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EXTERNAL CAVITY
TUNABLE LD LIGHT SOURCE

ECL-210

Operation Manual

santec

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About This Manual

This manual explains the operation and safety features of the ECL-210 External Cavity Tunable LD Light Source. To ensure the safe operation of the instrument, and to prevent the risk of personal injury and/or damage to the equipment we recommend that you read the manual fully before commencing installation and operation. In particular Chapter 6 outlines the precautions necessary to ensure safe operation. The following safety symbols are used throughout the manual and on the equipment to indicate safety related information.



This indicates a dangerous procedure that could result in serious injury or death if not performed properly.



This indicates a hazardous procedure or danger that might result in injury or that could damage the equipment if proper precautions are not taken.



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.



This mark is used on the equipment as a warning of danger.

Packing Materials

The original packing materials are required to ensure the safe long term storage and safe transportation of this equipment. It is recommended that all packing materials are kept for these purposes.

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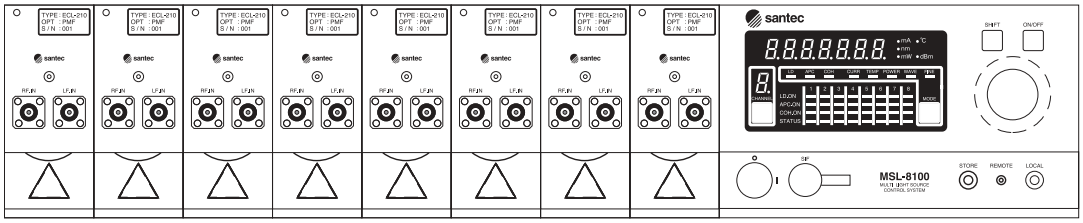
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1 Introduction



The ECL-210 is an electronically tunable multi-channel LD light source. It utilizes Santec's considerable expertise in external cavity type tunable semiconductor laser design, and in particular uses an interference filter in the external cavity for wavelength control and selectivity.

Wavelength and optical power can be set up by simple operation compared with usual manual tuning method. With the growth of the telecommunications industry, there is a need for tunable light sources to evaluate EDFA, and DWDM. Santec designed the ECL-210 to meet this need with a unit that has precise wavelength tuning accuracy, excellent wavelength and power stability, and high optical output power. Used as a stand-alone unit or as part of a larger test system, the ECL-210 is the excellent choice as a tunable light source to use in optical research and development, inspection, production testing.

The ECL-210 is wavelength stable light source which utilizes both a wavelength selecing and a wavelength locking filter filter inside the unit. High precision temperature control of wavelength locking filter enables extremely high wavelength stability and repeatability to be achieved.

To operate the ECL-210 the unit needs to be installed in either the MLS-2100 or MLS-8100 Rack. These racks provide a power supply and the control electronics for operation. The MLS-2100 is a two channel rack and the MLS-8100 allows up to eight channels to be used simultaneously.

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Specifications

2-1 ECL-210 standard specification

Specification

parameter	Unit	Min.	Spec.	Max.	Note
Wavelength					
Tuning range	nm	1530	-	1610	
Minimum tuning	nm	80	-	-	
Resolution	nm	-	-	0.024	<0.001nm When using fine tuning
Accuracy	nm	-	-	0.1	
Repeatability	nm	-	-	0.01	Number of times of measurement n=50, Measured at center wavelength
Stability	nm	-	-	0.01	1 hour, Measured at center wavelength
Fine tuning range	GHz	200	-	-	1.6nm(Typ.)
Power					
Maximum output power	mW	8	-	-	
		6	-	-	Minimum output power between a certain 40nm
		4	-	-	Minimum output power
Accuracy	%	-	-	5	
Repeatability	dB	-	-	0.01	Number of times of measurement n=50, Measured at center wavelength, +6dBm
Stability	dB	-	-	0.01	1 hour, Measured at center wavelength, +6dBm
Flatness	dB	-	-	0.2	Measured at +6dBm
Buit in attenuator	dB	0	-	20	Resolution: 0.04dB (Typ.)
Environmental condition					
Operating temp. range	°C	20	-	30	
Operating humidity range	%	-	-	80	No condensation
Storage temp. range	°C	10	-	40	
Storage humidity range	%	-	-	80	No condensation
Recalibration period	Year	1	-	-	Recommended
Spectrum					
Spectrum line width	MHz	-	-	0.2	Coherence control OFF
		0.2	-	200	Coherence control ON
SSR	dB	50	-	-	50dB(Typ.)
Interface					
Optical connector	-	-	FC	-	
Optical fiber	-	-	SMF	-	SM, 10/125-UV/UV-250
Connector polish	-	-	SPC	-	Supoer polish connector
RS-232IF	-	-	Yes	-	
LF Modulation					
Modulation range	KHz	0	-	10	Measured at -3dBm
Input level	V	-1	-	1	
Modulation coefficient	mA/V	-	100	-	
Input impedance	KW	-	4.7	-	
Modulation input	-	-	SMA	-	Input from the rear panel
Power supply					
Laser safety class	-	3A			
Dimensions					
Width, Height, Depth	mm	35,85,350			Excludes the projection
Weight	kg	0.5			

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Optiona List

parameter	Unit	Min.	Spec.	Max.	Note
Wavelength					
Tuning range	nm	1290	-	1360	Maximum tuning range: >70nm
		1430	-	1460	Maximum tuning range: >80nm (choose from 1430~1640nm)
Power					
Maximum output power	mW	10	-	-	High power output
Interface					
Optical connector	-	-	SC	-	
Optical fiber	-	-	PMF	-	SLOW axis, Polarization extinction ratio>17dB,Polarization angle error<10°
Connector polish	-	-	APC	-	Angled polish connector*1
RF Modulation					
Modulation range	MHz	1	-	100	Measured at -3dB
input level	dBm	-	-	+0	
Input impedance	W	-	50	-	
Modulation input	-	-	SMA	-	Input from the front panel

*1: Face of ferrule: SS-CS-001A FH(Protrusion): -100~100nm / ROC(Spherical radius): 5~12nm / AA(Polish angle): 7.7~8.3° / AO(Elleptical center): ≤50μm / Key error: -0.5~0.5°

NOTE

The warranty for ECL-210 is one year. We recommend to have ECL-210 inspected and calibrated regularly (once a year recommended).

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2-2 MLS-2100 standard specification

Item	Unit	Min.	Standard	Max.	Remarks
Slot	-	-	-	2	-
I / F	-	-	-	-	GP-IB
Voltage	V	90	-	250	Switch type
Frequency	Hz	48	-	62	-
Max. Power	W	-	-	50	2 Units
Dimentions	mm	-	230X412X88	-	WXDXH
Weight	kg	-	6	-	Without Units

Options

Black cover panel
Ear for standard rack mount
CP-10E (Control Key Pad)

2-3 MLS-8100 standard specification

Item	Unit	Min.	Standard	Max.	Remarks
Slot	-	-	-	8	-
I / F	-	-	-	-	GP-IB
Voltage	V	90	-	250	Switch type
Frequency	Hz	48	-	62	-
Max. Power	W	-	-	400	8 Units
Dimentions	mm	-	442X412X88	-	WXDXH
Weight	kg	-	8	-	Without Units

Options

Black cover panel
Ear for standard rack mount
CP-10E (Control Key Pad)

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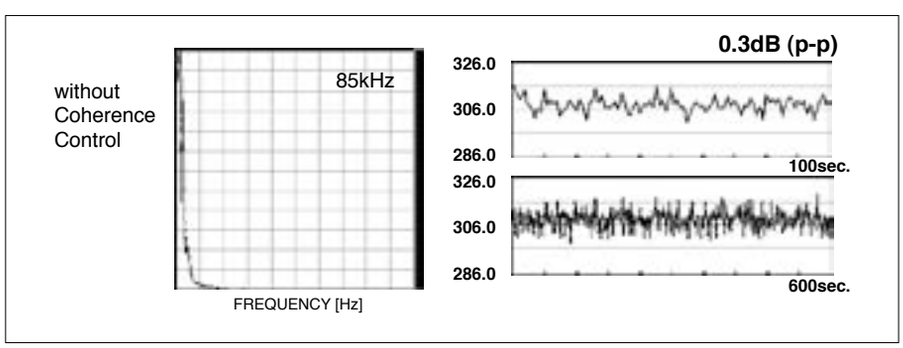
3 Features

3-1 Tuning Wavelength

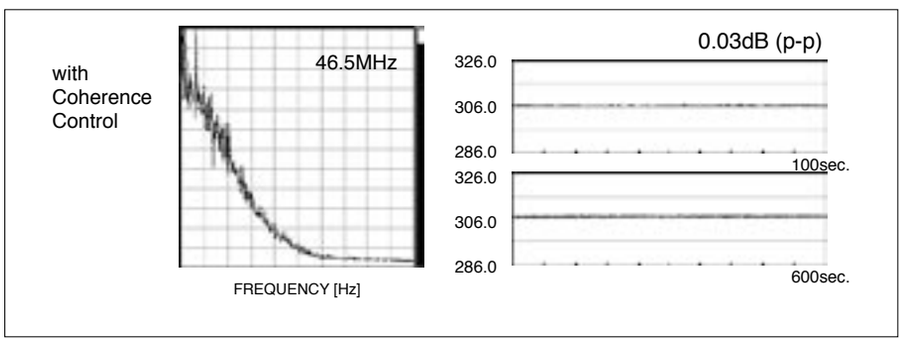
The oscillation wavelength can be widely tuned by controlling the loss against the components in selecting wavelength inside of external cavity module. The way of ECL selecting wavelength is to make the two independent OBPF and FLF work together. The excellent selectivity of FLF enables the wavelength of LASER to be locked automatically. This high-precise FLF control achieves superior wavelength accuracy, stability, and repeatability. OBPF and FLF are controlled by the control circuit in ECL, and those can be easily operated by setting target wavelength from external through MLS. For a small amount of wavelength rectification after setting wavelength, it is possible to set fine tuning independently.

3-2 Coherence Control

The oscillated spectrum linewidth of the ECL-210 is fairly narrow in comparison with normal semiconductor lasers. Spectrum linewidth is one of the factors that determines light coherence, and the narrower the spectrum linewidth, the more improved the coherence. Considering the length of fiber used or the complexity of some test set-ups, there is the possibility that within the length of fiber in the test set-up there is a reflection point in the optical fiber transmission system, optical output power changes within the fiber due to interference. To combat this, the ECL-210 is equipped with a Coherence Control.
Coherence control is radio frequency modulation against the external cavity module, and the spectrum line width of the narrow sense isn't expanded. However, it effects very much for the oppression of Brillouin scattering occurred with high optical power and optical power vacillation by interference in fiber. ECL is equipped with coherence control function for structuring a stable system on a few residual reflection points and high optical power. The coherent control enables to control ON/OFF and adjust the level.



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The measurement example of optical power stability and spectrum line width are shown below. Those are when connecting optical fiber type 3dB coupler to ECL output terminal. The open terminal of optical fiber is a connector with SPC and the rate of reflection here is approximately 4%.

3-3 LD injection Current, Control of Circumstance Temperature

To keep a stable oscillating condition of the semiconductor laser, the ECL precisely controls injection current and adjusts for ambient temperature change.

3-3-1. Control of LD Injection Current

The drive circuit with LD protection drives the injection current, and APC circuit etc. by digital PI control adopting optical power monitor signals against the circuit. When it reaches to a hardware limit, the current is clipped and the status LED of MLS is lit. Also, it is possible to control the current for the drive circuit by voltage signals from external. (Refer to 9-13. Low Frequency Modulation)

3-3-2. Control of Circumstance Temperature

The high precise digital PI control of LD block enables stable temperature. When the temperature control is unstable too, the MLS status LED is lit. The detail information of each unit can be recognized with communication commands.

NOTE

The protection circuit is also equipped with this system and each unit against abnormal voltage input.

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13-4 Precise Optical Power Control

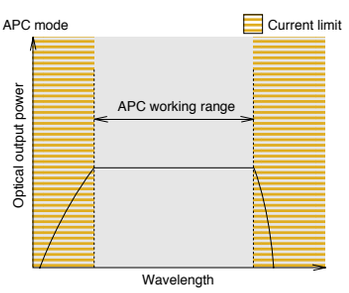
ECL has two modes to control optical power: Automatic Power Control (APC) mode, and Automatic Current Control mode.

3-4-1. High precise Optical Power Monitor

ECL has machinery monitoring divergently a part of light, to monitor optical output, using optical fiber coupler of low loss and wavelength independent type. ECL does wavelength sensitivity compensation, linear compensation of optical detector, cascade gain amplifier control.

3-4-2. APC Mode

In APC mode, ECL feedbacks this high precise optical power monitor signals, and controls optical power automatically by digital PI control. When APC mode is active and wavelength is reset, almost same optical power can be seen. Note that in a oscillation wavelength, the set optical power may not be able to achieve, even if the injection current is driven to the current limit.



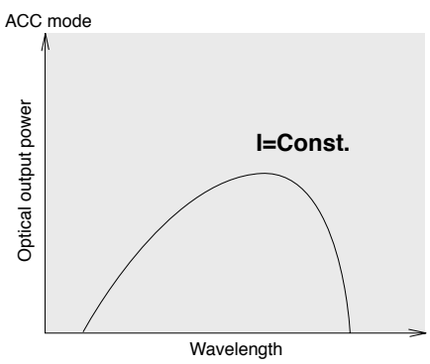
NOTE

Water molecule absorbs light in 1300nm~1500nm and the output power decreases when measuring with optical spectrum analyzer. It is impossible to avoid it because it is a physical phenomemon. We recommend to use ECL-210 in the condition with the extremely low humidity or avoid the water absorption points.

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3-4-3. ACC Mode

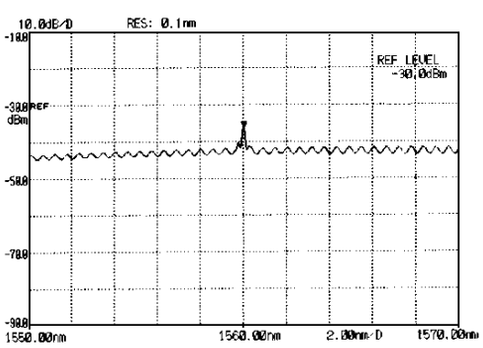
In ACC mode, ECL controls with set current in advance. It is possible to stabilize optical power by adding the feedback signals from external optical power criteria into low frequency modulation terminal. Note that optical power may fluctuate extremely depending on external modulation signal input.



