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OCLS-HSC-D100-TKSM

Dual High Speed Fiber Optical Comb

INSTRUCTION MANUAL

February 26th, 2016

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# 1. Product Summary

## 1.1. Summary

The Dual High Speed Fiber Optical Comb, Model: OCLS-HSC-D100-TKSM is a mode locked fiber ring laser system. Repetition frequency and offset frequency are locked to an accurate frequency standard with a high speed control. This system was developed with the technology about high speed controlled optical frequency comb provided by the National Institute of Advanced Industrial Science and Technology (AIST).

## 2. Safety Precaution

### 2.1. General Issue



**In order to avoid serious personal injuries, such as electric shocks, burns and so on, these instructions must be closely followed.**

- Do not use the product without its being securely connected to a well earthed circuit.
- Do not remodel or re-engineer the product in any way.
- Do not open the housing of the product.
- Connect all cables following the instructions for system set up shown in Section 8
- Do not disconnect any cable during the operation of the system.
- Do not disconnect cables directly after turning off the product. Cable disconnection 2 to 3 minutes after switch off is strongly recommended.
- Do not replace a fuse before turning off the product and disconnecting from the electrical supply.

### 2.2. Power Supply



OCLS-HSC-D100-TKSM is designed to work with Power Supply of AC100V± 5% (Single Phase, 50/60Hz).

Using any other voltage rate is strongly prohibited otherwise there will be a risk of product damage, fire or/and personal injury.

In the case of using other voltage rate, installation of appropriate transformer is necessary.

### 2.3. Product Protection



**The following instructions are important to protect the product from damage or/and failure.**

- Do not block air vents and laser emission aperture of the product.
- Avoid dew condensation to the product.
- Use and store the product in a stable environment. Environmental requirements are shown in Section 6 of this document.
- Do not allow the product to undergo any sudden shock or prolonged vibration.
- Closely follow the instructions in this document. Any other operations which are not stated in this document may lead to hazardous accidents and malfunctions of the product.

### 3. Laser Safety



The OCLS-HSC-D100-TKSM system is rated as "Class 3R (JIS C 6802)".

Before starting to use the product, please take the necessary measures to ensure compliance with the appropriate laser safety standards.

Because the output wavelength of the laser is in the near-infrared region, it is invisible to the human eye. Do not look directly into the laser and laser aperture and be aware of stray reflections of laser radiation. It is strongly recommended that appropriate laser eye glasses are worn during any laser operation.

In order to avoid accidental exposure to laser light, it is important to turn off the laser every time it is not in use. Each time after the operation, make sure to turn off the laser switch to the "OFF" position.

- **JIS C 6802 Regulation**

The OCLS-HSC-D100-TKSM complies with JIS C 6802 regulations. Based on the regulation's guide-line, the product is equipped with key-switch, remote interlock connector, laser radiation emission indicator, laser shutter and appropriate warning labels. For safe use of the product, it is important for users to be aware of these items.

- **Key Switch**

Key Switch is located to the front panel of Laser Controller.

When the Key Switch is turned to the "ON" position, the key is locked to the key outlet. In order to avoid accidental exposure to laser light, it is important to turn off the laser every time when it is not in use. Each time after the operation turn the Key Switch to the "OFF" position and remove the key. This should be stored in a safe and managed location.

- **Laser Emission Indicator**

A Laser Emission Indicator is located to the front side of Laser Controller.

When the Key Switch is turned to the "ON" position, the Emission Indicator light should also turn on.

Each time after the operation please make sure that the Key Switch is turned to the "OFF" position and check that Emission Indicator light is off.

- **Warning Labels**

Be aware of all labels, and please take the necessary measures to ensure compliance with the appropriate laser safety requirements.

- **Invisible Laser Radiation Warning Label**



- **Laser Class Label**



## 4. Guarantee

### ➤ **Guarantee Period**

The Guarantee Period is for the product is Twelve (12) Months after shipping.  
 Repairs or additions after this period will be charged separately.  
 System consumable parts are excluded from this guarantee.

### ➤ **Manufacturer's Responsibility**

Product defects or deficiencies caused by normal use are the responsibility of NEOARK CORPORATION and during the Guarantee Period are subject to Free Repair or Replacement of the defective parts.

### ➤ **Guaranteed Range**

This Guarantee signifies the guarantee of particular products of NEOARK CORPORATION ONLY.

The Guarantee does not include any loss, such as Operating Losses, caused by any product defect or deficiency.

### ➤ **Excluded Cases of Guarantee**

The following are specific examples of excluded cases of the guarantee.  
 Any Replacement or Repair related to these cases will be charged separately.

