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External Cavity Tunable LD Module

ECL-200

OPERATION MANUAL

santec

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Notes to Users

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Introduction

Thank you very much for your having purchased our product, Wide-band Wavelength Tunable LD Light Source ECL Series.
This Operation Manual contains information necessary for the operation of ECL-200, and it is indented for those with sufficient knowledge enough to conduct the evaluation of laser danger and its safe control. Before operating ECL-200, you should first read thoroughly this Operation Manual and become familiar to its contents. After reading this Operation Manual, keep it at your fingertip for easy reference at any time.

NOTE !

The packing materials and box of this product are needed for long-term storage or transportation, therefore, keep them even after unpacking this product.

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General Description

Constitution of this Operation Manual and How to Read it
This Operation Manual should be read before operating ECL-200.
This Operation Manual consist of 14 chapters, and the contents of each are as follows:
Chapters 1 through 8 describe the outline of the product, notes on safety, and installation of the product.
Chapter 9 describes how to operate the product. Before reading Chapter 10, you should read the descriptions from Chapter 1 through Chapter 8.
Chapter 10 explains information on the communication function such as to control ECL from the outside.
Chapter 13 describes troubleshooting.
Chapter 14 describes modulation options.

NOTE !

Before using this product, read this Operation Manual first.
This instrument uses a semiconductor laser. Caution-Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

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Marking on the instrument



This indicates that caution is required. Please refer to the operation manual.



This indicates there is a danger due to laser radiation. Do not look directly at the laser beam or look at the beam by eye through any optical instrument.

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Explanation of Terms

The meanings of the following terms used in this Operation Manual are defined as below:

(1) Meaning



DANGER --- This indicates pressing DANGER, and if it is not avoided, personnel death or serious injury results, therefore, it is the most emphasized special information.



WARNING --- This indicates potential danger, and if it is not avoided, personnel death or serious injury may result, therefore, it is a special information.



CAUTION --- This indicates potential danger, and if it is not avoided, middle or slight injury may result, therefore, it is a special information. Or it indicates potential danger leading to only physical damage.



NOTE --- This indicates supplementary explanation of the text, and thus other information than DANGER, WARNING, and CAUTION.

(2) Importance of Information

From the above meanings, the priority of the terms here are as shown below:

DANGER > WARNING > CAUTION > NOTE

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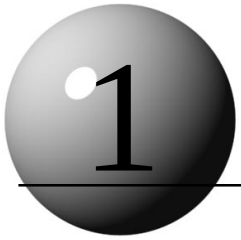
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Outline of Product

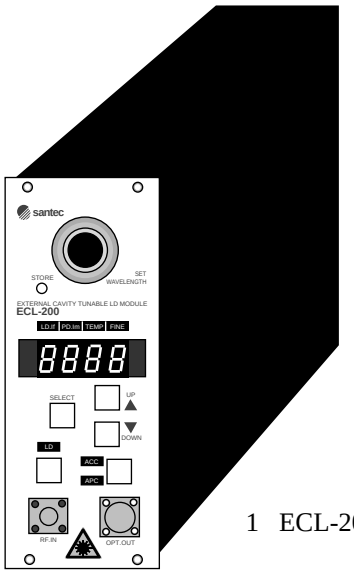
ECL-200 is a Manual Tunable LD Light Source Unit developed for multi light source on the basis of our technologies accumulated in our external cavity type semiconductor laser light source series.
ECL-200 is a wavelength stable light source wherein a light grid filter arranged inside of light source is wavelength standard type. High precision temperature control of the light grid filter to be the wavelength standard has realized highly stable wavelength and wavelength repeatability.
Up to eight channels of ECL-200 may be loaded on multi channel light source power source rack MLS-8000, which enables you to use ECL-200 as a light source to evaluate WDM communication and so forth.



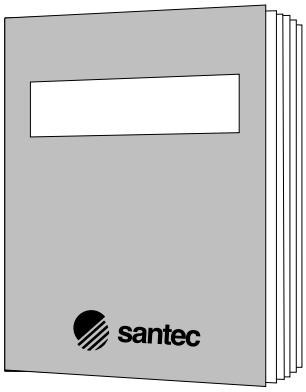
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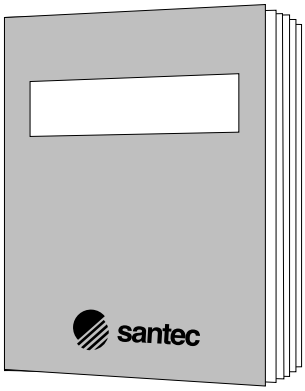
2 Configuration



1 ECL-200 mainframe 1 unit



2 Operation Manual (this document) 1 copy



3 Test Data 1 copy

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Specifications (Standard Specifications)

	Guaranteed value	Representative value
[Wavelength]		
Center wavelength	1550±10nm	1550nm
(Wavelength) Tuning range	> 70nm	100nm
(Wavelength) Tuning resolution	Rough adjustment : 100±5GHz (About 0.8nm)	100±5GHz (About 0.8nm)
	Fine adjustment : 0.01nm	0.005nm
(Wavelength) Repeatability	<±0.1nm *2	< ±0.01nm *2
(Wavelength) stability	<±0.01nm (30min)	< ±0.005nm (30min)
[Output Power]		< ±0.05nm (24h) *1
Output Power	> 4mW (1530～1570nm)	> 6mW (1530～1570nm)
(Output Power) Repeatability	< ±0.05dB *2	< ±0.05dB *2
(Output Power) stability	< ±0.05dB (30min)	< ±0.005dB (30min)
		< ±0.1dB (24h) *1
[Spectrum]		
Spectrum Linewidth	> 1MHz	> 1MHz
SSR	> 40dB	> 45dB
[Others]		
Communication	RS-232C	
Power source	±8V、0.7A, ±5V、2.0A	
Operating temperature range	25±5℃	
Maximum relative humidity	80%	
Polution class	2	
Laser safety class	3A	
Dimensions	51 × 280 × 129 mm	
Weight	1.5kg	

*1 : Referential value
*2 : Repeatability at power ON/OFF

Options

- Polarization maintaining fiber output
- FC-APC connector
- RF modulation function (scheduled)
- LF modulation function (scheduled)