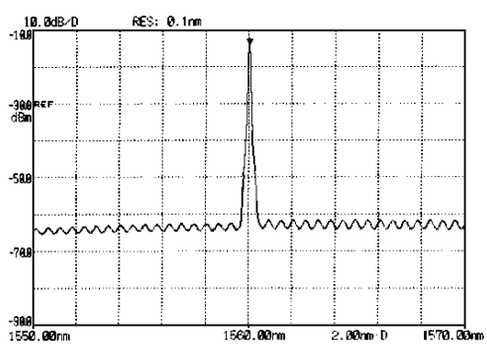
3-5 Built-in Attenuator

3-5-1. Introduction

By adopting an external cavity structure the product has maintained various semiconductor laser features. In particular this structure makes it possible to tune the wavelength of the laser light. However, the optical output power is controlled by tuning the LD injection current. This causes a change in the optical path length in the LD that can consequently cause an optical wavelength shift or cause difficulty in maintaining adequate SSR (side-mode suppression ratio). To counter these problems, a tunable attenuator (ATT) is fitted on the output side of the external cavity. The data below shows a comparison of the spectrum of the output signal with the output power set to -15dB with and without the attenuator.



Without ATT



With ATT

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3-5-2. Features and Principle Structure

The feature is the ability to reduce the optical output power loss from installing a variable attenuator in the optical test set-up. By including an internal ATT, variable attenuation is realized with a minimum of optical power loss when compared with an external attenuator set-up. An attenuator is made of a mechanically tunable graded ND filter. It can be tuned continuously with the resolution of 0.1dB within 0 to 20dB attenuation range.

3-5-3. Control Method

ATT option is not designed to frequently control the attenuation level. Both manual control and automatic control are available and these modes can be set using the external communication port.

1) Manual Control
Manual control of ATT is initially active when the unit is operated in ACC mode. It directly controls attenuation by setting parameter from the MLS front panel or via the external communication.

2) Automatic Control
Automatic control of ATT is initially active when the unit is operated in APC mode. When APC is in operation and the APC target value changes, if the current reaches its upper limit, the lower attenuation level is selected. If for some reason the APC target value setting is not achievable, the previous attenuation setting is used.

3-5-4 Control Method of Use

1) Manual Control Mode (ACC mode)
Manual control is possible using the external communication interface. Switch to manual control mode when the unit is operated in ACC mode or with external low frequency modulation. ATT is set to 0dB if APC mode is switched to ACC mode while automatic control mode of ATT is active. Manual control is effective only in ATT manual mode or in ACC mode.

2) Automatic control (APC mode)
Automatic control is available via key operation from the MLS front panel or via mode switching through the external communication port. In APC mode, ATT can be automatically set depending on the change of optical output power. When it is in Automatic Control mode LED of APC is lit and in the case of control by external communication 1 is added to the 4th digit of the status display. Details of reading the status display are given in section 10.

3) Confirmation of set value (AT)
Set value of ATT changes by automatic control. And this value can be confirmed (read-out) via external communication command (AT). Set value is fixed in manual control mode.

NOTE

Output power is controled by controling current to LD. When output power setting exceeds ATT control range in APC mode or ACC controls current by communication command in ACC mode, S/N characteristics decrease as the current decreases.

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3-6 Fine Wavelength Tuning Control

ECL controls OBPF and FLF independently against wavelength input. When some compensation is required after wavelength stable, it is possible to control only FLF independently.

3-7 Plug & Play

On the usual system, when units are required to be exchanged or to be added, the stable system must be down, and be exchanged or added, then, the system must be start up. However, it is possible to be plugged in and out with power on. In this case, re-start of the system is unnecessary only by the warm-up of the added unit. (Refer to 7.16. Plug and Play)

3-8 Communication Interface

GP-IB, RS-232C* are equipped with this system. The structuring various systems is possible by external communication control.
* RS-232C is an option.

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4 Principle of Operation

4.1. ECL Principle of Operation

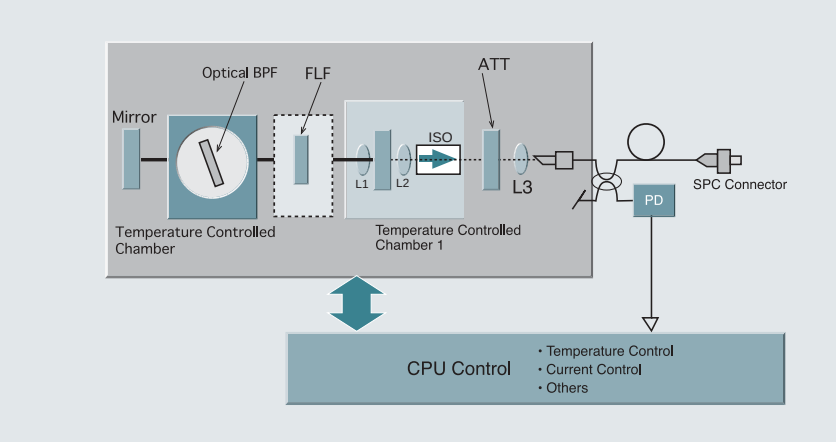


FIG.1. Structure diagram of ECL-210

FIG.1 shows the structure of ECL-210.

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 Frequency Lock Filter, and an isolator to prevent return light from the outside are arranged in a 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 frequency lock filter (FLF), 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 laser light goes through tunable attenuator (ATT) (* 1) and bounded to the optical fiber. The optical fiber is diagonally processed so as to prevent interference in fiber, and only connector for output employs SPC. FC-APC connector, SC connector and polarization maintaining fiber output are available as options.

The oscillation wavelength of ECL-210 is controlled by OBPF and FLF individually. The merit of ECL-210 is these two independent components controlled.

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The two components in selecting wavelength are to be controlled individually, and OBPF requires linear control in whole tuning wavelength range, and FLF requires periodical control. The oscillation wavelength depends on the rough tuning wavelength by OBPF and more accurate tuning wavelength by FLF. And the automatic locking wavelength by FLF precisely selecting wavelength enables excellent wavelength stability and repeatability.

The adopting branching light of coupler achieves high accuracy in monitoring ECL optical power. In addition, the attenuator control and slight injection current control for optical power enable highly precise control, which can reduce laser source S/N to get worse, in wide dynamic range.

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4.2. The Unit Principle of Operation

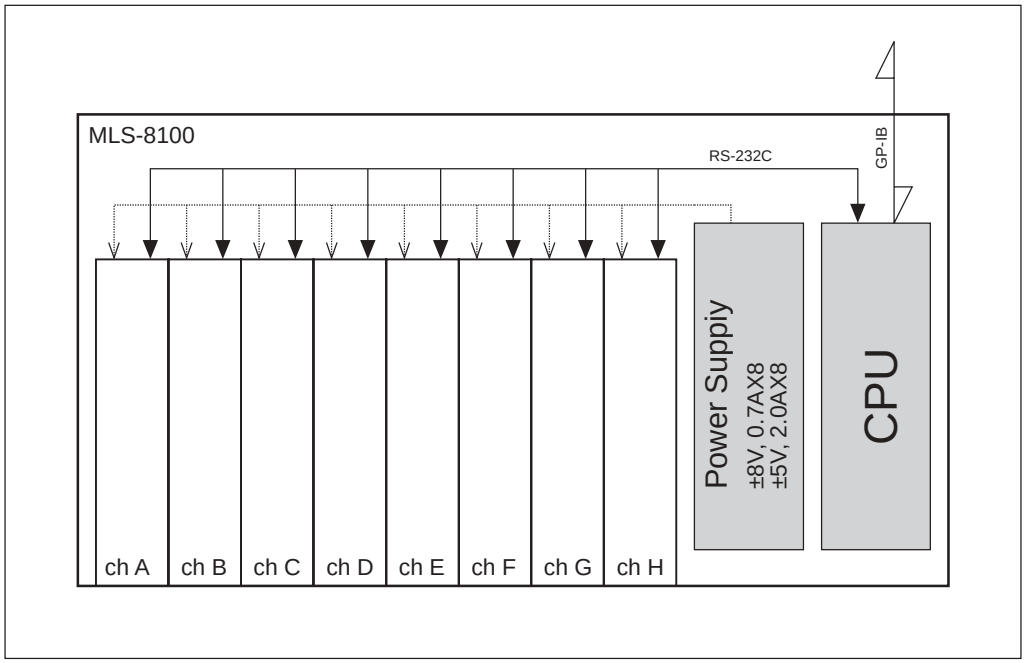


FIG.2. Structure of the MLS-8100

FIG.2 shows the structure of MLS-8100

This system is composed of External Cavity Tunable LD Module (ECL) and Multi-Channel Light Source Rack (MLS).

MLS controls and supplies power sources for required each unit from external AC power sources, and controls with TTL serial communications. This serial communications achieves high independency and flexibility for each unit and MLS.

MLS has control panel and display, and the selection control from each unit directly from MLS and monitoring are available. By input major parameters such as wavelength and optical power directly, the present selected unit can be recognized and each unit with communication can be controlled.

In addition, both GP-IB and RS-232C, which are external communication control, are supported. The communication control of MLS works as a switching interface between external communication control system and the each unit.

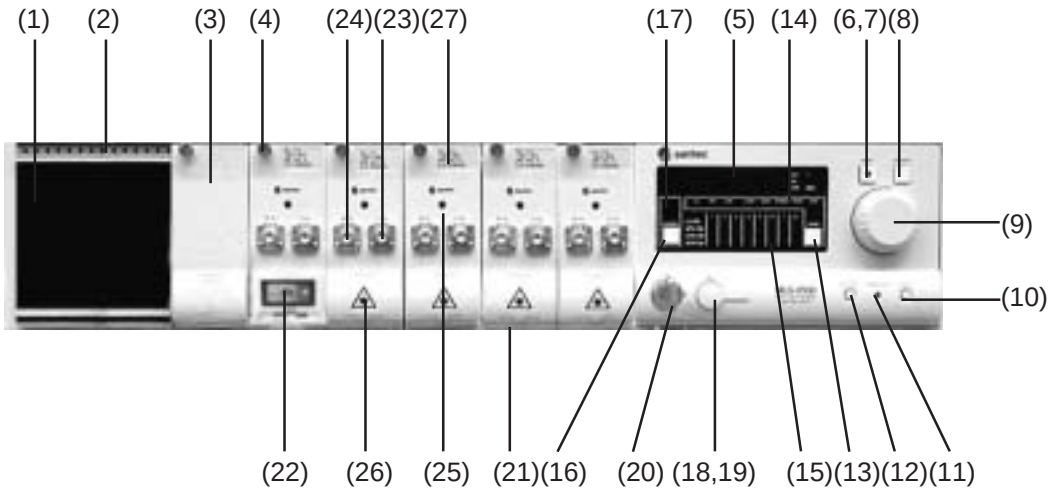
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In this way, it is easy to select each unit, set each parameter and monitor those by communication control from the direct control from MLS or the external communication systems. The parameters changed from MLS can be memorized in each unit by [STORE] key. (ref. 7.15.)

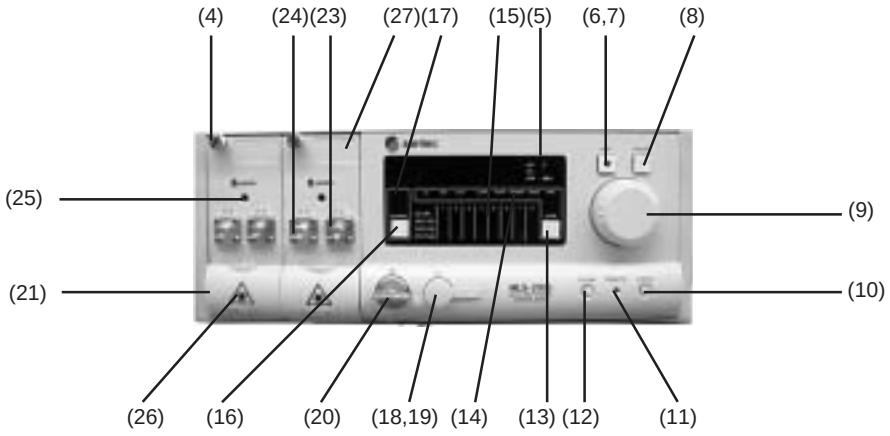
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5 Panel Descriptions

5.1. Front Panel



Front Panel MLS-8100



Front panel MLS-2100

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(1) Light source unit insertion slot

Each unit or blank cover is loaded on.

(2) Fixing screw hole

This is a hole for fixing each unit or blank cover.

(3) Blank cover

Insert the blank cover to an empty slot. If the blank cover is not inserted, the system may not work stably for heat generated.

(4) Unit fixing screw

This is the fixing screw for each unit or the blank cover. When pulling out the unit, pull slightly with loosing the screw.

(5) Parameter display

This indicates the parameters of each unit and MLS communication parameters.

(6) SHIFT key

This is the key for toggle movement (SHIFT ON/OFF) to ordinary status and MLS SHIFT status.

(7) SHIFT_LED

This is lit when the MLS status is SHIFT.

(8) ON/OFF key

When this key is effective, pressing this causes ON/OFF toggle movement settled in each MODE.

(9) Shuttle switch

This is for setting and monitoring parameters. The parameter goes up/down and the speed can be changed by angle.

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(10) LOCAL key

When the system is in remote status by GP-IB, pressing this switch causes the system to be back to the local status.

(11) REMOTE_LED

This indicates that the system is in remote status by GP-IB.

(12) STORE key

Pressing this switch causes each parameter setting value of the current ECL-210 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 again.
This works only for the unit selected by MLS.

(13) MODE key

This is for changing MLS MODE setting, monitoring, and controlling parameters of each unit.

(14) MODE_LED

This LED indicates MLS MODE setting, monitoring, and controlling parameters of each unit. According to the MODE lit at present, key operations and the display are decided.

(15) Unit status_LED

This is matrix LED to indicate the unit status inserted to each slot.
The vertical lines correspond to each slot and the horizontal lines indicate the status of each unit.

(16) Unit channel select key

This key selects the unit MLS controls.

(17) Unit select display

This indicates the unit number MLS controls.

(18) SIF connector cap

This protects the SIF connector from dust. Close the cap by no use.