- **Inappropriate Use**  
 Defects or/and Damage caused by inappropriate use or/and storage that are not stated in the product Instruction Manual.
- **Inappropriate Transportation**  
 Defects or/and Damage caused by transportation or/and moving the system by users.
- **Inappropriate Remodeling**  
 Defects or/and Damages caused by remodeling or/and repair of the system by users.
- **Inappropriate Power Supply**  
 Defects or/and Damage caused by inappropriate voltage input or/and connection of peripheral equipment (s) to the system
- **Force Majeure**  
 Defects or/and Damages caused by Force Majeure Accidents, such as Fire, Earthquake, Wind or Flood Damage, Salt-air Damage, Lightning, other natural disasters and War.

## 5. Repair Support

### ➤ Support Period

The support period for repair & maintenance is eight (8) years after shipping. After this period support may not be possible due to difficulties in obtaining parts.

### ➤ Contact Information

If there are any problems with the system or/and there are issues related to the product that need to be checked, please contact:

#### NEOARK CORPORATION

Phone Number: **+81-3-6379-5539\***

E-Mail Address: **[info@neoark.co.jp](mailto:info@neoark.co.jp)\***

### ➤ Repair and Maintenance

Repair and maintenance of the product will be supported by the manufacturer but will be chargeable. System defects or/and deficiencies that are caused by normal use in the guarantee period will be investigated by the manufacturer for its scope of application. A detailed report of any problem is required by the manufacturer for appropriate support. Supporting repair and maintenance of the system may take some time to carrying out.



## 6. Preparation

### 6.1. Unpacking

When unpacking the product please check the contents carefully. If there is any damage, sign of defects or/and loss of part(s) please contact NEOARK CORPORATION immediately. (Configuration List is shown below),

### 6.2. Configuration

- High Speed Er Fiber Comb Laser Head 2 Sets
- High Speed Controller 2 Sets
- Er Fiber Laser Amplifier Unit 2 Sets

#### Accessories

- Head-Controller Connection Cable 2 Sets
- Head-Amp Unit Connection Cable 4 Sets
- AC Power Cable 4 Sets
- Instruction Manual 5 Sets

### 6.3. Before Starting Operation

Read the Instruction Manual carefully before using the product. Any kind of use that is not stated in this Instruction Manual is strongly prohibited. In the case of inappropriate use or/and the deliberate breaking of the precautions shown in Instruction Manual, Product Warranty and Repair will not be supported.

Because the wavelength of the laser light is in near-infrared region it is not visible to human eyes. Do not look directly into the laser and laser aperture and be aware of stray reflections of laser radiation. It is strongly recommended to wear appropriate laser eye glasses during laser operation.

### 6.4. Installation Requirement

#### ➤ Power Source Requirement

- Necessary Line One Line (Single Phase, 50/60 Hz)
- Voltage AC100V±5%
- Power Consumption 250VA / Line

#### ➤ Environment Requirement

- Installation Place Flat and stable place. Optical Surface Plate which has enough space to place whole product is recommended.
- Operation Temperature 20°C - 25°C
- Storage Temperature 10°C - 30°C
- Humidity Less than 80%  
(Dew Condensation must be avoided)