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4 Principle of Operation

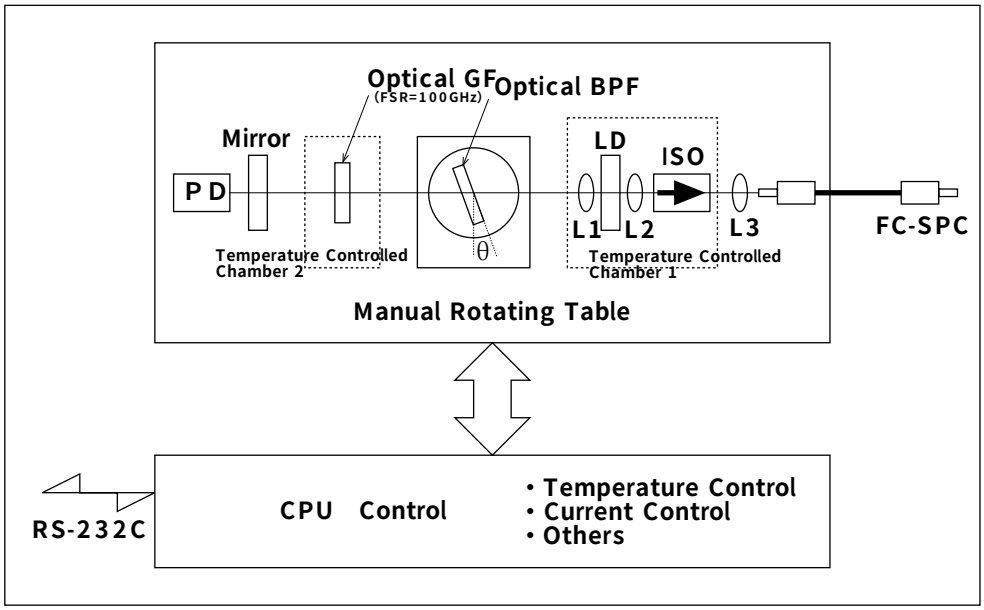


FIG.1 Structure diagram of ECL-200

FIG.1 shows the structure of ECL-200.

To the semiconductor laser (LD), employed is a Fabry-Perot type LD whose one end surface is coated by AR (anti reflection). In the LD block, an inside lens and output lens in an external cavity to configure an external cavity, and an isolator to prevent return light from the outside are arranged in a temperature controlled chamber (temperature controlled chamber 1), and temperature control is carried out by a Peltier element in a high precious manner.

The light injected from AR coated surface of LD is collimated by the external cavity inside lens, and its wavelength is selected by the optical band path filter (OBPF) and optical grid filter (OGF), and reflected by the external cavity mirror, and led from the AR coated surface to LD by the external cavity inside lens once again. When current is supplied into LD and the gain inside of LD becomes sufficient, laser oscillation is carried out by the external cavity.

The oscillation wavelength of ECL-200 is controlled by OBPF and OGF. Rough adjustment of oscillation wavelength may be carried out by tuning wavelength of OBPF at every OGF grid interval (about 100 GHz) (by the manual rotating table). And fine adjustment of the transmission wavelength may be made by adjusting the position of the wavelength grid through controlling the environmental temperature of OGF arranged on the temperature controlled chamber (temperature controlled chamber 2). The light injected from the external cavity laser goes through 2-step isolator that can restrict the return light by 60 dB and bounded to the optical fiber. The optical fiber is diagonally processed so as to prevent interferrence in fiber, and only connector for output employs SPC. (FC-APC connector, and polarization maintaining fiber output are available as options.) The monitor PD behind the external cavity mirror is used as monitor for optical output.

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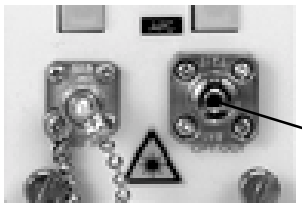
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5 Safety Notes and Safety Devices

Pay attention to the following for your safe operation without trouble in unit.

DANGER!!

This product employs a semiconductor laser. Laser beam may cause injury of your sense of sight, if it comes into your eye. It is very dangerous. Therefore, pay sufficient attention in handling it. And do not look into the light output terminal while the laser is operating.



CAUTION

To turn OFF this product:

1) In the case of use on the power rack MLS-8000
   It is necessary to turn OFF the main switch of the power rack MLS-8000.
2) In the case of use in single unit of ECL-200
   It is necessary to disconnect the external power cord. (Refer to Chapter 6.)

In the event of any of the following, make sure that the injection current of LD is 0, turn OFF the main switch, and then disconnect the power cord.

- Spilling liquid into this product
- Rain getting into this product, or excessive humidity
- Cleaning or moving this product
- Bedewing in this product

Pay attention always on the following:

- Avoid impact or shock.
- Keep this product away from water.
- Do not disassemble this product.
- Do not place anything on this product.
- Do not stuff up the ventilation hole or fan of this product.
- Avoid placing this product under direct sunlight.
- Avoid placing this product in a place full of dust, dirt, salt, corrosive gas.
- Avoid placing this product in a place subject to noise by electric field, magnetic field and so on.
- Avoid placing this product in a place subject to high temperature and high humidity.

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6 Installation

Pay attention to the following for your safe installation without trouble in unit.
This product is a high-precision device, so avoid placing it in the following places:

- Do not place in direct sunlight.
- Do not place under high temperature and high humidity.
- Do not place in an environment with dust, dirt, salt, or corrosive gas.
- Do not place in an area subject to large vibrations.
- Do not place in an area subject to noise by electric field, magnetic field, etc.
- Do not place in an area where the unit is subject to falling objects landing on it.
- Do not place with possible exposure to water.

6-1. In the case of use on the power rack MLS-8000

Before turning it ON, insert ECL-200 deeply into MLS-8000 along the guide rail.
Fix ECL-200 secure onto MLS-8000 with fixing screws at four corners of ECL-200 front panel.

> **NOTE**
> Read thoroughly the Operation Manual for MLS-8000, and follow the unit insertion procedures of MLS-8000.

6-2. In the case of use in single unit of ECL-200

ECL-200 may be used as a single unit by connecting external power source to the I/O connector (D-sub 25P) at the rear panel of the mainframe.

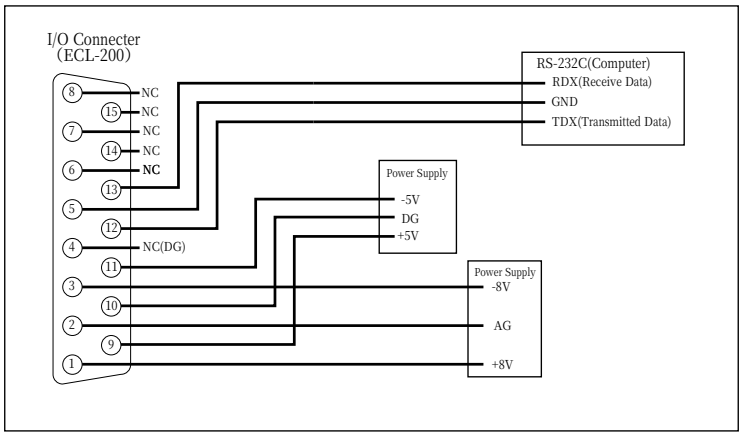


FIG. I/O connector connection

6-2-1. Production of connection cable

In reference to "FIG. I/O connector connection" and "I/O connector pin sign" in Chapter 7, produce a connection cable between external power source and computer for communication (RS-232C).

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CAUTION

Mistake in connecting cable may cause failure.

6-2-2. Cable Connection

Connect the ECL-200 mainframe and external power source by use of the produced connection cable.

NOTE

As external power source to be used, use a series power source with small noise for Å}8V supply. Use of switching power source, power source with noise for Å}8V supply may not allow sufficient characteristics.