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(19) SIF (serial interface) connector

This is a connector for RS-232C communication. It is used in numeric key operation or table operation by external devices such as Zaurus or so. (Please refer to Section 8.2. RS-232C)

(20) Main switch

This is the key switch to change power ON/OFF of the system. To cut off the power source from the system completely, pulling out the power code is required. The key cannot be pulled out with power ON.

(21) Protection cover

This is a protective cover to avoid direct output light and to protect the connector from damage and dust.

(22) Optical output connector

This is the optical output connector from light source unit.

(23) LF modulation input terminal

This is LF modulation input terminal for the control circuit of the light source unit. The driving current can be controlled for input voltage. The input impedance is 47kÉ∂ The connector is SMA.

(24) RF modulation input terminal (Option)

This is RF modulation input terminal for LD of the light source unit. The impedance is adjusted by 50É∂. The connector is SMA.

(25) Unit LED

This LED indicates the unit movement status. This is lit ON when the power is supplied from MLS.

(26) DANGER seal

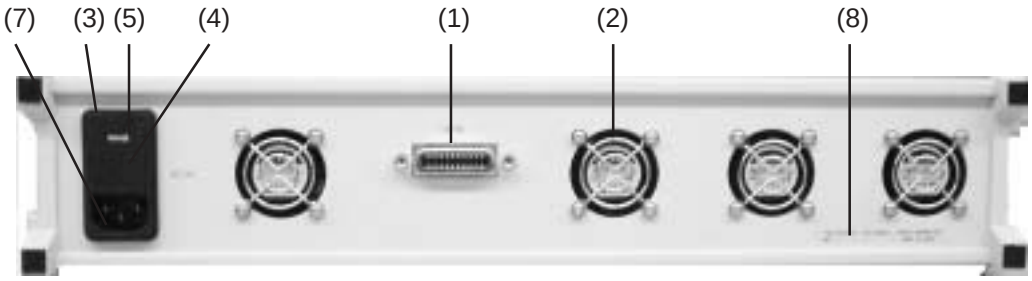
This mark indicates the possibilities of danger by LASER. Do not look into the beam directly.

(27) Inscription panel

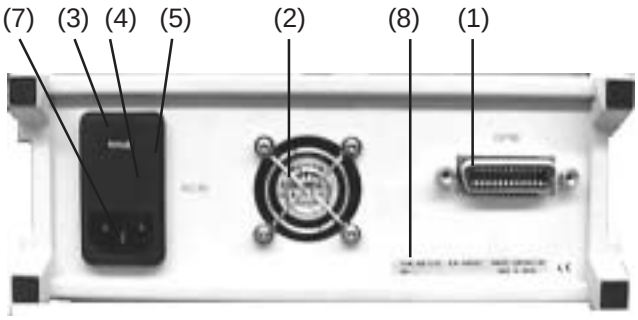
The model #, options, and serial # of ECL-210 are mentioned on this.

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5.2. Rear Panel



Rear Panel MLS-8100



Rear Panel MLS-2100

(1) GP-IB connector (Refer to 8.1. GPIB)

(2) Fan

The fan shapes of MLS-8100 and MLS-2100 are different. The function is same. Arrange space of over 5cm to allow for proper ventilation. (Refer to Section 6.2. Installation)

(3) Power Supply Part

The power supply part consists of the power voltage display panel, its lid, the power supply socket, the internal rotary switch for changing voltage, and the internal fuse box.

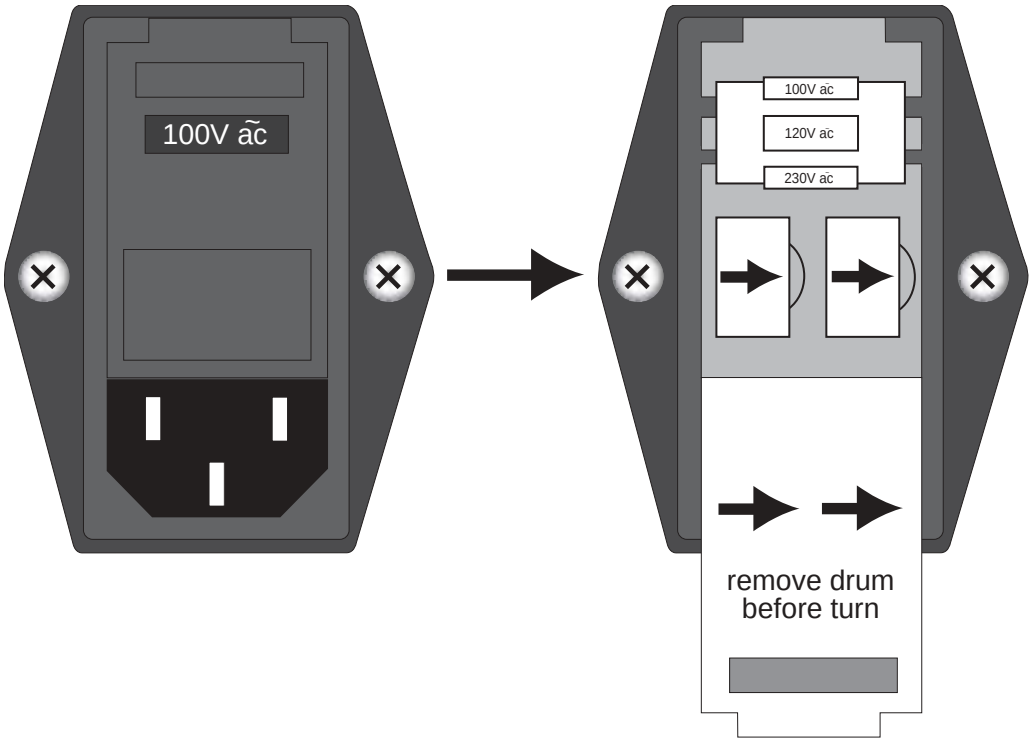
(4) Power voltage change switch and fuse box lid

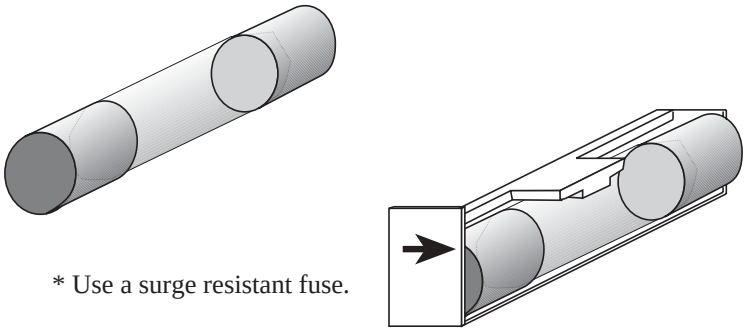
When it is necessary to change the power voltage setting, open the lid, set the internal rotary switch to the correct voltage and replace the fuses with the correct rating. Replace the lid.

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(5) Power Voltage Display Panel

The display panel and the rotary switch for changing power supply voltage are unified. It enables voltage change to open the lid and rotate the rotary switch with pressing it. If a different power voltage is used, make sure the rotary switch is set properly and the correct fuse is used.





* Use a surge resistant fuse.

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(6) Fuse Box

Firstly, after changing and making sure the fuse, open the lid of power voltage display panel and pull out the fuse box. And the fuse box is inserted with the arrow direction. Use the anti-surge type fuse.

(7) Power source socket

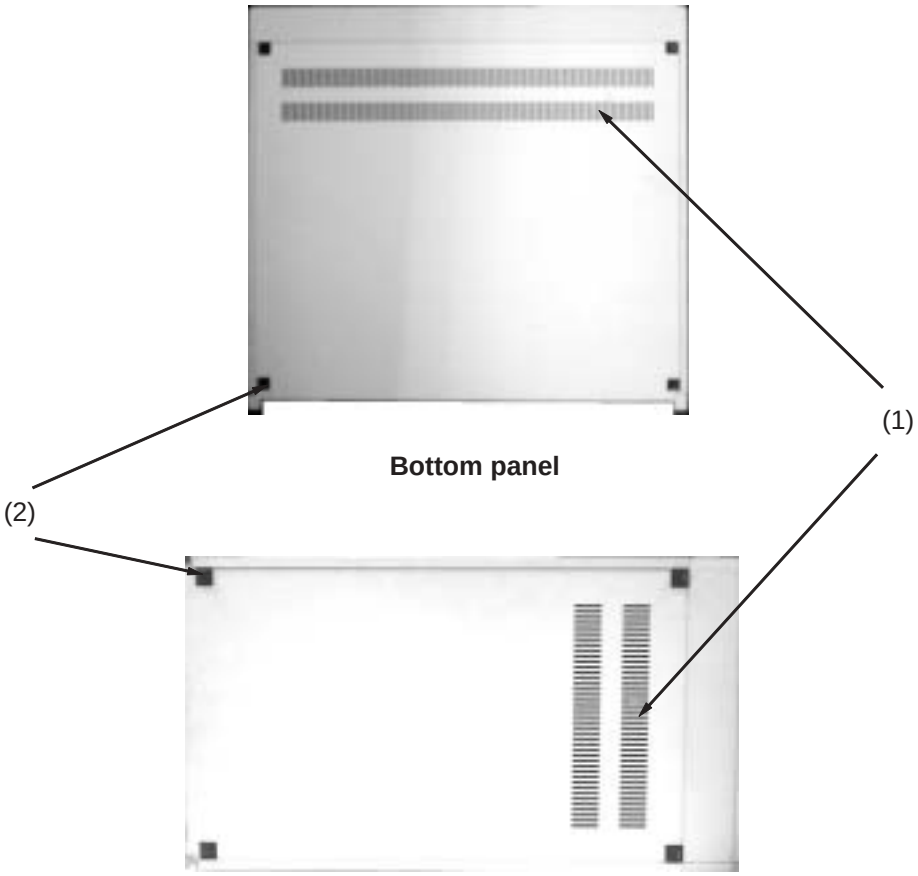
This system adopted the power code and plug of 3 line type, which has grand line for protection. The power code is a type to get on and off. Attach the power source socket in the power supply part on the rear panel.

(8) Name plate

Product type, option, and serial number are described on it.

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5.3. BottomPanel



Bottom panel

Bottom panel

(1) Slit

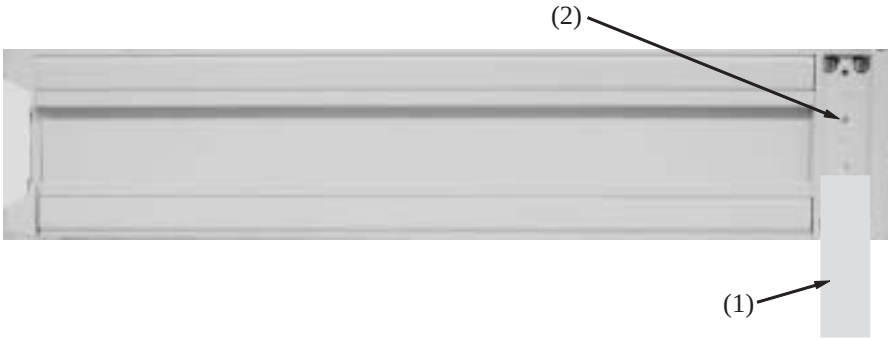
Slit for heat dissipation. Cooling air comes into inside of the slit. Do not cover the slit or put heat generator near the slit. This may cause incorrect movement and damage because of the system heat.

(2) Rubber boots

These support the system and prevent the slit from covering. Use the system with the boots.

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5.4. Side Panel



Side Panel

(1) Cover of rack fixing ear

There are screw holes under the cover. This ear is for attaching fixing screws to standard rack such as EIA or JIS specifications.

(2) Screw holes of rack fixing ear

This is for attaching fixing screws to standard rack such as EIA or JIS specifications.

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Safety Information

6.1. Mains Voltage

Please ensure the voltage indicated on the rear panel of the instrument corresponds with the main voltage supply. Applying an incorrect mains voltage will damage the equipment. See Section 5.2 for details of how to change the voltage setting and Section 10.4 for details of changing the fuse. Ensure that the rating of the fuse corresponds to the mains voltage selected; details are given in Section 10.4.

The unit is provided with a three pin cord. To ensure the safe operation of the instrument please make sure that this is connected to a grounded power outlet.

6.2. Installation

To ensure the safe operation of the instrument it should not be installed:

- In a position where the air from the cooling fan cannot flow freely. Allow at least 5cm behind the unit for this purpose.
- Where there are high levels of vibration.
- Where it would come into contact with water.
- In very humid or dusty locations.
- Where there are strong electric or magnetic fields.
- In direct sunlight.
- Where there are extremes of temperature.

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6.3. Safe Operation

The unit should not be operated in any of the following circumstances:

- If water or other liquid is spilt on the unit.
- When the unit is cleaned or moved.
- If damage is found to the mains cord.

In the event that these occur while the unit is being used the Power On / Off Key Switch should be turned off immediately, and the mains power turned off at the outlet.

Also, please note that if the unit is moved from a cool location to a warm location there is a possiblity that condensation may form on the inside of the instrument. In these circumstances allow sufficient time for the instrument to dry out thoroughly before connecting the mains power.



There is a danger of serious injury or death from electric shock if the instrument is used without the correct connection to ground.

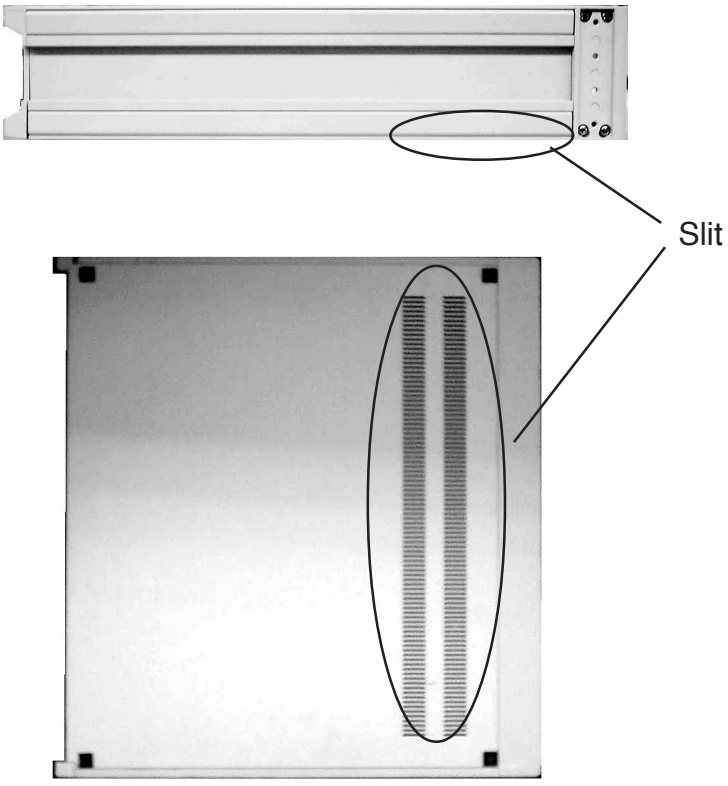
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6.4. Heat Dissipation Environment

The fan for heat dissipation is located in back of MLS. Please secure an opening 5cm or more from a fan, and air should flow into it from the slit of the bottom front part. If the slit is closed, or the air doesn't espace from the bottom properly, the equipment generates heat and it may not operate stably. It also causes the same when the blank cover is not inserted in the empty slot. When there is an empty slot, please be sure to fix a blank cover firmly.