#### ➤ Other Conditions

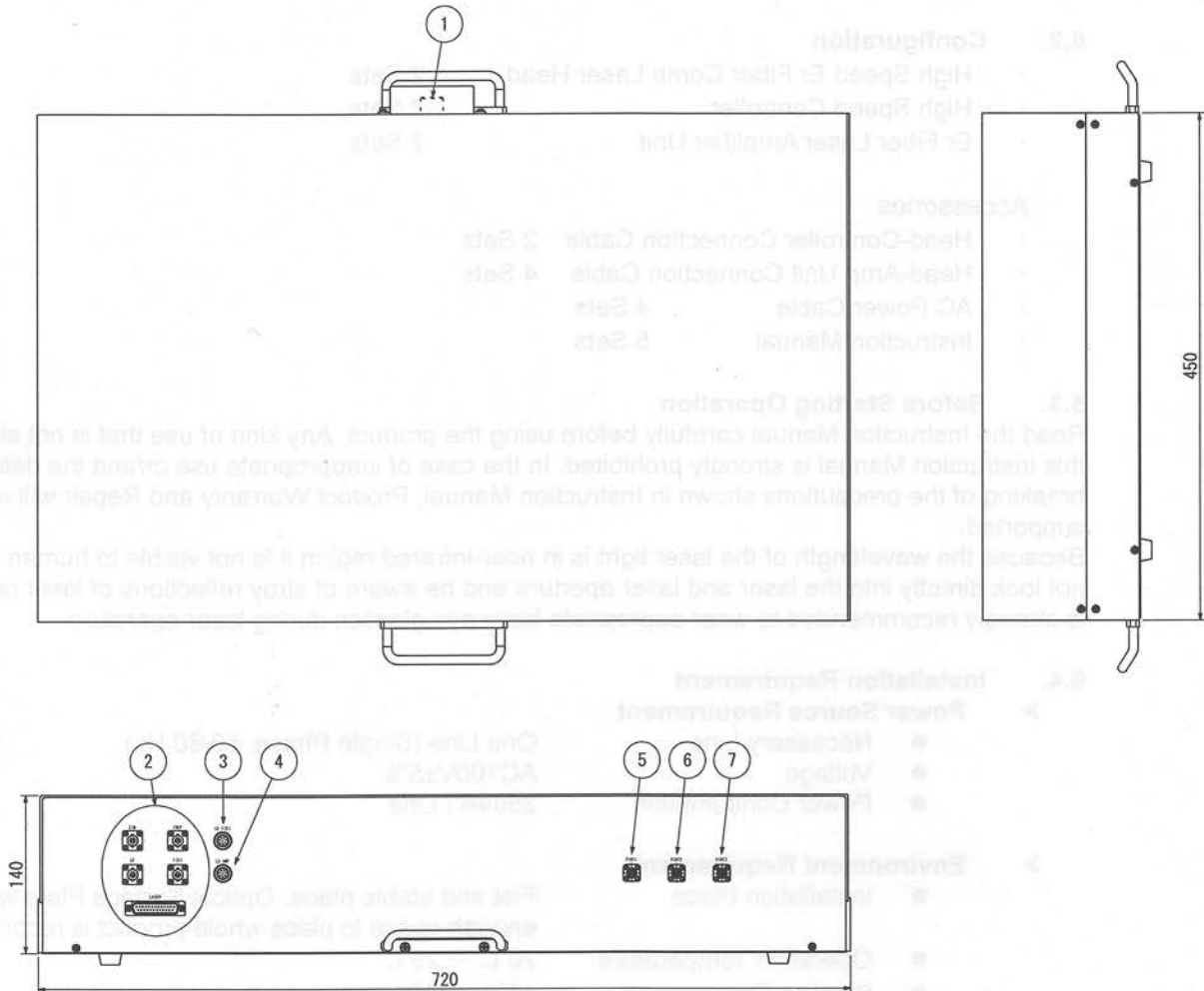
This product is a sensitive instrument, and is NOT designed for use in harsh conditions. The following factors should be eliminated from the environment around the product as much as possible or the system may be severely damaged or will not operate correctly. In cases where the product is affected by any of these factors and it becomes unusable then it is outside the product guarantee conditions and any liability ends.

- Fire, Heat, Shocks, Vibration and any other factors which may damage the product.
- Water, Water Droplets, Vapor, Dew Condensation and any other water related problems.
- Dust, Sand, and any other small particulates.
- Severe change of room temperature or/and humidity to beyond the specification range stated above.