CAUTION

Before attaching or detaching ECL-200 mainframe and external power source, be sure to turn OFF the external power source. Attaching or detaching while the external power source is turned ON may cause failure or damage.

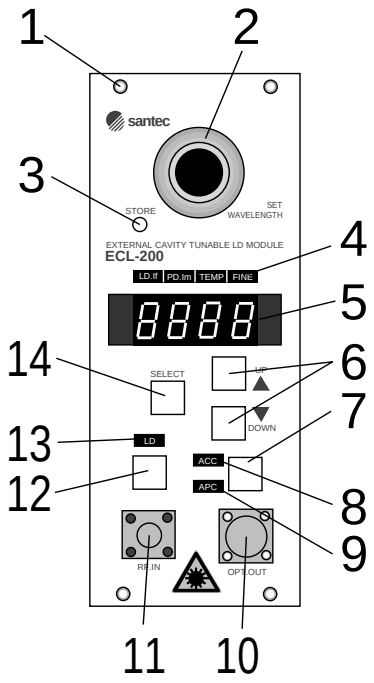
6-2-3. Turning Power ON

Refer to "9-1. How to Turn It ON".

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7 Descriptions of Panel Equipment

• **Descriptions of Front Panel Equipment**



(1) Fixing screw

This is the fixing screw to be used when to load ECL-200 onto the power source rack MLS-8000.

(2) Wavelength setting dial

Turning this dial enables rough adjustment of wavelength. (Refer to Chapter 8.) The division of the dial is optional, and is not correlated with the actual wavelength tuning amount. Lowering the lever at the right top of the dial causes the dial locked.

(3) STORE key

Pressing this switch causes each parameter setting value of the current ECL-200 to be memorized in the internal memory. When the unit is turned OFF once and then turned ON, the unit starts under the conditions memorized previously in the memory. To change the memorized conditions, press this key once again.

(4) Mode indication LED

The currently selected mode is indicated.
LD.lf mode : Setting / monitoring of LD injection current is available.
PD.im mode : Monitoring of PD current and setting of target value at APC are available.
TEMP mode : Setting / monitoring of LD environmental temperature is available.
FINE mode : Fine adjustment of ECL transmission wavelength is available. (Refer to Chapter 8.)

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(5) Numeric value display board

Set value / monitor value of the mode indicated on the mode indication LED is displayed.
When the mode indication LED currently selected flickers, set value is displayed, while it is lit on, monitor value is displayed.

(6) UP / DOWN key

This changes the set value of the mode currently selected. Change is available only when the current value is displayed on the numeric value display board (mode indication LED flickers).

(7) ACC / APC change key

This key switches ACC / APC. At this moment, LED at the right of the key (ACC, APC) is lit and the current status is displayed.

(8) ACC mode LED

When this LED is lit, it shows that LD drive mode is ACC mode.

(9) APC mode LED

When this LED is lit, it shows that LD drive mode is APC mode.

(10) High frequency signal input terminal (option)

SMA type adapter When the high frequency modulation function is optionally selected, this terminal becomes the input terminal of modulated signals.

(11) Optical output terminal

This is an FC type adapter, and its inside is SPC polished connector - single mode optical fiber. (FC-APC connector and polarization maintaining fiber output are available optionally.)

(12) LD drive key

This toggles ON/OFF the current to LD. When it is turned ON, the LD drive LED at the top of the key is lit. When power is supplied, current is not supplied to LD.
When to shut off power, be sure to shut off the LD.
Shutting off power while current is supplied to the LD may damage LD.

(13) LD drive LED

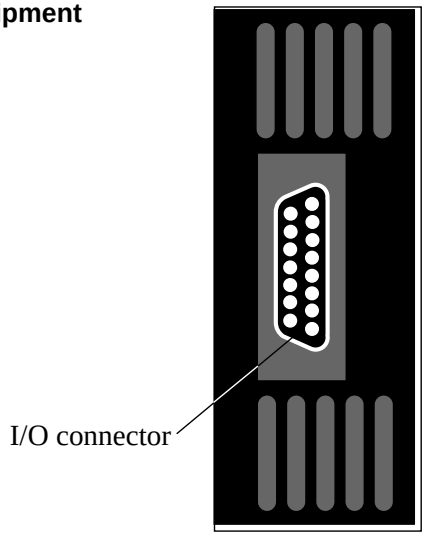
This LED indicates ON/OFF status of the current to LD and ON/OFF status of coherence control.
LED Off : Current to LD OFF, coherence control OFF
LED On : Current to LD ON, coherence control OFF
LED Flickering : Current to LD ON, coherence control ON

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(14) Mode SELECT key

Pressing this switch selects each mode in the order, LD.lf Å® PD.lm Å® TEMP Å® FINE Å® LD.lf ... At this moment, selected mode is displayed on the mode display LED. When a mode is changed, selected mode display LED flickers for a certain time (about 3 seconds), and the current set value is displayed on the numeric value display board. If there is no change in the set value in this period, the mode display LED is lit and the monitor value is displayed on the numeric value display board. And pressing this key over 3 seconds toggles ON/OFF the coherence control.

• Descriptions of Rear Panel Equipment



I/O connector (D-sub 25P)

Connection terminal for ECL-200 power supply and communication (RS-232C).

I/O connector pin sign

1 Analog power input
2 Digital power input

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8 Functions of This Unit

Wavelength Tuning Function

ECL-200, having two wavelength selection elements, an optical band pass filter and an optical grid filter, in its external cavity, has 2 kinds of wavelength tuning functions by controlling respective wavelength selection elements.

Rough adjustment function of transmission wavelength:
This is the function wherein the arrangement angle of the optical band pass filter is adjusted by the wavelength setting dial, the wavelength between transmission wavelength synchronized with the wavelength grid of the optical grid filter is changed. In this wavelength tuning function, it is possible to change frequency in wide range, but the minimum resolution of wavelength variable is limited by the grid interval of the optical grid filter 100 GHz.

Fine adjustment function of transmission wavelength:
This is the function wherein the environmental temperature of the optical grid filter is controlled by FINE mode, and the position of the wavelength grid of the optical grid filter is finely adjusted, thereby fine wavelength tuning is carried out. In this wavelength tuning function, the wavelength tuning range is up to 100 GHz (the interval of the optical grid filter grid), but the minimum resolution of wavelength tuning is available below 0.01 nm.

These two wavelength tuning functions enables wavelength setting in wide range and at high resolution.

LD Drive Current / Temperature Control Function

In order to keep the LD oscillation status stable, drive current and environmental temperature are controlled at high precision. As for the drive circuit, LD is driven by a constant current drive circuit with LD protective circuit. The temperature control circuit is controlled by digital PI control at high precision.

ACC/APC Function

This unit has two LD drive modes, ACC (automatic current control) and APC (automatic power control), and in APC mode, the current value of monitor PD is made as target. Switching ACC/APC is made by the switch at the front panel.