NOTE

A blank cover has the effect which keeps the flow of the cooling inside a main part.



NOTE

Since the rubber legs are for securing a slit, please use rubber legs, without removing them from this equipment.

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Operation Procedures

7.1. Contents of Fundamental Operation

7.1.Contents of Basic Operation
7.2. Turning Power ON
7.2.1 The First Power ON
7.2.2. Turning MLS Power ON
7.2.3. Setting RS-232C Delimiters of MLS
7.2.4. Turning ECL Power ON
7.2.5. ECL Initial Values and Movement
7.3. Optical Fiber Connection
7.3.1. Cleaning the Optical Connectors
7.3.2. Caution for the Optical Connector
7.3.3. Procedure of Cleaning the Optical Connector
7.3.4. Optical Fiber Connection
7.4. Selecting Units in MLS
7.5. MLS MODE
7.6. MLS Matrix LED
7.7. Shuttle Switch
7.8. Driving LD and Shutting LD OFF
7.8.1. Driving LD
7.8.2. Shutting LD Off
7.9. Setting Wavelength
7.10. Setting Optical Output Power
7.10.1. APC Function
7.10.1.1. Procedure of Setting for APC Function
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7.10.2.1. Procedure of Setting for ACC Function
7.10.2.2. Setting Current
7.11. Fine Tuning Function
7.11.1. Setting Fine Tuning
7.12. Coherence Control
7.12.1. Coherence Control Off
7.13. Low Frequency Modulation

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7.13.1. Specifications
7.13.2. Caution
7.13.3. Usage
7.14. Setting GPIB Address and Delimiters
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7.14.2. Changing Address
7.14.3. Changing Delimiter
7.15. Parameter Memory of Each Unit
7.16. Plug and Play
7.16.1. Unit Insertion
7.16.2. Pulling Unit Out
7.17. Shutting Power Off

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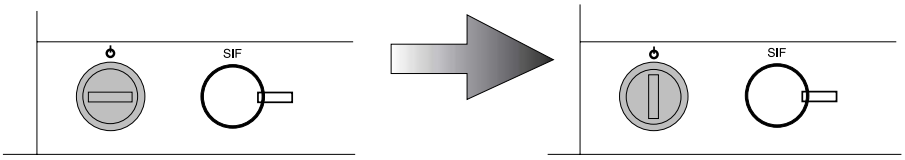
7.2. Power On / Off

7.2.1. The First Turning Power On

For safe and stable operation, make sure to read Chapter 6. Confirm the power supply voltage before using this system. If the wrong voltage were supplied this would be broken. Insert the unit to MLS without fail, and fix it with fixing screws. Make sure the blank covers for empty slots. Confirm the protection shutter closed or fiber connected when turning power on. Laser beam may cause visual injury if it gets in eye. The power in from the external is into MLS.When the external power is supplied, the system is in the state of waiting. After MLS starting up, MLS recognizes each unit and supplies and shuts down power to each unit.

7.2.2. MLS Turning Power Supply On

Make sure the power voltage, and supply AC power source by the attached power code. Turn it 90 degree to the right by power key to turn the system ON.



When the system is turned ON, the following actions are carried out until the system is activated.

1) All the indications and LEDs are lit.
2) All the LEDs put off.
3) [GP-Ib] is displayed.



4) GPIB address is displayed.



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5) GP-IB delimiter is displayed.



6) [RS-232C] is displayed.



7) RS-232C delimiter is displayed.



8) All the indications and LEDs are lit.

9) The system confirms the state of unit inserted.

If the units are inserted, the parameter is displayed. If not, [non] is displayed.

7.2.3. Setting MLS RS-232C Delimiters

MLS RS-232C delimiters can be changed by pushing [CHANNEL], [MODE] keys in power on. In the state of power waiting, turn power on with keeping pushing the either or both buttons, so that RS-232C can be changed. The start-up movement is the same as 7.2.1. After proper start-up, the delimiter setting is maintained even when power to the unit is turned off.

[CHANNEL]	**: CR**
[MODE]	**: LF**
[CHANNEL]+[MODE]	**: CR/LF (Push the both)**

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7.2.4. MLS shuttle mode setting

There are two modes for MLS shuttle switch.

Shuttle mode ON: Parameter setting value changes depending on the shuttle switch's angle.
Shuttle mode OFF: Parameter changes at regular interval.

Shuttle mode can be selected by pressing [SHIFT] or [ON/OFF] key when the power is turned on.

NOTE

Press and hold the key for two seconds. Shuttle mode setting is memorized after the power is off.

[SHIFT] : shuttle mode ON
[ON/OFF] : Shuttle mode OFF

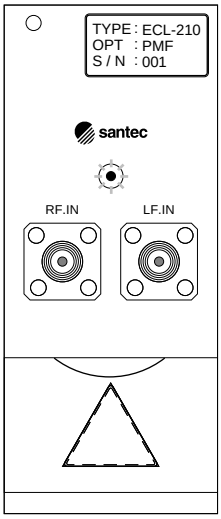
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7.2.5. Turning ECL Power ON

MLS confirms the insertion state of each unit, and supplies power sources to the slots inserted. The supplied units start up independently and those are communicated with MLS and controlled.

When the system is turned ON, the following actions (Sequence) are carried out until the system is activated.

1) Initialize optical systems and control circuits.
2) If the self-checking is okay, LEDs are lit.



3) Cancel the LD protection circuit
4) Supply the power for driving LD from MLS (cancel the protection circuit in MLS)
5) Start communication with MLS when the communication control is ready.
6) Set each parameters, and start up the conditions memorized

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7.2.6. ECL Initial Values and Movement

The conditions memorized returns after the power is turned ON. But LD injection current stays shut-down. Drive LD from MLS.

ECL initial values: LD injection current set value, circumstance temperature set value, APC optical power set value, APC/ACC, COH control ON/OFF, COH control amount, wavelength (fine tuning set value)

NOTE

There may be the case that small current value is displayed even in not driving LD. This is caused by offset voltage by the protection circuit. In the state of LD-OFF, the protection circuit works and the current is not injected. Similarly, the optical power is displayed approximately –40.00dBm. The minimum display value of ECL is –40.00dBm and, at this time, current is not injected to LD.

NOTE

The status LED of MLS is lit when the present control temperature is out of Å}0.1Åé range for set temperature. The LED is lit until the temperature control is stable, that is several minutes after power is ON. It depends on external circumstance, but it takes nearly 10 minutes to light LED OFF. It is same by MLS as the case of changing a target temperature.

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7.3. Optical Fiber Connection

Ensure that the optical connector on the optical fiber is clean, then pull down the safety cover on the front of the ECL-210 unit and connect the optical fiber to the connector.



Before connecting an optical fiber, always clean the end face of the connector. In addition, we recommend that the socket on each ECL-210 unit is also periodically cleaned . The cleaning procedure is explained in Section 10.3. If dirt is present on either the end face of the connector or the socket the insertion loss will be increased. In addition, when high optical powers are used there is the possibility that the connectors may be damaged by scorching.

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7.4. Selecting a Unit in MLS

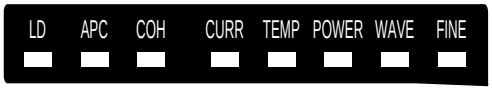
When the units are inserted into MLS, it is required to select the unit controlled. When looking at the front of the MLS unit the slot on the farthest left hand side is numbered one. The MLS-2100 has two slots numbered one and two, the MLS-8100 has eight slots numbered one to eight. When operated through the the communication ports, these assignments become A and B for the MLS-2100 and A to H for the MLS-8100. (details are given in Chapter 9). The selected ECL-210 unit is shown on the unit selection display. To change the selected slot, push the key [CHANNEL] each time the slot number selected at present enables to shift the slot number inserted to right direction. When the very right slot selected, it goes back to the very left slot number. The condition becomes waiting for parameter display and key input after unit is selected according to the MODE set up in the previous time.

NOTE

If MLS is operated without CHANNEL confirmation, the wrong unit is selected and the parameters are changed. Be sure to confirm the CHANNEL number in setting parameters and monitoring. Especially, [STORE] key.

7.5. MLS Mode

The MLS display, parameter setting, monitoring, and control ON/OFF, are controlled by MODE. The present MODE is shift-selected to right direction by [MODE] key. The present MODE can be recognized with LED. Each key and shuttle switch are active for the display and operation which are prepared on each MODE.

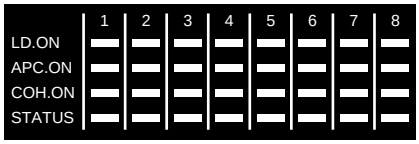


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MODE	Display,shuttle switch	Unit	ON/OFF key
LD	Current	mA	Current ON/OFF
APC	OpticalPower	dBm	APC/ACC Switching
COH	OpticalPower	dBm	COH ON/OFF
CURR	Current	mA	N/A (Non Applicable)
TEMP	LD Temperature	°C	N/A
POWER	Optical Power	dBm	N/A
WAVE	Wavelength	nm	N/A
FINE	Fine Tuning	-	N/A

7.6. MLS Matrix LED

MLS provides matrix LED for monitoring the status of the all unit inserted. The vertical line shows slot numbers and the horizontal line does the status of each unit.



The relation between the unit status of the horizontal line and LED is as follow.

Silk	The Condition of Lighting
LD.ON	Current is injected into LD.
APC.ON	The status isAPC.
COH.ON	COH is ON.
STATUS	It indicates the plural operations state. It shows OR of the tuning wavelength, changing current, unstable temperature, and controlling ATT.

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7.7. Shuttle Switch

MLS does not prepare numeral keys to input values. Therefore, use the communication function or shuttle switch for input. The shuttle switch is used for setting main parameters such as wavelength and optical power, and setting MLS communication parameters, and also monitoring. The shuttle switch enables to set the present parameters on the display and monitoring.

When the shuttle switch is located in the center, the display shows the present value.

The set values are showed on the parameter display when it turns right and left a little. The display shows the set value for nearly 1 second when it turns back to the center from that condition.

The shuttle switch can change by 6 steps from the center to right and left. The CW(Clock wise) is increment, and CCW(Counter Clock wise) is decrement.

Center	1st Step	2nd Step	3rd Step	4th Step	5th Step	6th Step
Actual	Target	Min. Digit	High-speed Min. Digit	X10	X100	X1000

7.8. Driving LD and Shutting LD Off



Before turning ON the unit, make sure that the protective shutter is closed or the optical fiber is connected. Keep the optical output terminal away from your eyes. Laser beam, if it comes into your eye, may cause injury in your sense of sight.

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NOTE

When ECL is turned ON, current is not supplied to LD because of protection circuit. Therefore, to drive LD, it is necessary to supply current unto the LD by key operation from MLS or by communication control.

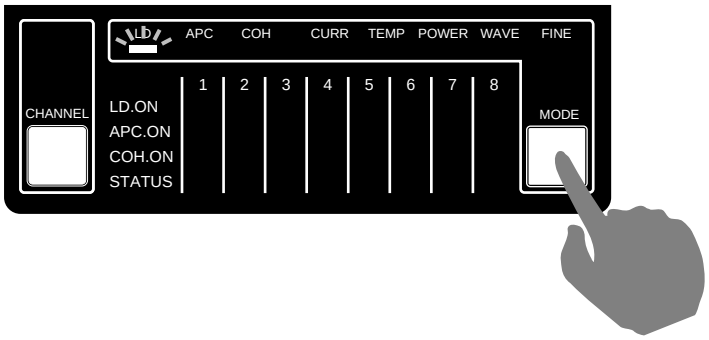
NOTE

ECL operates in either APC (automatic power control) mode or ACC (automatic current control) mode. In the APC mode, the optical output power can be set and the injection current information is fed back so that the optical power is kept at the set value. In the ACC mode, control is made using the predetermined amount of injection current.

7.8.1. Driving LD

When the LED is lit in the [LD.ON] line of the Matrix LD to operate, that LD is driving. When the LED is not lit, drive the LD as the following procedure.

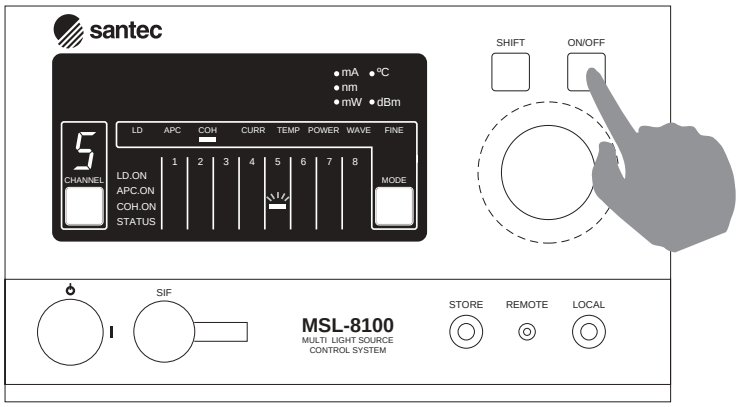
1) Select the target unit to drive LD on MLS. (Refer 9-4. Selecting a unit in MLS)
2) Set the MODE LD using [MODE] key.



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3) Press [ON/OFF] key.

4) LED lights, and current is injected into LD.