## 7. Product Appearance

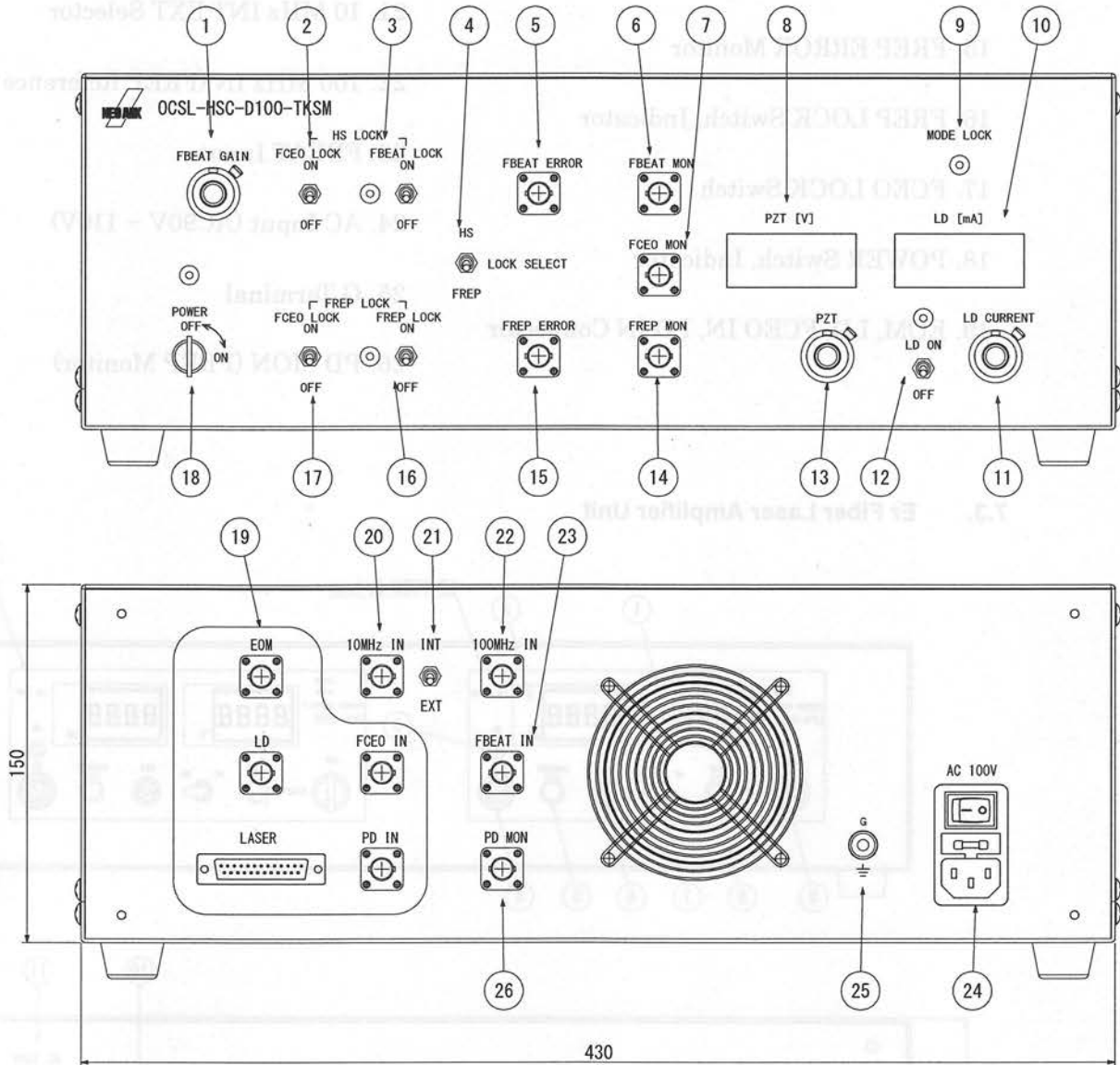
※ The actual product appearance, especially the location of labeling, may vary depending on production circumstances.

### 7.1. High Speed Er Fiber Comb Laser Head



- |   |  |
|---|--|
| 1. Repetition Rate adjusting knob       | 5. OUT 1 Port (Amplified Output, FC/APC) |
| 2. EOM, FREQ, LD, FCEO, LASER Connector | 6. OUT 2 Port (FC/APC)                   |
| 3. LD FCEO Connector                    | 7. OUT 3 Port (FC/APC)                   |
| 4. LD AMP Connector                     |  |