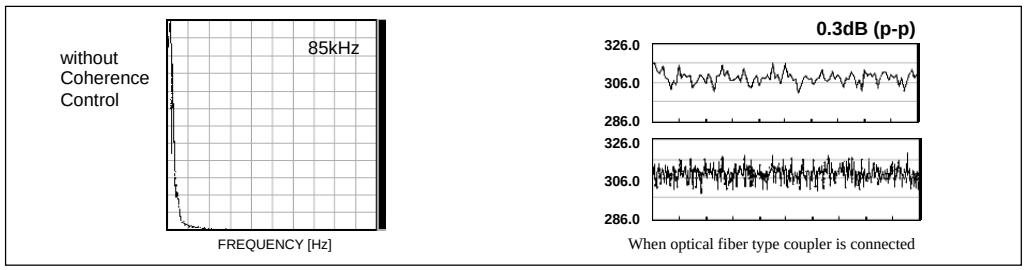
Set Parameter Memory Function

This is the function to memorize set parameters of this unit (LD drive current value, LD environmental temperature, APC target value, FINE mode set value). After setting respective parameters, pressing the STORE key causes the set parameters to be memorized in the internal memory. By use of this function, the unit operates according to set parameters memorized previously when the power is supplied again.

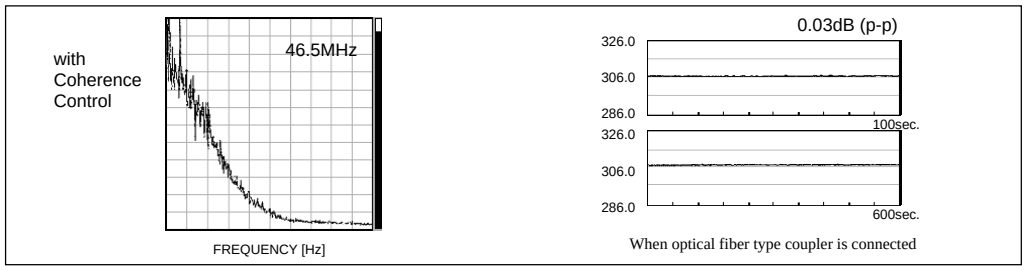
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Coherence Control

In external cavity LD, oscillated spectral line width is largely contracted compared with normal semiconductor. Spectral line width is one of the factors to determine light coherence, and the narrower the spectral line width, the more improved the coherence. Optical fiber may be said the most excellent propagation path from the viewpoints of optical mode, loss, and so on. In considering that light of several km order may be transmitted in optical fiber, if there is reflection point in optical fiber propagation system in short distance, light intensity changes within optical fiber by interference. The measurement example of light output stability and spectral line width in the case where optical fiber type coupler is connected at the output end of ECL is shown below:



ECL has the spectral line width 2-step control so as to configure a stable measurement system even in such a case. The light output stability at control and the measurement example of spectral line width are shown below:



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9 Fundamental Operation

9-1. Turning Power ON / Setting delimiter

9-1-1. Turning Power ON

1) In the case on power source rack MLS-8000

Turn ON the main switch of the power source rack MLS-8000.

If power is supplied to ECL-200 mainframe, each temperature control (LD, optical GF environmental temperature) starts.

In this unit, current is not supplied to LD while power is supplied.

2) In the case of use as single unit of ECL-200

Connect the connection cable to the I/O connector at the rear panel of the mainframe, and turn ON the switch of the external power source.

> NOTE
>
> As for the connection between the I/O connector and the external power source, refer to Chapter 6.

If power is supplied to ECL-200 mainframe, each temperature control (LD, optical GF environmental temperature) starts.

In this unit, current is not supplied to LD while power is supplied.

9-1-2. Setting delimiter

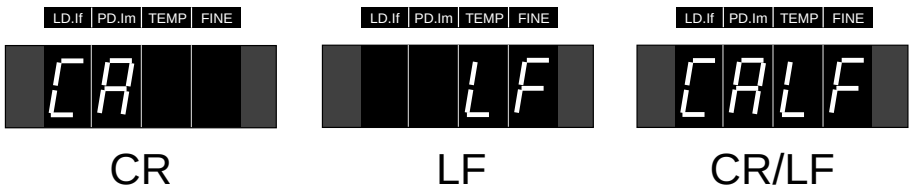
Setting of the communication delimiter is made when power is turned on.

More concretely:

- Press the UP key and turn ON power. : CR
- Press the DOWN key and turn ON power. : LF
- Press the UP/DOWN key and turn ON power. : CR/LF

If setting of the delimiter is not carried out when power is turned on, the previous setting conditions are maintained.

After turning power on, the delimiter setting conditions are displayed on the numeric value display board for a certain time (about 1 second).



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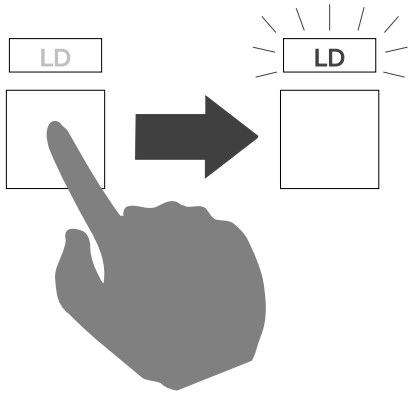
9-2. Driving LD

9-2. Driving LD

Turning ON/OFF the current to LD is carried out by the LD drive key at the front panel.

CAUTION

Before turning ON/OFF the power to the mainframe and switching ACC/APC, be sure to shut off the current supply to LD. Otherwise, LD may be damaged.



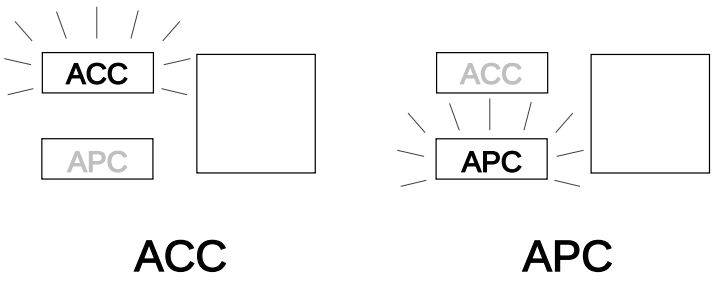
9-3. Switching ACC/APC

9-3. Switching ACC/APC

Switching ACC/APC is carried out by the ACC/APC switching key at the front panel.

CAUTION

Before switching ACC/APC, be sure to shut off the current supply to LD. Otherwise, LD may be damaged.

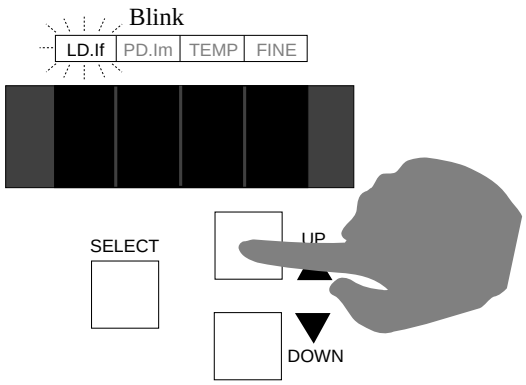


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9-4. Operation in each mode

9-4. Operation in each mode

Switching each mode (LD.lf, PD.im, TEMP, FINE mode) is made by use of the mode SELECT key at the front panel. At this moment, selected mode is displayed on the mode display LED.
Mode changes in the order, LD.lf Å® PD.lm Å® TEMP Å® FINE Å® LD.lf ...
When a mode is changed, selected mode display LED flickers for a certain time (about 3 seconds), and the current set value is displayed on the numeric value display board.
Only when the mode display LED is flickering, set values can be changed by use of the UP/ DOWN key.