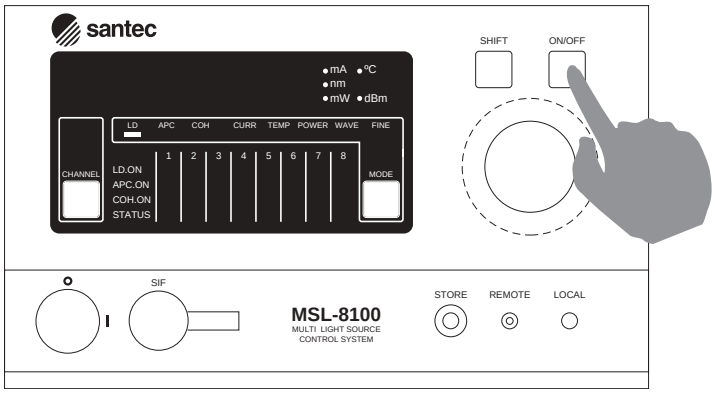
5) The current value differ from the set current value and the LD driving method(APC/ACC).

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7.8.2. Shutting LD Off

When the LED is not lit in the [LD.ON] line of the Matrix LD to operate, that LD is not driving. In this condition, the driving circuit shuts off and the protective circuit works. When the LED is lit, shut the LD off as the following procedure.

1) Select the target unit to shut LD off on MLS. (Refer 9-4. Selecting a unit in MLS)
2) Set the MODE LD using [MODE] key.
3) Press [ON/OFF] key.
4) The current goes down gradually, and the driving circuit works to the end.
5) When the current is 0, the driving circuit shut off and the protective circuit works.
6) LED is turned off.



NOTE

Shutting LD off takes time because of the internal process. After executing commands, the status does not change during processing. After all processes of shutting off are finished, the status changes. It is same as in communication control.

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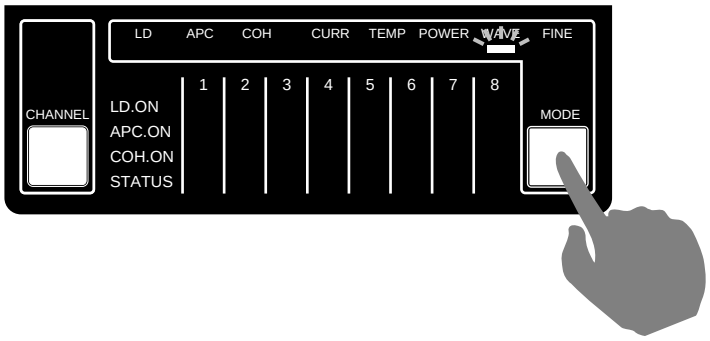
7.9. Setting Wavelength

NOTE

ECL controls the two components, PBPF and FLF, in selecting wavelength independently. It takes time more or less for FLF to be stable.

Here shows the procedure of setting wavelength and the internal sequence.

1) Select the target unit on MLS. (Refer 7.4. Selecting a unit in MLS)
2) Set MODE to change to WAVE using [MODE] key



3) Set wavelength using the shuttle switch. (Refer 7.7. Shuttle switch)
4) OBPF and FLF is controlled to the set wavelength.
5) If the present value is off the point much, the wavelength value is calculated based on the sensor output attached to OBPF.
6) When the OBPF wavelength tolerance becomes less than Å}0.2nm, the wavelength value is calculated based on FLF monitor signals.
7) The status LED is lit until OBPF and FLF values goes into a range.

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NOTE

The direct angle sensor is attached to OBPF. The angle sensor enables the actuator to feed-back control. There may be cases of little overshoot and undershoot.

NOTE

The monitor signals of thermistor, attached to FLF, are temperature-controlled precisely by PI control. The FLF control takes time, and the overshoot and undershoot may be repeated. In that case, wait a little (nearly 1 minute) to be stable adequately, though it seems wave-length to be stable.

NOTE

The present value of wavelength is calculated from OBPF sensor signals and FLF sensor signals. The excellent FLF characteristics for selecting wavelength enable precise accuracy on the display. The accuracy is approximately ±3GHz.

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7.10. Setting Optical Output Power

NOTE

Here explains the setting optical power on the assumption that LD is driving. (Refer 7. 8. Driving LD and Shutting LD off)

NOTE

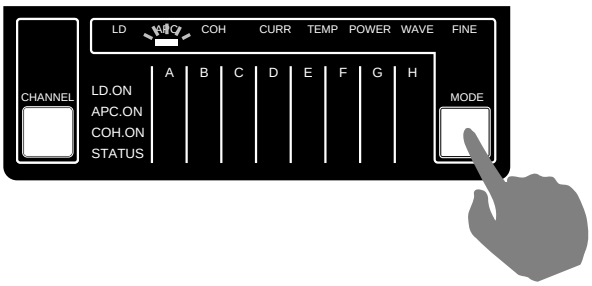
Setting optical power is available only with dBm unit. It is same as in communication control.

7.10.1. APC Function

It is necessary to operate the machine in APC mode to set optical output power. Optical output cannot be set in ACC mode. Be sure that the mode is in APC. If ACC, change the mode to APC. If the LED is not lit in the [LD.ON] line of the Matrix LD to operate, the mode is ACC and it is required to change to APC.

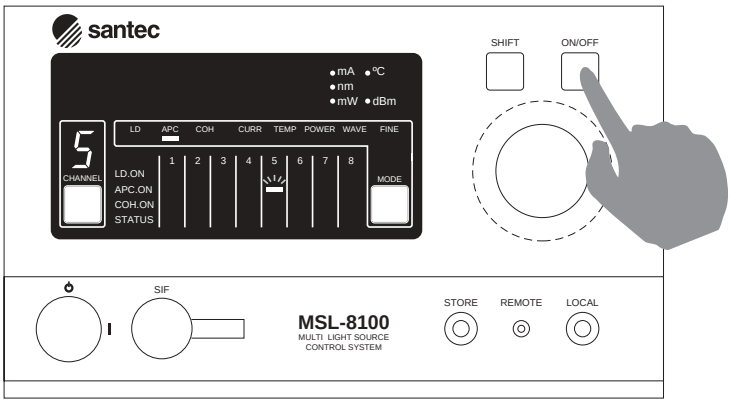
7.10.1.1. Procedure of Setting for ACC Operation

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MDOE APC.



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3) Press [ON/OFF] key and the LED on the [APC.ON] line is lit.



7.10.1.2. Setting Optical Output Power

NOTE

Here explains the setting optical power on the assumption that LD is driving and that the MODE is APC. (Refer 7.8. Driving LD and Shutting LD off)

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MDOE either APC, COH, or POWER.
3) Use the shuttle switch to set optical output power. (Refer 7.7. Shuttle switch)
4) MLS controls the set optical output power.

NOTE

If the system has the ATT option, the control method is different. The optical output power is originally controlled by controlling injection current. But when to set low optical output power, if the injection current is controlled, it causes worse S/N of signals. In the case of the built-in ATT option, the ATT processes the rough adjustment, and current does the subtle fluctuation and adjustment. In that case, it does not worse S/N of signals.

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NOTE

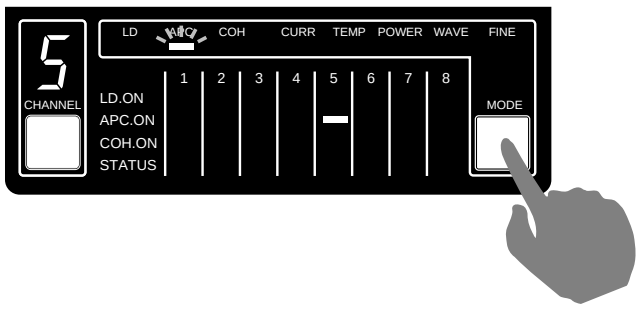
When to set wavelength again in the state of APC, according to set wavelength or set optical output power, there may be cases that set optical output power cannot be made, though LD injection current is maximum. In such a case, the status LED is lit and this indicates that the injection current is max. (Refer 8-4. Precise Optical Output Control Function)

7.10.2. ACC Function

In most cases, ECL is used with APC function. However, there may be cases it is required with ACC function when the optical output control is required by external criteria. For example, when LF modulation is required, it causes signal deformation with APC function. Also, when the power is required to fit some criteria (not optical output power), this can be achieved by feed back the signal to LF modulation terminal. If the LED is not lit in the [LD.ON] line of the Matrix LD to operate, the mode is ACC. If it is, it is required to change to ACC, and set the MODE ACC.

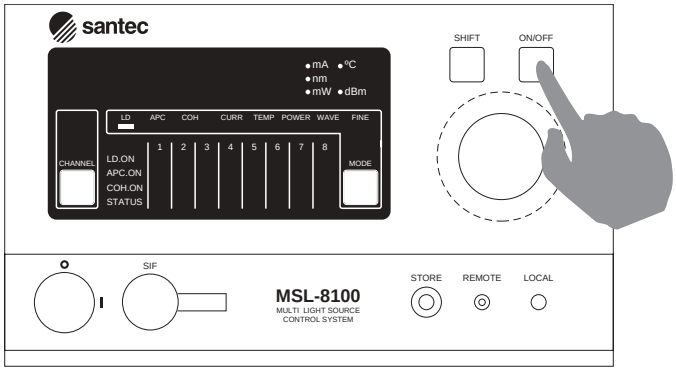
7.10.2.1. Procedure of Setting for ACC Function

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MDOE APC.



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3) Press [ON/OFF] key and the LED on the [APC.ON] line is lit off.

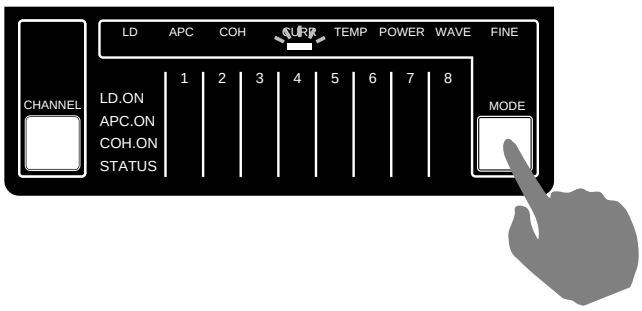


7.10.2.2. Setting Current

NOTE

Here explains the setting current on the assumption that LD is driving and that the MODE is ACC. (Refer 7.8. Driving LD and Shutting LD off)

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MODE CURR.



3) Use the shuttle switch to set current. (Refer 7.7. Shuttle switch)
4) MLS controls the set current.

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NOTE

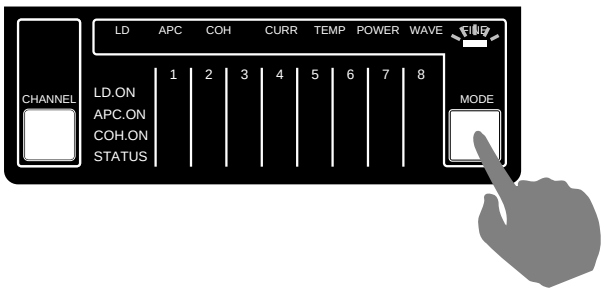
The range of set current differ each ECL unit more or less. It is allowed to set 0 to the current limit value by software. The unit is mA.

7.11. Fine Tuning Function

ECL can tune oscillation wavelength in a wide range by controlling the loss for the components in selecting wavelength in external cavity. The method of ECL selecting wavelength is to operate the 2 independent components in selecting wavelength (OBPF and FLF) together. The wavelength of laser is automatically locked by high precise characteristic of selecting wavelength. This high precision control of FLF enables excellent wavelength accuracy, stability, and repeatability. The control circuits in ECL precisely controls OBPF and FLF, and it is easy to operate to set wavelength from the external through MLS.
After setting wavelength, it is possible to set FINE control (fine-tuning) independently for making small wavelength change.

7.11.1. Setting Fine Tuning

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MODE FINE.



3) Use the shuttle switch to set control amount. (Refer 7.7. Shuttle switch)
4) MLS controls the set control amount.

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NOTE

The control of the fine tuning is ±100. There does not exist the unit for the fine tuning, and the control range corresponds to proximately ±100GHz.

NOTE

The amount of the fine tuning controlled independently, cannot be memorized in the unit with STORE function.

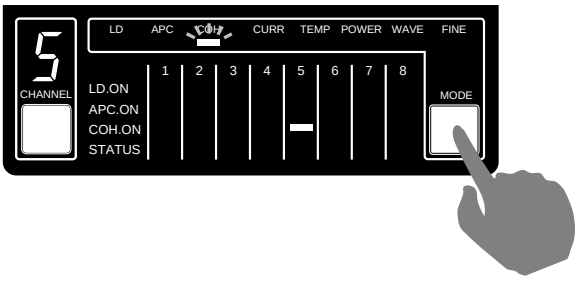
7.12. Coherence Control

NOTE

If the LED is lit in the [COH.ON] line of the Matrix LD to operate, the state is ON. If it is not lit, the state is OFF.

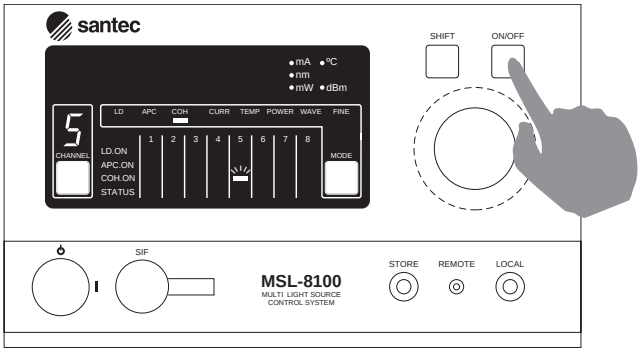
7.12.1. Coherence Control ON

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MODE COH.



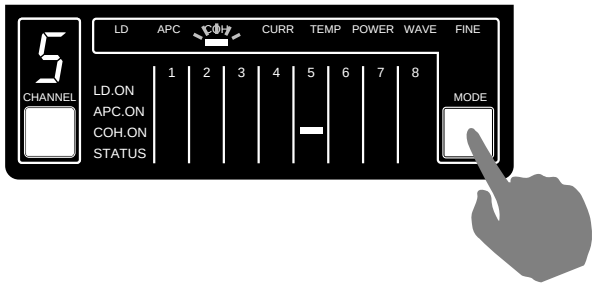
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3) Press [ON/OFF] key and the LED on the [COH.ON] line is lit.