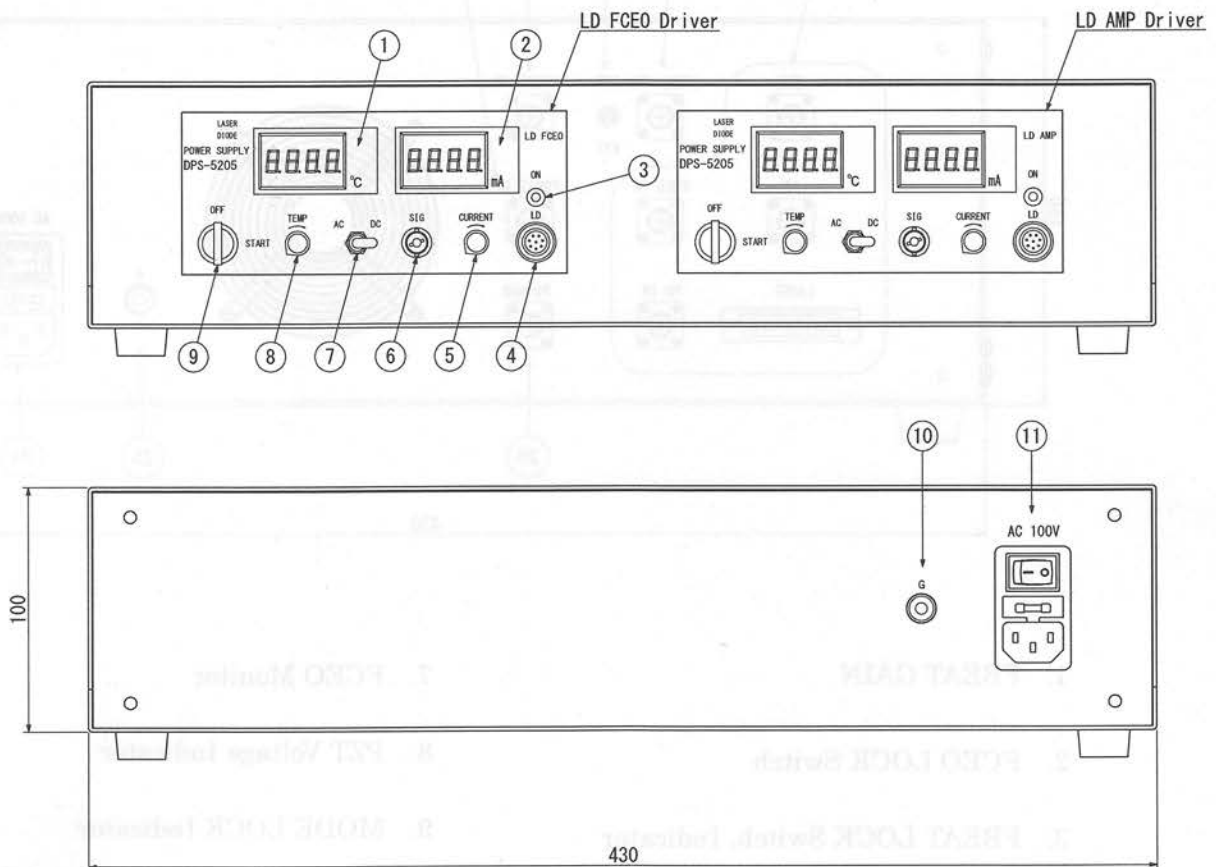
7.2. High Speed Controller



- |                                 |                               |
|---------------------------------|-------------------------------|
| 1. FBEAT GAIN                   | 7. FCEO Monitor               |
| 2. FCEO LOCK Switch             | 8. PZT Voltage Indicator      |
| 3. FBEAT LOCK Switch, Indicator | 9. MODE LOCK Indicator        |
| 4. HS FREP LOCK Selector        | 10. LD Current Indicator      |
| 5. FBEAT ERROR Monitor          | 11. LD CURRENT Adjusting Knob |
| 6. FBEAT Monitor                | 12. LD ON Switch              |

- |                                       |   |
|---------------------------------------|---|
| 13. PZT Voltage Tuning Knob           | 20. 10 MHz IN (FCEO, FBEAT Reference Input) |
| 14. FREP Monitor                      | 21. 10 MHz INT-EXT Selector                 |
| 15. FREP ERROR Monitor                | 22. 100 MHz IN (FREP Reference Input)       |
| 16. FREP LOCK Switch, Indicator       | 23. FBEAT Input                             |
| 17. FCEO LOCK Switch                  | 24. AC Input (AC90V ~ 110V)                 |
| 18. POWER Switch, Indicator           | 25. G Terminal                              |
| 19. EOM, LD, FCEO IN, PD IN Connector | 26. PD MON (FREP Monitor)                   |

**7.3. Er Fiber Laser Amplifier Unit**



## 8. Operation Procedures

1. Temperature Indication
2. LD Current Indication
3. Emission Indicator
4. LD Connector
5. LD Current Adjusting Knob
6. (Modulation Input)
7. (Modulation Input Selector)
8. (Temperature Adjusting Knob)
9. LD Switch
10. G Terminal
11. AC Input (AC90V ~ 110V)



1. Turn on the switch (1) on the rear panel of the controller. Turn on the POWER switch (2) on the front panel of the controller. Leave the laser more than 1 hour for warming up.
2. Turn on the LD ON switch (3). Turn LD CURRENT adjusting knob (4) to clockwise until MODE LOCK indicator (5) starts to glow. Adjust LD current to about the value noted on the inspection sheet. Laser output comes out from OUT2 and OUT3 and OUT1 port.
3. Turn the LD current adjusting knob (6) to clockwise. The amplified laser power is output from OUT1 port.
4. Turn on the LD switch (7) of the LD AMP Driver.
5. Turn on the switch (8) on the rear panel of the Er Fiber Laser Amplifier.
6. Turn on the switch (9) on the rear panel of the controller. Turn on the POWER switch (10) on the front panel of the controller. Leave the laser more than 1 hour for warming up.
7. Turn on the LD ON switch (11). Turn LD CURRENT adjusting knob (12) to clockwise until MODE LOCK indicator (13) starts to glow. Adjust LD current to about the value noted on the inspection sheet. Laser output comes out from OUT2 and OUT3 and OUT1 port.
8. Turn the LD current adjusting knob (14) to clockwise. The amplified laser power is output from OUT1 port.