NOTE

A certain time (about 3 seconds) after mode change, the indication of the mode display LED changes into lighting on.
While the mode display LED is lit, changing set values is not available.

Set values in respective modes may be set as shown below
LD.lf mode : 0 - 200 mA
Only when ACC mode is selected, setting numeric value is available.
PD.im mode : 0 - 9999µA(setting of APC target)
Only when APC mode is selected, setting APC target is available.
Set APC target within the setting limit of the current.
TEMP mode : 15.00 - 35.00 Åé
FINE mode : -100 - +100

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Example 1) Setting the LD input current to 100.0 mA

(1) Turn OFF the LD drive key.
(2) Select ACC by the ACC/APC switching key.
(3) Turn ON the LD drive key.
(4) Select the LD.lf mode by the mode SELECT key.
(Confirm that the mode display LED is flickering.)
(5) Set the UP/DOWN key so that the numeric value display board should indicate 100.0.

Example 2) Setting the APC target (monitor PD current value) to 500.0 μA

(1) Turn OFF the LD drive key.
(2) Select APC by the ACC/APC switching key.
(3) Turn ON the LD drive key.
(4) Select the PD.lm mode by the mode SELECT key.
(Confirm that the mode display LED is flickering.)
(5) Set the UP/DOWN key so that the numeric value display board should indicate 500.0.

Example 3) Setting the LD environmental temperature to 25.00 ºC

(1) Select the TEMP mode by the mode SELECT key.
(Confirm that the mode display LED is flickering.)
(2) Set the UP/DOWN key so that the numeric value display board should indicate 25.000.

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9-5. Coherence Control

9-5. Coherence Control

Turning ON/OFF the coherence control is carried out by use of the mode SELECT key. Pressing the mode SELECT key over 3 seconds causes the coherence control to get ON. Pressing the mode SELECT key over 3 seconds once again causes the coherence control to get OFF. When the coherence control is ON, the LD drive LED flickers.

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9-6. Setting wavelength

9-6. Setting wavelength

In ECL-200, there are 2 kinds of wavelength tuning functions, that is, rough adjustment function of transmission wavelength in reference to the grid interval of optical grid filter, and fine adjustment function of transmission wavelength to control the wavelength grid of optical grid filter.

As for the transmission wavelength of ECL-200, laser oscillation is made at wavelength wherein the selection wavelength of the optical band pass filter in the external cavity (adjustable by the wavelength setting dial) synchronizes with the wavelength grid of the optical grid filter (adjustable by FINE mode). (Refer to FIG. Lasing wavelength of ECL-200.)

Therefore, when the optical grid filter is fixed and the selection wavelength of the optical band pass filter is changed by adjusting the wavelength setting dial, the transmission wavelength of ECL-200 varies by the wavelength grid interval of the optical grid filter (100 GHz). This is the rough adjustment function of wavelength.

In the rough adjustment function of transmission wavelength, it is possible to change frequency in wide range, but the minimum resolution of wavelength tuning is limited by the grid interval of the optical grid filter 100 GHz.

While, when the environmental temperature of the optical grid filter is controlled by FINE mode and thereby the position of the wavelength grid of the optical grid filter is adjusted, it is possible to obtain wavelength that cannot be obtained by only adjusting the wavelength setting dial. This is the fine adjustment function of wavelength.

In the fine adjustment function of wavelength, the wavelength tuning range is up to 100 GHz (the interval of the optical grid filter grid), but the minimum resolution of wavelength tuning is available below 0.01 nm.

These two wavelength tuning functions enables wavelength setting in wide range and at high resolution.

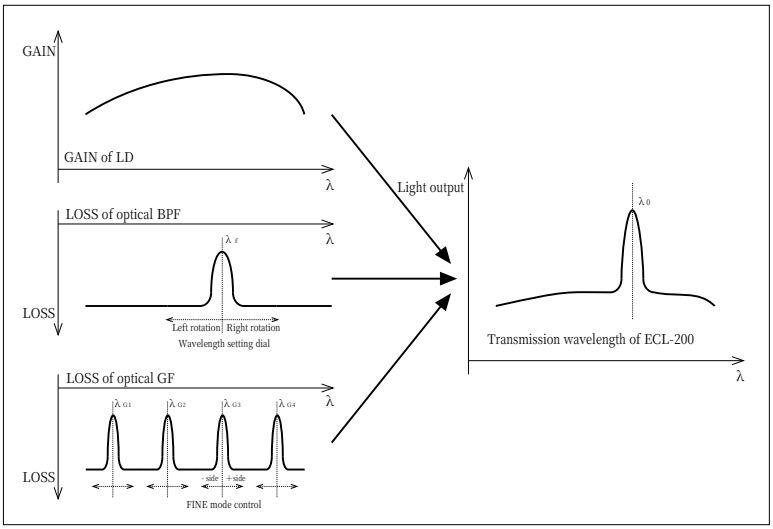


FIG. Lasing wavelength of ECL-200

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9-6-1. Rough adjustment function of wavelength

The rough adjustment function of wavelength is carried out by the wavelength setting dial at the front panel.

Turning this dial causes the wavelength of ECL-200 to vary between grids of the optical grid filter inside.
Turning the dial to the right (clockwise) causes the wavelength to change to long wavelength side, while turning it to the left (counterclockwise) causes the wavelength to change to the short wavelength side.

NOTE

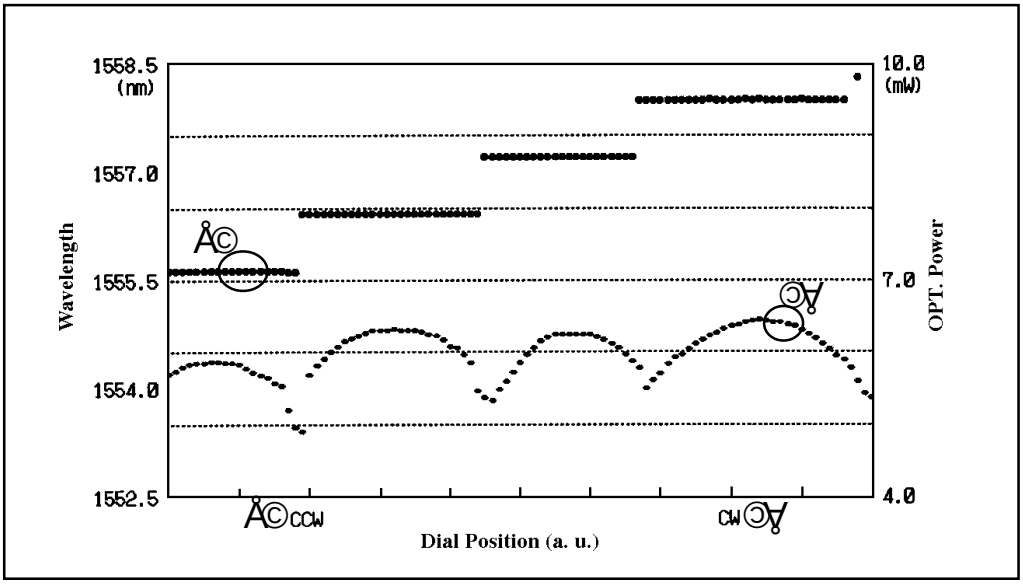
Turning the dial by 360 degrees makes the wavelength change about 10 nm.

