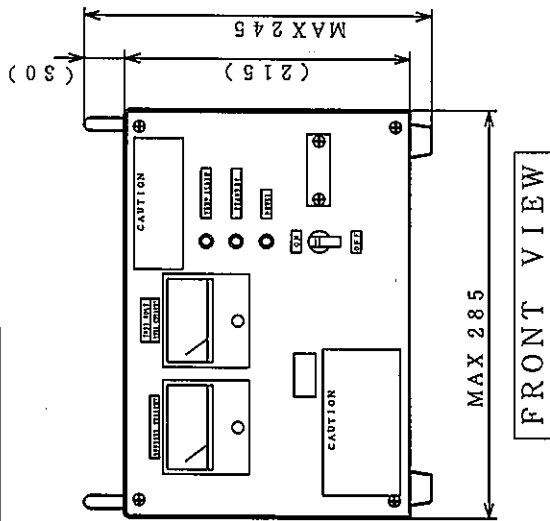
±2mm TOLERANCE APPLIES TO ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED.

UNIT: mm

DO NOT SCALE

11-3 Power Supply Model : CD6122C

DO NOT SCALE



±2mm TOLERANCE APPLIES TO ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED.

UNIT : mm