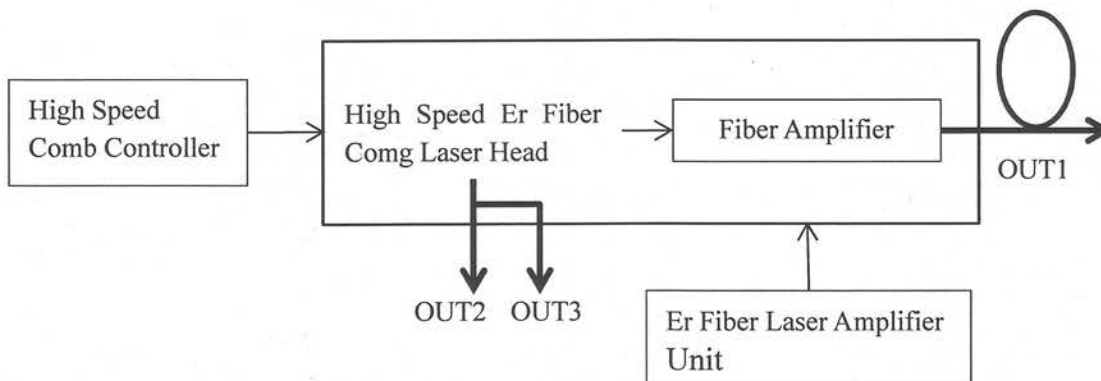
## 8. Operation Procedure

Before starting operation it is highly recommended that attention is given to the instruction manual, which should be read carefully and fully understood, giving due attention to any warnings relevant to laser safety.

Do not forget to prepare the necessary measures for Laser Safety based on Laser Safety Class indicated in the instruction manual.

### 8.1. Turning on the fiber laser

1. Put the Laser Head on a stable table and connect with the controller and the amp unit with connection cables as below. Connect the controller and the amp unit to AC 100V power source.



2. Turn on the switch⑭ on the rear panel of the controller. Turn on the POWER switch⑯ on the front panel of the controller. Leave the laser more than 1 hour for warming up.
3. Turn on the LD ON switch⑫. Turn LD CURRENT adjusting knob⑪ to clockwise until MODE LOCK indicator⑨ turns to green. Appropriate LD current is about the value noted on the inspection sheet. Laser output comes out from OUT2 and OUT3 port.

### 8.2. Turning on the Er fiber amplifier

1. Turn on the switch⑩ on the rear panel of the Er Fiber Laser Amplifier Unit.
2. Turn on the LD switch⑨ of the LD AMP Driver.
3. Turn the LD current adjusting knob⑤ to clockwise. The amplified laser power is output from OUT1 port.

### 8.3. FCEO Signal Observation

1. Connect FCEO MON connector ⑦ to a spectrum analyzer.
2. Turn on the LD switch⑨ of the LD FCEO Driver of the Er Fiber Laser Amplifier Unit. FCEO signal appears. Adjust the LD current with LD Current Adjusting Knob④ of the Amplifier Unit to maximize FCEO signal. Appropriate LD FCEO current is about the value noted on the inspection sheet.

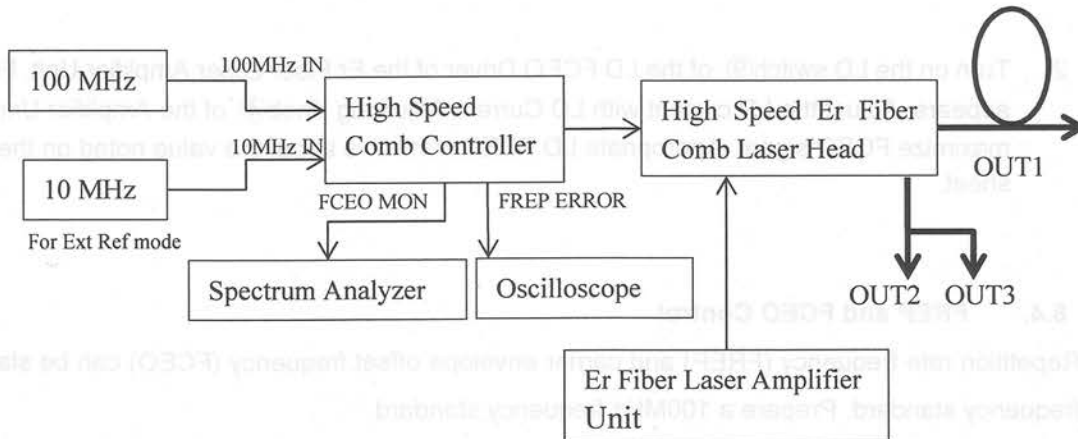
### 8.4. FREP and FCEO Control

Repetition rate frequency (FREP) and carrier envelope offset frequency (FCEO) can be stabilized to a frequency standard. Prepare a 100MHz frequency standard.