CAUTION

The dial turns up to 15 rotations (window division 0 - 15). Turning it forcibly more than 15 rotations may damage it.

How to adjust

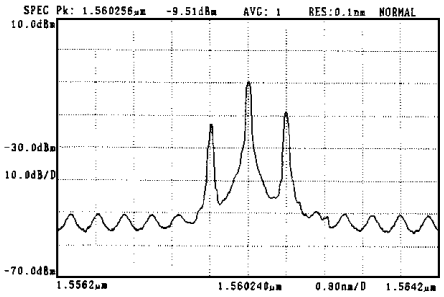
The adjustment of the wavelength setting dial makes the wavelength and light output of ECL-200 change as shown below.
At the position where the light output becomes maximum in an identical wavelength, the synchronized conditions between the optical band pass filter and the optical grid filter becomes best. Therefore, after setting the wavelength by the setting resolution 100 GHz, it is necessary to carry out fine adjustment of the dial so that light output should become maximum.



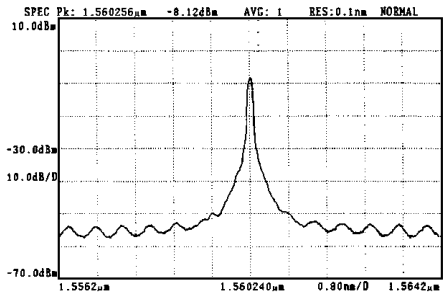
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NOTE

When multi-mode osciliation is carried out at desired wavelength by adjustment of the wavelength setting dial, it is considered because the adjustment of the internal mode of LD chip and the optical grid filter is not good. In this case, fine adjustment of LD environmental temperature within ±3 degrees (corresponding to the range to move the internal mode of LD chip by 1 FSR) make the adjustment with the optical grid filter better, and single mode osciliation is available.



LD. Temp =25 ºC



LD. Temp =23 ºC

Procedures

(1) Monitor the light output of ECL-200 by use of an optical wavelength meter or an optical spectrum analyzer.
(2) Turn the wavelength setting dial to set it to your desired wavelength
(at this moment, setting wavelength resolution is grid interval of optical GF).
(3) Finely adjust the wavelength setting dial so that the light output
(to be monitored by PD.lm mode or an optical power meter) should be maximum at the set transmission wavelength.
(4) Lock the wavelength setting dial.

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9-6-2. Fine adjustment of wavelength

The fine adjustment of wavelength is carried out by FINE mode and the wavelength setting dial. In FINE mode, the environmental temperature of the optical grid filter is controlled, and thereby the position of the wavelength grid of the optical grid filter is adjusted.
The movement amount of the wavelength grid filter by FINE mode is about -60 GHz - +60 GHz by -100 - +100.
The adjustment of the wavelength setting dial is used to re-synchronize the selected wavelength of the optical band pass filter that will become out of tune owing to the movement of the wavelength grid position.

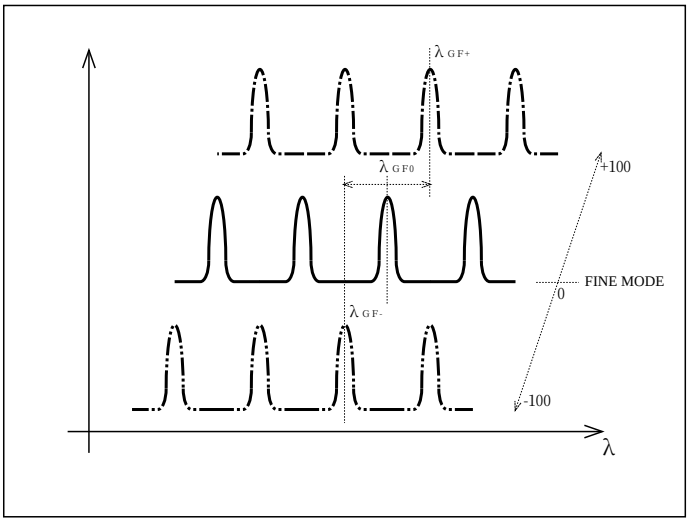


FIG. Adjustment of optical grid filter by FINE mode

How to adjust

By use of the wavelength setting dial, adjust the wavelength of ECL-200 adjacent to the target wavelength. Move the position of the wavelength grid by adjusting FINE mode, and adjust the wavelength of ECL-200 to the target wavelength. At this moment, it is necessary to adjust the selected wavelength of the optical band pass filter to the moved wavelength grid by finely adjusting the wavelength setting dial.

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NOTE

If the optical band pass filter is not synchronized with the moved wavelength grid, mode hop or multi mode transmission may be carried out to the adjacent wavelength grid.
When to move the wavelength grid in FINE mode, be sure to always synchronize the optical band pass filter.
When synchronization of the optical band pass filter is made and multi-mode transmission is carried out at desired wavelength by adjustment of the wavelength setting dial, it is considered because the adjustment of the internal mode of LD chip and the optical grid filter is not good. In this case, fine adjustment of LD environmental temperature within ±3 degrees (corresponding to the range to move the internal mode of LD chip by 1 FSR) make the adjustment with the optical grid filter better, and single mode transmission is available.

Procedures

(1) Monitor the light output of ECL-200 by use of an optical wavelength meter or an optical spectrum analyzer.
(2) Turn the wavelength setting dial to set it to your desired wavelength.
(3) Select FINE mode by the mode SELECT key. (Confirm on the mode display LED.)
(4) Adjust the wavelength to the desired one by the UP/DOWN key.
(5) Finely adjust the wavelength setting dial so that the light output (to be monitored by PD.lm mode or an optical power meter) should be maximum at the set transmission wavelength.
(6) Lock the wavelength setting dial.