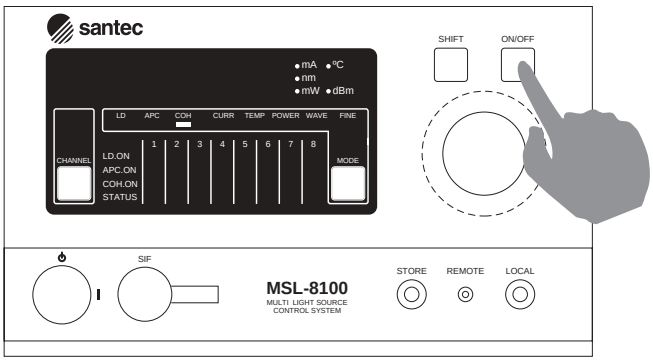


7.12.2. Coherence Control OFF

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Use [MODE] key to set the MODE COH.



3) Press [ON/OFF] key and the LED on the [COH.ON] line is lit off.



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NOTE

The coherent control can set ON/OFF and the amount of control. The control range is 0 to 10, and 0 is weak and 10 is maximum. It is possible to change by communication control. The direct set from the shuttle switch on MLS is not available. When the unit ships out from Santec, the set value has been adjusted properly.

7.13. Low Frequency Modulation

7.13.1. Specifications

Tuning band range	: 0~10KHz
Input level	: ±1V
Modulation efficiency	: 100mA/V
Input impedance	: 4.7kΩ

7.13.2. Caution

Do not apply voltage in excess of input level amount. When not using Low Frequency modulation, be sure to cap the terminals, so that deterioration of terminals does not occur.

7.13.3. Usage

In the low frequency modulation, the current driver to drive LD is controlled by external input voltage signals. The current driver to drive the LD is given current limitation by hardware limit circuit, and thereby is protected against excessive injection current. Make sure that the power between ECL and signal source is shut off in advance, and connect the cable to input modulation signal, and change power to the mainframe and signal source.

ECL has the current control mode (ACC) and the power control mode (APC). In either case, feed back loop control to stabilize optical output power inside is conducted. In the case to use low frequency modulation, if feed back loop is not removed, external input voltage is handled as fluctuation, so preferable modulation is not available. Remove the feed back loop in the above procedures before use. Use ECL with ACC mode.

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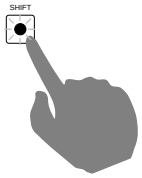
7.14. Setting GPIB Address and Delimiter

7.14.1. Cautions

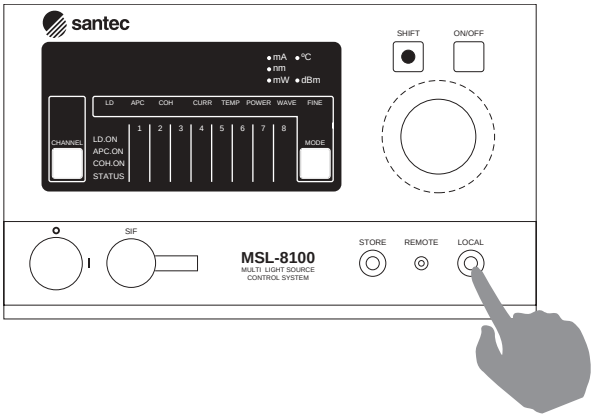
MLS saves the address and delimiter in internal memory. Even if you turn the power switch off after changing the data of the internal memory, the changed data is not canceled. When the system is turned on, the changed address and delimiter are settled. Just after changing, the previous address and delimiter are still maintained. Executing the IFC command of GP-IB can reset those to GP-IB driver.

7.14.2. Changing Address

1) Press the shift key and SHIFT-LED is lit. (Refer SHIFT-LED)



2) Press [LOCAL] key in SHIFT condition.

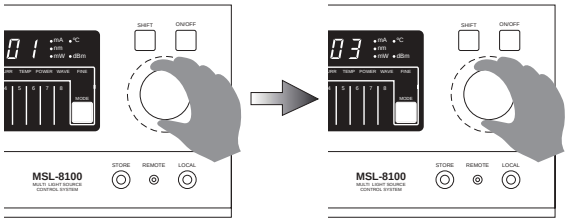


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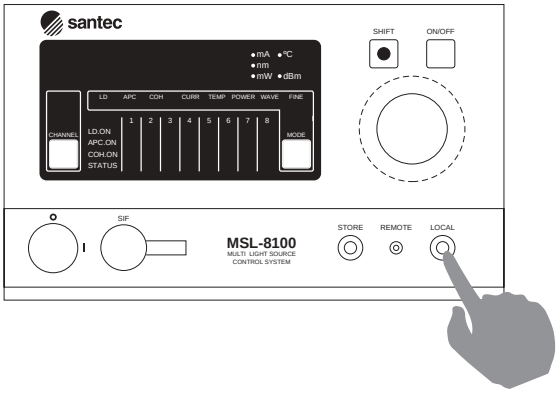
3) The ordinary mode is changed to change mode.

4) The current address is displayed on the parameter indicator.

5) Change the address by shuttle switch and confirm it.

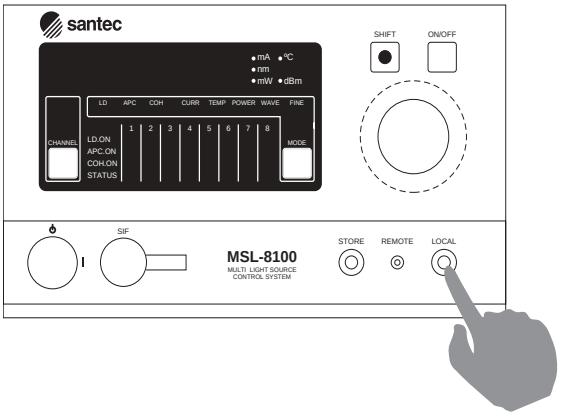


6) Press [LOCAL] key again.



7) The current delimiter is displayed on the parameter indicator.

8) Press [LOCAL] key again.



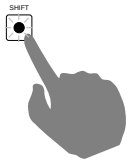
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9) The change mode is finished and it goes back to the ordinary mode.

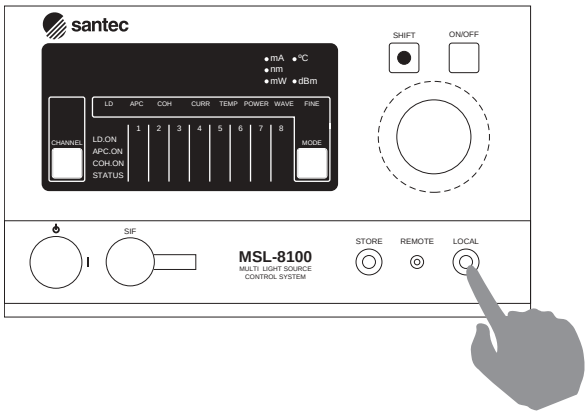
> **NOTE**
>
> The address can be set 0-30. Increment and decrement is by rotating the shuttle.

7.14.3. Changing Delimiter

1) Press the shift key and SHIFT-LED is lit. (Refer SHIFT-LED)



2) Press [LOCAL] key in SHIFT condition.

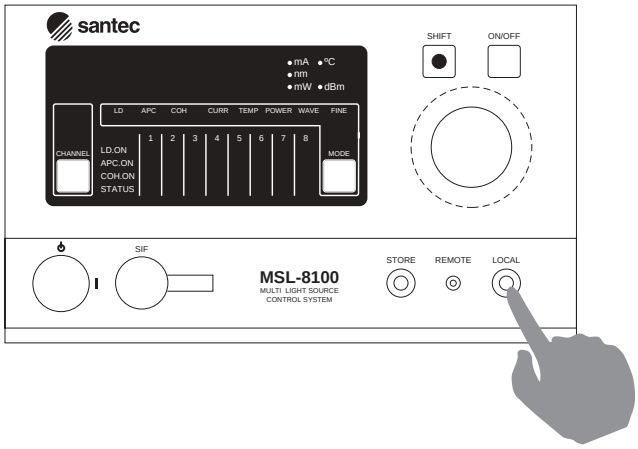


3) The ordinary mode is changed to change mode.

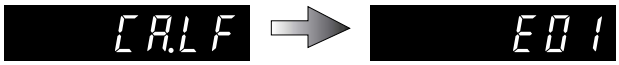
4) The current address is displayed on the parameter indicator.

5) Press [LOCAL] key again.

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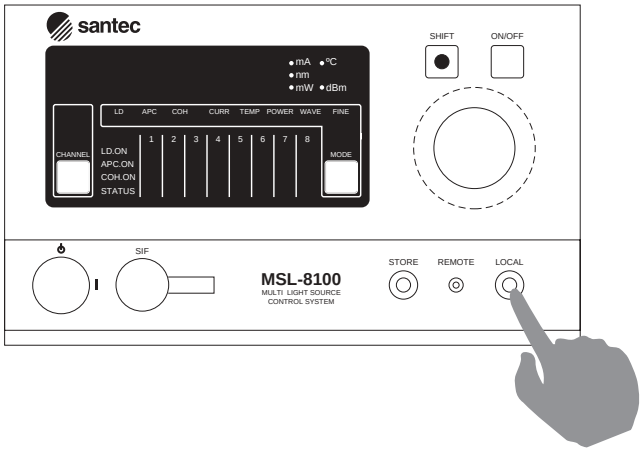


6) The current delimiter is displayed on the parameter indicator.



7) Change the address by shuttle switch and confirm it.

8) Press [LOCAL] key again.



9) The change mode is finished and it goes back to the ordinary mode.

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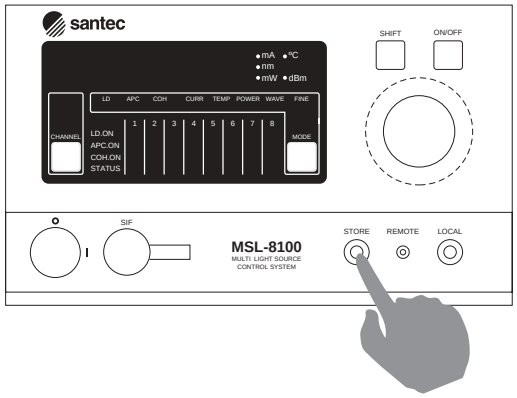
NOTE

The delimiters are CR, LF, CR+LF, and EOI without characters. The address can be set 0-30. It moves by rotating the shuttle.

7.15. Parameter Memory of Each Unit

After setting and changing the parameters of each unit from MLS, the state of each unit can be saved to memory. When you turn on the system again, the current situation appears again.

1) Select the unit to operate on MLS. (Refer 7.4. Selecting Units in MLS)
2) Press [STORE] key.



3) The STORE command is sent to the unit selected by MLS.

NOTE

Memorized parameters are injection current set value for LD, temperature set value, APC optical power set value, APC/ACC, COH control ON/OFF, COH control amount, and wavelength (Fine tuning set value)

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NOTE

The fine tuning amount, which is auto-set independently by setting wavelength, cannot be saved to unit memory by STORE command.

7.16. Plug and Play

When units are exchanged or added in old type system, the stable system must be turned off and units are exchanged or added, and then system must be turned on again. However the units can be exchanged and added as the system is on in this system. Turning the system on again is not necessary. The warm up of the unit is only required.

7.16.1. Unit Insertion

Here shows the procedure of inserting a unit.

1) Insert unit along the guide of MLS slot.
2) Insert the unit to the bottom and firmly fix the unit fixing screw on the left top of unit by rotating.
3) MLS confirms the slot in which unit is inserted to MLS.
4) After MLS self check, the unit LED is lit if there is no problem.
5) MLS starts supplying power source and communication control to the new unit.

NOTE

Make warm up for several minutes of the new unit.

NOTE

In inserting some new units, insert the next unit after the first unit insertion sequence finished completely. Do not insert units at the same time. It may cause damage.

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NOTE

In fasten the fixing screw after inserting unit, the unit would go out if the screw position does not fit. In this case, the system can be damaged. Be careful of it.

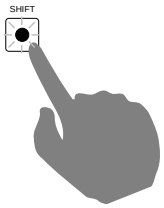
9-16-2. Pulling Unit Out

NOTE

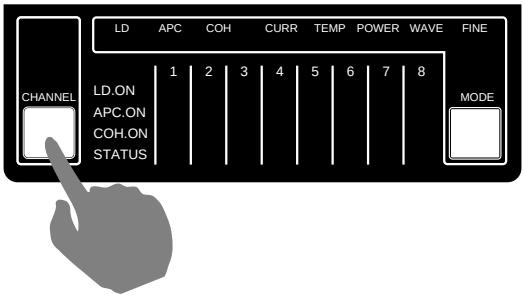
Pull a unit out after shutting LD down. It may cause LD damage.

Here shows the procedure of pulling a unit out.

1) Select the unit to pull out on MLS. (Refer 9-4. Selecting Units in MLS)
2) Press the shift key and SHIFT-LED is lit. (Refer SHIFT-LED)



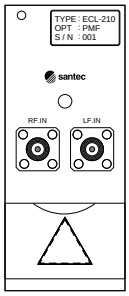
3) Press [CHANNEL] key



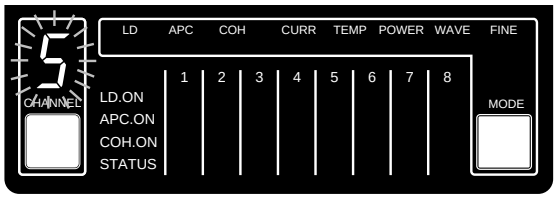
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4) MLS starts the sequence to shut down the unit selected.

5) The power supply of the units shuts down and the unit LED is lit off.



6) The unit select indicator of MLS turns light on and off.



7) Loosen the unit fixing screw on the left top of unit by rotating, and pull out the unit with holding the screw.

8) When MLS confirmed the unit pulled put, it comes back to the ordinary condition

NOTE

It is possible to pull out units with MLS power ON, but be sure to do along with the procedure of Pulling Unit Out. It may cause system damage.

NOTE

Be sure to insert new units or attach blank cover for empty slots. If not, it may cause that the system can generate heat and can be unstable.

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7.17. Shutting Power Off

NOTE

Before shutting off the power, make sure that LDs and LD drive LEDs of all the units are off. Otherwise, LD maybe damaged.

Make sure that the LD drive LEDs of all ECL units are off, then turn the power key 90degrees to the left to turn off the power.

NOTE

To shut off the power completely from the system, it is required to pull off the power code.

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8 Communication Interfaces

The ECL-210 supports both GPIB and RS-232C communication protocols. This enables remote operation of the device, and integration in automated test and measurement systems. Although the two protocols are fundamentally different the core control commands are the same.