1. Connect a 100MHz frequency standard to the 100MHz IN connector⑳ on the rear panel of the controller. Frequency reference signal should be lower than -6dBm.
2. If the external frequency standard is preferable, turn 10MHz INT-EXT selector㉑ to EXT and connect a 10MHz frequency standard to the 10MHz IN connector㉒ on the rear panel of the controller. Frequency reference signal should be than 0 – 6dBm.
3. Turn HS FREP LOCK selector to FREP mode. Connect FREP ERROR monitor㉓ to an oscilloscope. Sine wave (difference frequency between FREP from 100MHz) is observed. Take off the cover and turn the repetition rate adjusting knob① of the laser head to make the FREP ERROR signal lower than 100Hz.
4. Turn PZT Voltage Tuning Knob⑬ to about 50V. Take off the cover and turn the repetition rate adjusting knob① of the laser head and PZT Voltage Tuning Knob⑬ of the controller to make the FREP ERROR signal lower than 10Hz.
5. Turn on FREP LOCK switch㉔. When the FREP frequency is locked to a reference signal, the indicator turns to green.



- Turn LD CURRENT knob⑪ to make FCEO to be 10MHz. Appropriate LD current is about the value noted on the inspection sheet. Turn on FCEO LOCK switch⑫. FCEO signal is fixed to 10MHz.



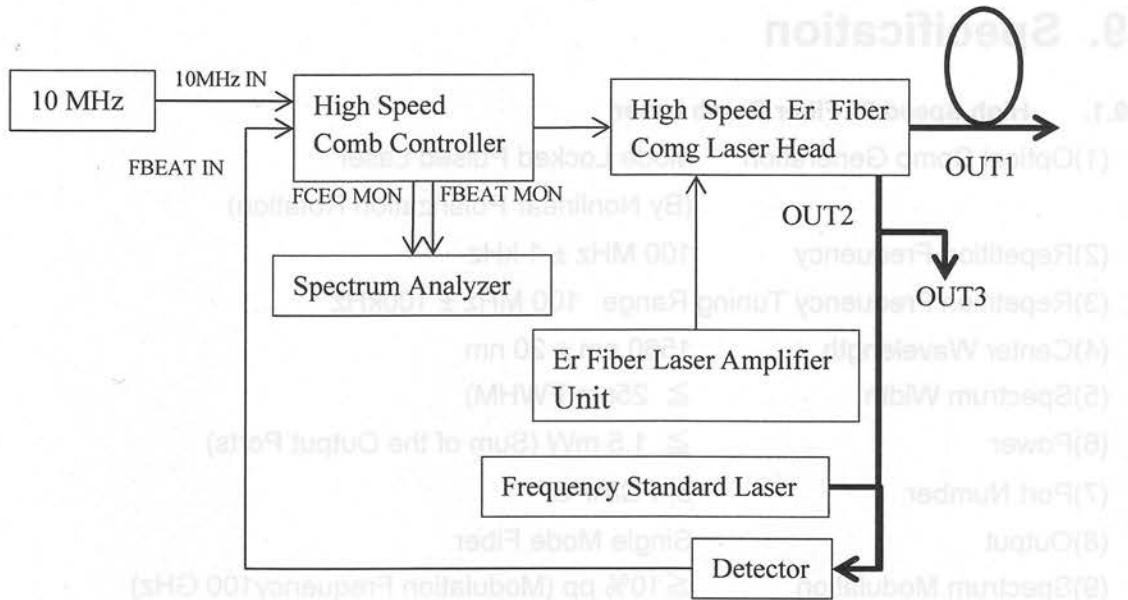
### 8.5. FBEAT and FCEO Control (High Speed Control)

The fiber comb frequency can be stabilized to a frequency standard and a standard laser with high speed servo control.

Prepare 10MHz frequency standard and a frequency standard laser.