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9-6-3. How to set transmission wavelength of ECL-200

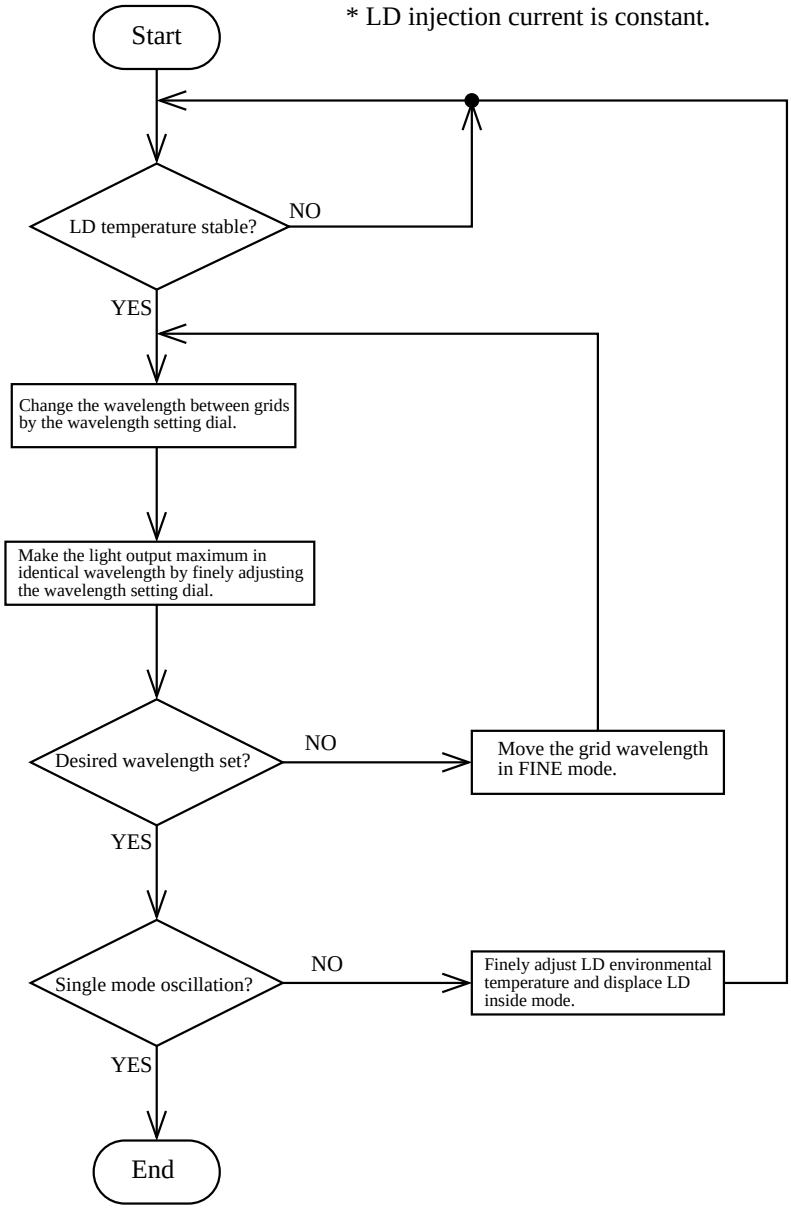


FIG. How to set the wavelength of ECL-200

NOTE

In the case of large change in supplied current, make sure the wavelength.

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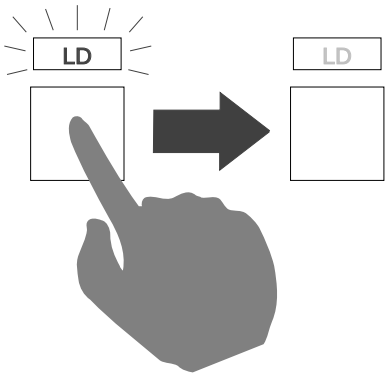
9-7. How to shut power OFF

9-7. How to shut power OFF

1) In the case of use on power source rack MLS-8000

Press the LD drive key to shut off the supplied current to LD.

Make sure that the LD drive LED goes out, and turn OFF the main switch of the power source rack MLS-8000.



CAUTION

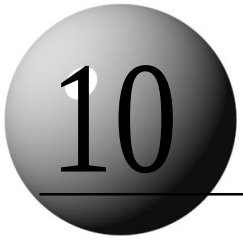
When to shut power off, be sure to shut off the current supplied to LD.
If power is shut off while current is supplied to LD, LD may be damaged.

2) In the case of use as single unit of ECL-200

Press the LD drive key to shut off the injection current to LD.

Make sure that the LD drive LED goes out, and turn OFF the switch of the external power source.

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10 Communication

A single unit of ECL-200 supports RS-232C for communication function, and it enables to control it from the outside.

NOTE

In the case of use on MLS-8000, the communication method follows the communication (GP-IB) of MLS-8000. Read thoroughly the operation manual for MLS-8000, and follow the communication functions of MLS-8000.

10-1 RS-232C

1) Outline

RS-232C was originally designed to connect a data terminal device and a modem, and it requires power source larger than the power source 5V which is used in current personal computers, and it also requires minus power source. But, today most of personal computers are equipped with RS-232C, which requires only 3 lines, hence it is easy to handle.

2) How to Use

The basic lines needed for communication are 3 lines, namely, data send line, data receive line, and ground line, and between devices to be connected, receive line is connected to send line. Besides the above, there are control lines to show whether data communication is available or not, and to know the operating condition of devices, but these are connected internally for communication. However, when to interrupt communication, to transmit data in long distance, or to transmit data at high speed, then appropriate lines for these purposes are necessary.
Mismatch in communication conditions prevents current communication even after correct connection of devices. Communication conditions include communication method, baud rate, data length, stop bit, parity check, X control, delimiter, and so on.

10-2 RS-232C of ECL-200

RS-232C of ECL-200 employs the most simple 3-line communication method. When to connect it to a computer, connect TDX to the receive line of ECL-200, connect RDX to the send line of ECL-200, and connect ground line to SG, and short-circuit 4 terminals RTS, CTS, DSR, and CD at computer side. To make the communication of command and data precise, send back echo back after execution of command.

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1) Communication Conditions

Communication conditions of ECL-200 are fixed, so cannot be changed. Communication conditions of ECL-200 are as follows:

Start-stop	Full duplex
Baud rate	9600 bps
Data length	8 bit
Stop bit	1 bit
Parity	None
X control	None

2) Command, Data, Delimiter

Command consists of 2 alphabetical letters, irrespective of upper or lower case. When to input data, input numeric value data following command. When it receives a correct command, it echoes back 2 letters of command irrespective of data presence or absence. But when a wrong command is received, ECL-200 outputs "NR".

It always confirms echo back and controls to make communication of command and data precise.

To take out data from ECL-200, command for takeout without data of echo back is prepared.

Delimiter may be set to CR, LF, CR/LF.

As for the setting method, refer to "9-1-2. Setting delimiter".

3) RS-232C connecting terminal

RS-232C connecting terminal of ECL-200 is at the I/O connector.

As for the connection of the communication line, refer to FIG. Connection of I/O connector.

I/O connector pin sign

1	Analog power source
2	Digital power source

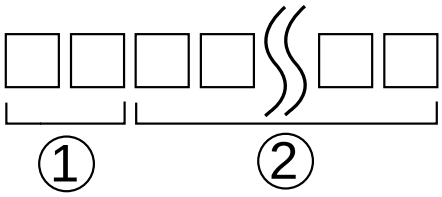
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10-3. Communication control

1) Commands

As for commands, there are ones to change internal conditions, and ones to change output data and control data. When to change output data, send only command of 2 alphabetical letters. When to change control data, send numeric data following command of 2 alphabetical letters. At this moment, output data is changed at the same time. After sending out command, RS-232C echoes back 2 alphabetical letters after sending command irrespective of data presence or absence. (DI and SU commands are exceptions.)