8-1. GPIB Control

A standard GPIB delta connector is used. Connections should be made using IEEE-488 compatible cables.

The GPIB protocol requires each device connected to the data bus to have a unique address. The ECL-210 allows addresses to be set in the range 00 to 30. The factory default setting is 01.

To enter the GPIB Address Setting Mode or to check the address that has been set press the SHIFT key followed by the Local key. The current GPIB Address will be displayed. To exit the Address Setting Mode without changing the address press the Local key twice in succession. To change the GPIB Address type in the required value using the number keypad. The address is saved by pressing the Local key twice in succession.

When GPIB remote control is active the 'Remote LED' on the front panel will be lit. Control is returned to the front panel by pressing the Local key on the front panel. The GPIB Local Lockout command (LLO) can be issued to prevent operation of the front panel Local key. In Visual Basic this command is issued using the 'Call SendLLO(0)' code. When the Local Lockout command has been issued control can only be returned to the front panel using the GPIB Interface Clear command (IFC). In Visual Basic this is issued as 'Call SendIFC(0)' where '0' is the GPIB interface number.

CAUTION

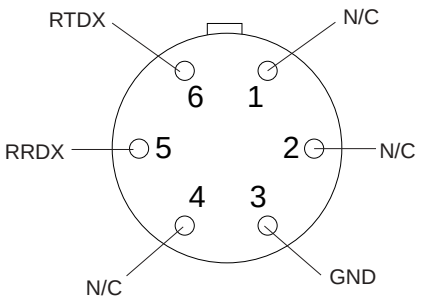
Please ensure the power to the unit is turned off before connecting or disconnecting either the GPIB or RS-232C interfaces.

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8.2. RS-232C Control

The ECL-210 provides support for RS-232C communication through the SIF connector on the front panel. The RTDX (transmit) terminal of the ECL-210 should be connected to the receive terminal of the external device (e.g. computer). The RRDX (receive) terminal of the ECL-210 should be connected to the transmit terminal of the external device. Please ensure that the handshake line on the external device is closed. The terminals for the SIF interface (Hirose HR10-7P-6S) are listed below:

1	N/C	Not used (Do not connect)
2	N/C	Not used (Do not connect)
3	GND	Ground
4	N/C	Not used (Do not connect)
5	RRDX	RS-232C Receive
6	RTDX	RS-232C Transmit



NOTE

This is a SIF connector on the front panel looking from the front.

The following table lists the communication conditions that should be set to enable communication through the RS-232C interface of the ECL-210.

Communication Method	Full Duplex
Baud rate	9600 bps
Data Length	8 bit
Stop Bit	1 bit
Parity	None
Flow Control	None

The delimiter for RS-232C communication is set in the factory as CR (carriage return). This can be changed when power to the ECL-210 is initially switched on. For an explanation of this procedure please see Section 7.1 Power On.

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[RS-232C Sample Connection]

D sub 9 pin connector

No.	Signal	
1	Data Carrier Detect	DCD
2	Receive Data	RXD
3	Transit Data	TXD
4	Data Terminal Ready	DTR
5	Signal Ground	SG(GND)
6	Data Set Ready	DSR
7	Req uest To Send	RTS
8	Clear To Send	CTS
9	Ring Indicate	RI

SIF Connector

No.	Signal
1	N/C
2	N/C
3	GND
4	N/C
5	RRDX
6	RTDX

D sub 25 pin connector

No.	Signal	
1	Frame Ground	FG
2	Transit Data	TXD
3	Receive Data	RXD
4	Req uest To Send	RTS
5	Clear To send	CTS
6	Data Set Ready	DSR
7	Signal Ground	SG
8	Data Carrier Detect	DCD
9		-
:		-
25		-

SIF Connector

No.	Signal
1	N/C
2	N/C
3	GND
4	N/C
5	RRDX
6	RTDX

CAUTION

If pingassignment is connected incorrectly, ECL-210 might be broken down. Be careful when connecting it.

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8.3. Control Commands

The table below lists the control commands specific to the ECL-210 which can be implemented using either the GPIB or RS-232C protocols. A command consists of two letters and may be written in either upper or lower case. As appropriate, the commands can be issued with or without a numerical suffix. A delimiter must be attached to the end of each command to ensure correct execution and termination of each command line. The delimiter required for GPIB operation is CR+LF. The delimiter required for RS-232C operation can be CR, LF or CR+LF. This delimiter is set in the factory to CR and this can be changed during the 'Power On' procedure; for details see Section 7.1 Power On.

To access individual units in the MLS-2100 or MLS-8100 racks it is necessary to prefix the command with a slot indicator; for example the command "B:WA1550.120" sets the wavelength of the ECL-210 unit in slot B of the rack to 1550.120nm. The MLS-2100 has two slots A and B, the MLS-8100 has eight slots indicated by the letters A to H.

To read data from the ECL-210 it is first necessary to set the output parameter to the required data parameter. When subsequent read commands are issued the data corresponding to the set paramter is output. In RS-232C communication "echo-back" is used to verify correct communications. Once the output paramter has been set the DI command is used to request data from the unit. In both GPIB and RS-232C protocols when a command is issued that cannot be interpreted the ECL-210 outputs "NR" to the next data request. This output stops when a valid command is received.

Command	Description	Format
LO	Switches LD inj ection current on.	LO
LF	Switches LD inj ection current off.	LF
WA	Sets output variable to indicate actual wavelength.	WA
	Sets wavelength to a specific value (nm).	WA x x x x .x x x
	Sets output variable to indicate target wavelength (nm).	WAT
OP	Sets output variable to indicate actual optical power (dBm).	OP
	Used with APC control, sets target optical power (dBm).	OP x x .x x
	Sets output variable to indicate target optical power (dBm).	OPT

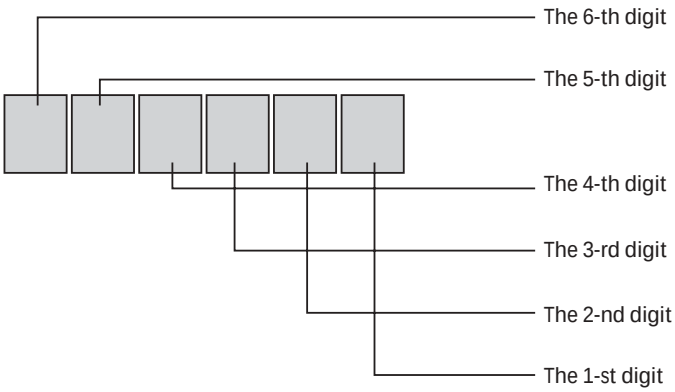
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CU	Sets output variable to actual LD inj ect current (mA).	CU
	Used with ACC control, sets target LD inj ection current (mA).	CU x x x .x x
	Sets output variable to target value for LD inj ect current (mA).	CUT
AO	Sets control mode to ACC mode (ACC on).	AO
AF	Sets control mode to APC mode (ACC off).	AF
AT	Sets output variable to indicate attenuator setting (dB).	AT
	Sets attenuator setting to a specific value (dB).	AT x x .x x
	Switches automatic attenuator control mode on.	ATE
	Switches automatic attenuator control mode off.	ATF
TL	Sets output variable to indicate actual LD temperature (˚C).	TL
	Sets target value for LD temperature (˚C)	TL x x .x x x
	Sets output variable to indicate target LD temperature (˚C).	TLT
FI	Sets output variable to indicate actual fine tuning setting.	FI
	Sets target value for (target) fine tuning setting.	FI x x x .x x
	Sets output variable to indicate target fine tuning setting.	FIT
CO	Switches coherence control function on.	CO
CF	Switches coherence control function off.	CF
CV	Sets output variable to indicate coherence control setting.	CV
	Sets coherence control setting to specific value (range 0-10).	CV x x .x x
RE	Initiates reset of MLS rack and ECL-210 units.	RE
XW	Stores all current parameter settings to internal memory.	XW
SU	Sets output variable to indicate status.	SU*
DI	Receive data command for RS-232C communication only. The value of the output variable that has been set is received after this command is issued.	DI*

*This command does not support "echo-back" in RS-232C communication.

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Status Command



The SU command is provided to enable the current operation status of the ECL-210 to be probed. The command returns a positive or negative six digit number. The interpretation of the six digit number is detailed below:

- (minus) - LD injection current (laser) is on.
6-st digit 0 - Coherence control is off.
1 - Coherence control is on.
5-nd digit 0 - Normal operation.
4-rd digit 0 - APC mode is active.
1 - ACC mode is active.
3-th digit 0 - Temperature of LD and optics is stable (normal operation).
1 - Temperature of LD block and/or optical unit is greater than ±0.1˚C from target.
2-th digit 0 - LD current is within operating range (normal operation).
1 - LD current has reached its maximum limit.
1-th digit 0 - Normal operation.
1 - Filter is tuning.
2 - LD injection current is not at set value (tuning).
3 - LD injection current is not at set value and filter is tuning.

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9 Example Programs

9.1. GPIB Program

The following program provides an example of the use of the Control Commands for GPIB communication. The program is written in Visual Basic and has an input function to set the wavelength of an ECL-210 unit placed in slot A of a MLS rack, and an output function to read the current optical ouput power and the target optical output power of the same ECL-210 unit.

```
' Set Wavelength Routine                          ' Subroutine description
Private Sub Wavelength_Set()                     ' Sets routine name to
                                                 Wavelength_Set


' Define Variables                               ' Comment
Dim ans As String * 30                           ' Dimensions ans array as
                                                 String of length 30
Dim ecl210 As Integer                            ' Dimensions ecl210 as
                                                 integer
Dim ecl210a As Integer                           ' Dimensions ecl210a as
                                                 integer for error checking


' Initialise Device                               ' Comment
Call SendIFC(0)                                  ' Initialise GPIB interface
Call ibdev(0, 1, 0, T10s, 0, 0, ecl210)          ' Open and initialise device
Call ibln(ecl210, 1, 0, ecl210a)                 ' Check for device presence
                                                 (error checking)
gpib_dl$ = Chr$(13) + Chr$(10)                   ' Set Cr/Lf as delimitter


' Set Wavelength Subroutine                       ' Comment
ans = InputBox("Required Wavelength (nm)")       ' Ask user for required
                                                 wavelength value
Call ibwrt(ecl210, "A:WA" + ans + gpib_dl$)      ' Set wavelength to value
                                                 defined by user input


End Sub                                          ' End subroutine
```


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```
' READ POWER (dBm) ROUTINE                    ' Subroutine description
Private Sub Power_Read_dBm()                  ' Sets routine name to
                                              Power_Read_dBm

' Define Variables                            ' Comment
Dim ActualPower_dBm As String * 30            ' Dimensions array as
                                              String of length 30
Dim TargetPower_dBm As String * 30            ' Dimensions array as
                                              String of length 30
Dim ecl210 As Integer                         ' Dimensions ecl210 as
                                              integer
Dim ecl210a As Integer                        ' Dimensions ecl210a as
                                              integer for error checking

' Initialise Device                           ' Comment
Call SendIFC(0)                               ' Initialise GPIB interface
Call ibdev(0, 1, 0, T10s, 0, 0, ecl210)       'Open and initialise device
Call ibln(ecl210, 1, 0, ecl210a)              ' Check for device presence
                                              (error checking)
gpib_dl$ = Chr$(13) + Chr$(10)                ' Set Cr/Lf as delimitter

' Read Actual Power                           ' Comment
Call ibwrt(ecl210, " A:OP" + gpib_dl$)        ' Set output variable to
                                              actual output power in dBm
Call ibrd(ecl210, ActualPower_dBm)            ' Read set output variable
MsgBox (" Actual Power= " & Str(ActualPower_dBm)) ' Output read data to screen

' Read Target Power                           ' Comment
Call ibwrt(ecl210, " A:OPT" + gpib_dl$)       ' Set output variable to
                                              target output power in dBm
Call ibrd(ecl210, TargetPower_dBm)            ' Read set output variable
MsgBox (" Target Power = " & Str(TargetPower_dBm)) ' Output read data to screen


End Sub                                       ' End subroutine
```


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9.2. RS-232C Program

The following program provides an example of the use of the Control Commands for RS-232C communication. The program is written in Visual Basic and has an input function to set the wavelength of an ECL-210 unit placed in slot A of a MLS rack, and an output function to read the current optical ouput power and the target optical output power of the same ECL-210 unit. The communications port in this example is Com1 and requires the ActiveX MSComm component to be included in the program.

```
' Set Wavelength Routine                                    ' Subroutine description
Private Sub Wavelength_Set()                                ' Sets routine name to
                                                            Wavelength_Set

' Define Variables                                          ' Comment
Dim ans As String * 30                                      ' Dimensions ans array as
                                                            string of length 30
Dim ActualPower_dBm As String * 30                          ' Dimensions array as
                                                            string of length 30
Dim TargetPower_dBm As String * 30                          ' Dimensions array as
                                                            string of length 30

' Set Wavelength Subroutine                                 ' Comment
ans = InputBox (" Required Wavelength (nm)" )               ' Ask user for required
                                                            wavelength value
Form1.MSComm1.PortOpen = True                               'Open Port MSComm1 in Form1
                                                            of program
Form1.MSComm1.Output = " A:WA" + ans + Chr$(&HD)            Send value of wavelength to
                                                            Com port with CR delimiter.
Form1.MSComm1.PortOpen = False                              'Close Port MSComm1 in Form1

End Sub                                                     ' End Subroutine
```


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```
‘ READ POWER (dBm) ROUTINE                    ‘ Subroutine description
Private Sub Power_Read_dBm()                  ‘ Sets routine name to
                                              Power_Read_dBm

‘ Define Variables                            ‘ Comment
Dim ans As String * 30                        ‘ Dimensions ans array as
                                              String of length 30

‘ Read Actual Power Subroutine                ‘ Comment
Form1.MSComm1.PortOpen = True                 'Open port MSComm1 of Form1
Form1.MSComm1.Output = “ A:OP” + Chr$(&HD)    Set output variable to actual
                                              output power in dBm.
Form1.MSComm1.Output = “ A:DI” + Chr$(&HD)      ‘ Send receive data command
                                              for RS-232 (echo back)
For I = 1 To 1000000                          'Delay to wait for echo back
Nex t I
ActualPower_dBm = Form1.MSComm1.Input         Read data from MSComm1 port
MsgBox (“ Actual Power = “ & ActualPower_dBm) Output read data to screen
Form1.MSComm1.PortOpen = False                ‘ Close communication port

‘ Read Target Power Subroutine                ‘ Comment
Form1.MSComm1.PortOpen = True                 'Open port MSComm1 of Form1
Form1.MSComm1.Output = “ A:OPT” + Chr$(&HD)   Set output variable to target
                                              output power in dBm.
Form1.MSComm1.Output = “ A:DI” + Chr$(&HD)      ‘ Send receive data command
                                              for RS-232 (echo back)
For I = 1 To 1000000                          'Delay to wait for echo back
Nex t I
TargetPower_dBm = Form1.MSComm1.Input         Read data from MSComm1 port
MsgBox (“ Power = “ & TargetPower_dBm)        Output read data to screen
Form1.MSComm1.PortOpen = False                ‘ Close communication port


End Sub                                       ‘ End subroutine
```


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Care and Maintenance

10.1. Care

The ECL-210 is a precision optical instrument and as such requires reasonable care to be taken with its handling, operation and storage. In particular:

- Do not drop or expose the unit to shock as this may cause misalignment of the optics,
- Do not expose the unit to direct sunlight or to extremes of temperature or humidity,
- Avoid letting dust, water, oil or other dirt into the unit and do not operate the unit within such an environment.
- Do not apply a voltage exceeding that indicated in the specifications.