- Connect a 10MHz frequency standard to the 10MHz IN connector⑳ on the rear panel of the controller. Frequency reference signal should be lower than 0 – 6dBm.
- Connect FBEAT signal to FBEAT IN connector on the rear panel of the controller.
- Turn HS FREP LOCK selector to HS mode. Turn LD CURRENT knob⑪ to make FCEO to be 10MHz. Turn on FCEO LOCK switch⑫. FCEO signal is fixed to 10MHz.
- Connect FBEAT MON connector⑥ to a spectrum analyzer. Turn PZT knob ⑬ to make fbeat signal to be 10MHz.
- Turn on FREP LOCK switch⑯. FBEAT signal is fixed to 10MHz, and the indicator turns to green.





### 8.6. Turning off the Laser

1. Turn off the frequency lock (FCEO, FBEAT, FREP).
2. Turn off the LD switch④ of LD FCEO driver and LD AMP driver of the amp unit. Turn off the power switch⑪ on the rear panel of the amp unit.
3. Turn off the LD switch⑫ of the controller. Turn off the power switch⑳ of the rear panel of the controller.

## 9. Specification

### 9.1. High Speed Er Fiber Comb Laser

- (1)Optical Comb Generation Mode Locked Pulsed Laser  
(By Nonlinear Polarization Rotation)
- (2)Repetition Frequency 100 MHz  $\pm$  1 kHz
- (3)Repetition Frequency Tuning Range 100 MHz  $\pm$  100kHz
- (4)Center Wavelength 1560 nm  $\pm$  20 nm
- (5)Spectrum Width  $\geq$  25nm(FWHM)
- (6)Power  $\geq$  1.5 mW (Sum of the Output Ports)
- (7)Port Number 3, FC/APC
- (8)Output Single Mode Fiber
- (9)Spectrum Modulation  $\leq$  10% pp (Modulation Frequency 100 GHz)

### 9.2. Er Fiber Laser Amplifier

- (1)Input 1560 nm  $\pm$  20 nm, FC/APC
- (2)Center Wavelength 1560 nm  $\pm$  20 nm
- (3)Spectrum Range  $\geq$  50 nm (FWHM)
- (4)Output Power  $\geq$  30 mW
- (5)Output Port 1, FC/APC
- (6)Output Single Mode Fiber

### 9.3. High Speed Controller

- (1)Repetition Frequency Stabilization External Microwave Signal
- (2)Repetition Frequency Monitor Signal Output BNC
- (3)Repetition Frequency Reference Signal Input BNC
- (4)CEO Frequency Stabilization No Frequency Division  
Servo Range  $\geq$  200 kHz,  
Carrier Signal S/N Ratio  $\geq$  75 dB  $\cdot$  Hz  
(By a spectrum analyzer, no cycle slip in one hour)
- (5)CEO Frequency Tuning Range  $\geq$  50 MHz (S/N30dB@300kHzRBW)
- (6)Stabilization to a CW Laser By an EOM in the Laser Cavity  
Servo Range  $\geq$  400 kHz  
Carrier Signal S/N Ratio  $\geq$  75 dB  $\cdot$  Hz  
(By a spectrum analyzer, no cycle slip in one hour)
- (7)CEO Frequency Monitor Signal Output BNC
- (8)CEO Frequency Reference Signal Input BNC
- (9)Stabilization Signal Input BNC

- \* 1 Specification 9-3(4) and (6) can be realized simultaneously.
- \* 2 An optical spectrum analyzer is required to mode lock adjusting.
- \* 3 Frequency standard and synthesizer (with frequency resolution <1Hz) is required to FREP stabilization.



**CONTACT INFORMATION**

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E-MAIL: [info@neoark.co.jp](mailto:info@neoark.co.jp)  
URL: [www.neoark.co.jp/english/](http://www.neoark.co.jp/english/)

**HEAD HEADQUARTER**

ADDRESS: 2062-21, Nakanomachi, Hachioji-shi, Tokyo, 192-0015 JAPAN

**TOKYO SALES OFFICE**

ADDRESS: Station Plaza Daitabashi 108, 2-17-6, Ohara, Setagaya-ku, Tokyo, 156-0041 JAPAN

**OSAKA SALES OFFICE**

ADDRESS: Heim Senba 201, 2-3-8, Kyutaroumachi, Chuo-Ku, Osaka, 541-0056 JAPAN

**FACTORY 1**

ADDRESS: 2062-21, Nakanomachi, Hachioji-shi, Tokyo, 192-0015 JAPAN

**FACTORY 2**

ADDRESS: 2073-1, Nakanomachi, Hachioji-shi, Tokyo, 192-0015 JAPAN