The command and format of data are shown below:



(1) Command of 2 alphabetical letters to ECL-200

(2) Data in the case when data is added to command, or expanded portion of command

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List of Commands

Command	Contents	Message type
LF	Cuts the current supplied to LD.	LF
LO	Supplies the current to LD.	LO
WA	1) Sets output variable to current. 2) Sets injection current to numeric data added to command. Unit is mA.	1, CU 2, CU X X X . X
AF	Changes over control mode to ACC mode.	AF
AO	Changes over control mode to APC mode.	AO
AT	1) Sets output variable to APC target. 2) Sets APC target to numeric data added to command. Unit is É A.	1, AT 2, AT X X X X
IM	Sets output variable to monitor current value.	IM
TL	1) Sets output variable to LD temperature. 2) Sets LD environmental temperature to numeric data added to command. Unit is Åé.	1, TL 2, TL X X . X X
FI	1) Sets output variable to FINE mode set value. 2) Sets FINE mode set value to numeric data added to command.	1, FI 2, FI X X X X
ST	Memorizes the current set parameters into the internal memory.	ST
SU	Sets output variable to status. Does not echo back.	SU
DI	Non echo command to receive data by RS-232C. When this command is sent, and data is requested, data of the command that has been executed previously is output.	DI
CO	Turns ON the coherence control.	CO
CF	Turns OFF the coherence control.	CF

2) Taking Out Data

When a command is executed, it echoes back. When a wrong command is received, ECL-200 outputs "NR", but when it receives a correct command, it echoes back 2 letters of command. Then it sends non echo back command "DI" for data request, and when data is requested, the data of the command that has been executed is selected and output. ECL-200 outputs the current data at data request until the next output data change command is received.

For example, so as to take out the injection current data, the injection current command "CU" or command with addition of data "CU100" is sent. After confirmation of echo back of the command that has been executed, command "DI" is sent and at data request, the injection current value is sent back.

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NOTE

In the case of use of ECL-200 loaded on the power source rack MLS-8000, communication gets in the communication method (GP-IB) of MLS-8000, and there is no echo back by execution of command. Accordingly, there is no need to use "DI" command so as to take out data.
After command execution, when data is requested, the current command data may be taken out until the next command execution.

3) Status

The status of ECL-200 is represented by a code and 6-digit 0 or 1. Status can be taken out by communication SU command, and each status may be confirmed by the display panel and LED on the front panel. The contents of each digit and code are shown below.

(code) - (minus) or non
- (minus) shows that current is supplied to LD.
(6th digit) 1 or 0
Not in use currently
(5th digit) 1 or 0
Not in use currently
(4th digit) 1 or 0
1 shows COH ON, while 0 shows COH OFF.
(3rd digit) 1 or 0
1 shows that LD block temperature control is out of the range ±0.1 degree to the set value.
(2nd digit) 1 or 0
1 shows that LD current driver has reached hard limit.
(1st digit) 1 or 0
1 shows that the temperature of optical grid filter is now under control in FINE mode.
Example) "-001001"
-001001 shows that current is supplied to LD, it is in APC mode, and LD temperature is stable, and injection current is within the control current range of LD driver, and the temperature of the optical grid filter is now under control in FINE mode.

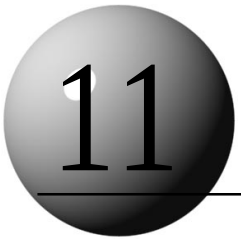
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10-4 Sample Program

Here is a sample program written in N88BASIC by NEC-9800 series.
This program steps the injection current from 0 to 150 mA in unit of 1 mA, and reads the monitor current value. This program assumes that all the required communication conditions such as delimiter are already set.

1000	OPEN "COM1:N81N" AS Âî1	RS-232C line file open, communication type setting
1010	PRINTÂî1,"AF"Â@	Changes into ACC mode.
1020	INPUTÂî1,ANS$Â@	Waits for echo back.
1030	PRINTÂî1,"LO"Â@Â@	Supplies current to LD.
1040	INPUTÂî1,ANS$Â@	Waits for echo back.
1050	FOR I=0 TO 150 STEP 1	Varies the injection current from 1 to 150 mA by 1 mA.
		Reads monitor current.
1060	PRINTÂî1,"CU"+STR$(I)Â@Â@	Sets the injection current.
1070	INPUTÂî1,ANS$Â@Â@Â@Â@Â@Â@Â@	Waits for echo back.
1080	PRINTÂî1,"IM"Â@Â@Â@Â@Â@Â@Â@	Sets output variable to monitor current.
1090	INPUTÂî1,ANS$Â@Â@Â@Â@Â@Â@Â@	Waits for echo back.
1100	PRINTÂî1,"DI"Â@Â@Â@Â@Â@Â@Â@	Reads output variable without echo back.
1110	INPUTÂî1,MON$Â@Â@Â@Â@Â@Â@	Reads monitor current.
1120	NEXT	
1130	ÂLE@Â@Â@Â@Â@Â@Â@Â@Â@Â@Â@	Closes RS-232C line.
1140	STOP	

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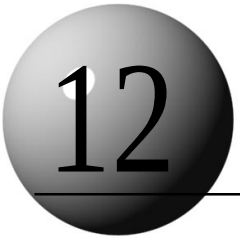
11 Maintenance

Daily Maintenance

As for daily maintenance, turn the unit off, disconnect the power source cord, and wipe the unit with dry and soft cloth. Do not use any chemical (acetone, alcohol, liquid cleanser). Otherwise, painting may be damaged. And, do not wipe the display panel excessively. Otherwise, failure may result.

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12 Long-term Storage

Here are some instructions on long-term storage of this product.

NOTE

Recycling the packing materials will help repackage this product, so keep the packing materials.

Notes before Storage

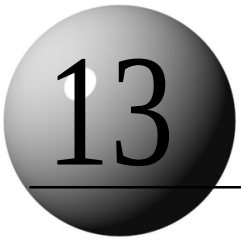
1) Wipe away dust, dirt, finger print, other stain on this product.
2) Use the packing materials for packing.
3) Avoid storing this product in the following places:
   - Place subject to direct sunlight
   - Place under high temperature and humidity
   - Place full of dust, dirt, salt, corrosive gas
   - Place under vibration
   - Place subject to noise from electric field, magnetic field, etc.

Note on Transportation

This product is a high-precision device, so avoid any shock or impact, and observe the above notes before storage prior to transportation.

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13 Troubleshooting

WARNING!

In the event of any trouble with this product, turn the unit off in accordance with the procedures to shut off the power described in this operation manual, disconnect the power source cord, make sure the product name and serial number described on the name plate of the product, and then contact our dealer at your place or directly contact us at Santec Photonics Laboratories. Our telephone number and facsimile number are shown below. However, we are not responsible for any trouble arising from your own repair or modification on this product.

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