10.2. Maintenance

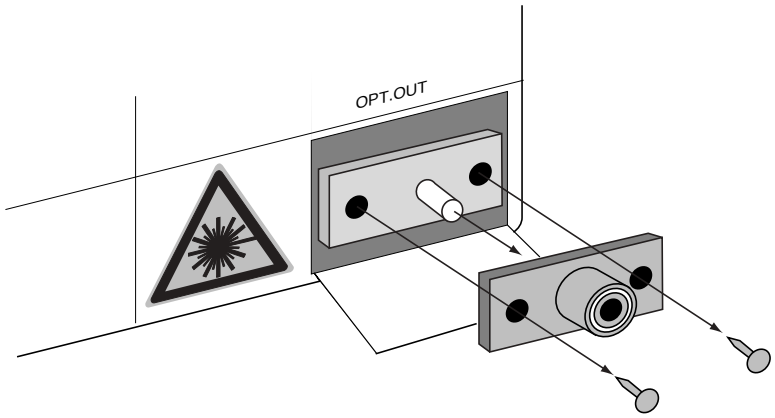
Occasional cleaning of the exterior surfaces of the unit may be required. Please do not use chemical cleaning agents. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone or similar solvents. A dry or slightly damp cloth is recommended.

It is also recommended that the optical connector is cleaned periodically with a cotton pad dipped in alcohol.

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10.3. Cleaning the Optical Connectors

It is important to ensure the optical connector of the ECL-210 remains clean. Any dirt that accumulates will cause increased loss and when high optical powers are used may lead to connector damage. Periodic cleaning of the optical connectors is recommended. This is achieved by removing the connector adapter as indicated in the cleaning procedure below.



1. Remove the two screws holding the connector adapters as shown in the diagram above.

2. Pull the connector adapters forward to remove it from the ECL-210 unit.

3. Carefully clean the surface of the protruding optical connector using a soft lint free cloth moistened with alcohol. Do not press unnecessarily on the end of the connector as this will cause it to become detached from its socket.

4. Carefully replace the connector adapter by sliding it over the protruding optical connector and tighten with the two fixing screws. The alignment notch in the connector adapter should be positioned at the top of the connector.

DANGER!!

This product uses a semiconductor laser. The laser beam may cause injury if it impinges the eye. Always ensure that the ECL-210 unit is off and no light is being emitted before cleaning the optical connector.

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10.4. Changing the Fuse

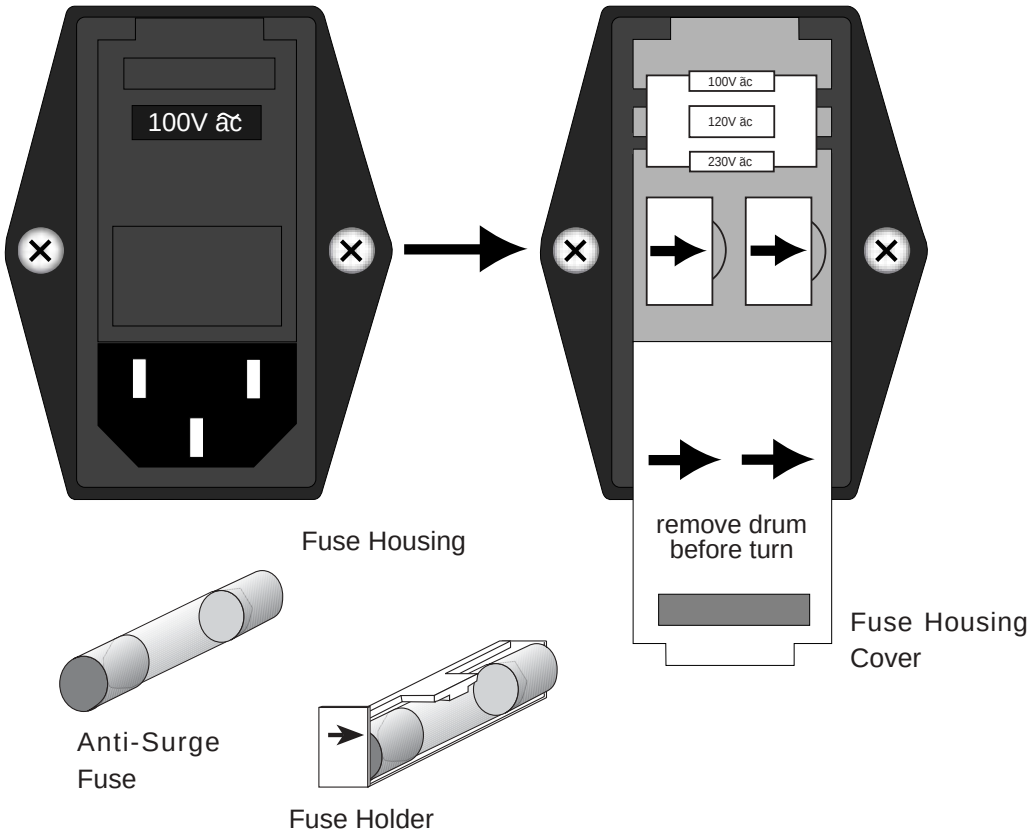
If the fuse blows it is important to determine the cause and repair the fault before replacement. The fuse rating is determined by the supply voltage as indicated below. Failure to use a fuse of the correct rating may result in damage to the equipment. An anti-surge type fuse is required.

Main Voltage	Fuse Rating
100V - 120V	6A/125V
230V - 240V	3.15A/250V

To change the fuse first remove the mains cord from the back of the instrument and open the cover of the fuse housing using a small screwdriver. Note the direction of the arrows on the end of each fuse holder. The fuse holders can then be removed by pulling from the housing.

When replacing the fuse holders into the housing, ensure that the direction of the arrows on the end of the fuse holder corresponds with the marking on the housing cover. Also, ensure that the housing cover is firmly closed before reconnecting the mains cord.

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CAUTION

Before changing the fuse, always disconnect the power cord from the power outlet.

NOTE

Inspection and calibration

The warranty for ECL-210 is one year.
We recommend to have ECL-210 inspected and calibrated regularly (1 year).
For inspection or calibration, please contact our sales team.

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11 Option

11-1 High Frequency Modulation (RF)

13-1-1. High frequency modulation characteristics

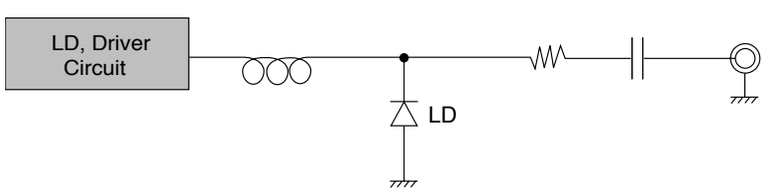
Modulation band	: 1-100MHz
Input level	: <0dBm
Input impedance	: 50Ω

13-1-2. Method

CAUTION

Do not apply voltage which is outside the input level. When not using high frequency modulation, terminate the high frequency modulation port. Otherwise optical output power may become unstable.
Input the high modulation signal only while the current is being injected into the LD. Otherwise, damage to the LD will occur.

The high frequency modulation terminal is connected to the LD through the matching resistor and condensor and has no protection. The input level must be kept low enough not to cause damage to the LD. The bias current is injected into the LD from the current driver through the coil.



Before inputting the signal, turn on power to the unit and turn on LD key.

13-1-3. Procedure

When using high frequency modulation, follow the following procedure.

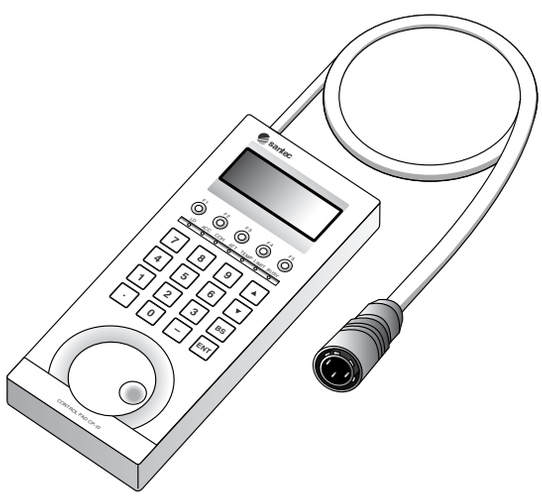
(1) Make sure that both ECL-210 and signal souce are off. Connect the signal source to the ECL-210 through the connection cable.
(2) Turn on ECL-210 and the signal source.
(3) Press LD key to inject the current to the LD.
(4) Feed the external signal to the LD.
(5) To shut off the current being injected into the LD, first turn off the external signal.

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11-2 Control Pad (CP-10E2)

11-2-1. Introduction

ECL-210 is designed with a simple and easy to use front panel interface. It has minimal function keys and does not have a numeric keypad for direct wavelength and power setting input. The CP-10 control pad addresses both of these issues, and provides full support of all functions in a compact, handheld design. The unit is programmable enabling up to 128 combinations of wavelength and power settings to be stored and wavelegnth sweeps to be performed.
The CP-10 unit connects to the ECL-210 unit through the front panel SIF connector and communicates through the RS-232C interface.



11-2-2. Function

(1) Direct command

(2) Digit input command

NOTE

Fore more details, please read CP-10E2 operation manual.

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11-3 Blank Cover

11-3-1. Introducation

A blank cover is for closing the ventilation from slot insertion of MLS and the ventilation hole inside MLS. Each unit is designed that the air fro cooling flows from the slot bottom inside MLS towards the upper parts. Without blank cover, the flow of the air for cooling is blockedd and heat dissipation is not fully performed.

11-3-2. Procedure

To install/uninstall the blank cover, please follow the following procedure.

Installation

(1) Insert a blank cover along with the guide of the slot insertion part of MLS.

(2) Insert it firmly to the back and fix it witht the fixed screw at the upper left of the unit.

Uninstallation

(1) Loosen and remove the fixed screw at the upper left of the unit.

(2) When empty slot is made insert new unit or avoid prolonged use.

(3) Please store the blank cover without bending the plate.

NOTE

If the plate of a blank cover has bent or damaged normal operation may not be able to be performed. Please store the blank cover undamaged.

NOTE

If empty slot is made insert a blank cover. Otherwise normal operation may not be able to be performed.

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11-4 Rack Mount Angle

This option is to attacch rack mount angles to fix ECL-210 to EIA or JIS standard rack. Ears for MLS-8100 are different from those for MLS-2100.

11-4-1. MLS-8100

(1) Remove a cover from where rack mount angles will be fixed.

(2) Fix the rack mount angle with screws.

(3) Fix ECL to the rack with screws.

NOTE

MLS-8100 weighs 8kg without the unit. Please be aware of dropping it when attaching it to the rack.

11-4-2. MLS-2100

11-4-2-1. Rack mount angle (A/B)

(1) Remove a cover from where the rack mount angle will be fixed

(2) Fix the rack mount angle with screws.

(3) Fix ECL to the rack with screws.

11-4-2-2. Rack mount angle (C)

(1) Remove a cover from where the rack mount angle will be fixed

(2) Fix the rack mount angle with screws.

(3) Fix ECL to the rack with screws.

NOTE

MLS-2100 weighs 6kg without the unit. Please be aware of dropping it when attaching it to the rack.

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11-5 RS-232C Cable

RS-232C is available for ECL. This is a cable to connect RS-232C, TTL serial communication connector and PC.

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12 Troubleshooting

Problem	Possible Cause	Remedy
Unable to switch on.	Power cable is unplugged.	Make sure the cable is plugged in.
	No fuse in unit.	Open the fuse holder cover on the rear panel and check the supply voltage and fuse.
	Fuse is blown.	
	Wrong supply voltage.	
No light output.	LD is not switched on.	Select correct ECL-210 unit and switch LD on.
Output power is low.	Mode setting is incorrect.	Set to APC mode and check APC power setting.
	Optical connector is not clean.	Clean optical connector of both ECL-210 and connecting fiber.
	Optical connector is incorrect type.	Check connector type of ECL-210 unit and connecting fiber.
Unable to use front panel.	In GPIB remote mode.	If the GPIB remote LED is lit, press local key to release the GPIB remote mode. Note this function will not work if the Front Panel lockout command has been issued via GPIB.
	Unit is initializing (after ECL-210 unit has been inserted in slot).	Wait for initializing procedure to complete.
GPIB Communication is not possible.	GPIB address is not set correctly.	Press Shift + Local to check GPIB address and set if necessary.
	Delimiter setting is incorrect.	Check the delimiter setting.
	Cable is not connected properly.	Check the connection of the cable.
RS-232C Communication is not possible.	Communication protocol is incorrect.	Check the communication protocol.
	Delimiter setting is incorrect.	Check the delimiter setting.
	Cable is not connected properly.	Check the connection of the cable.
	Cable is not wired correctly.	Check the pin assignment of the cable.

If after checking the above, the unit is still not operating correctly please contact Santec's technical support division.

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13 Warranty

This product is warranted by Santec Corporation of Japan against defect in material or workmanship for a period of one year from the date of delivery. In the event that a defect occurs during the warranty period, Santec Corporation of Japan will repair this product within a reasonable period of time after notification, free of parts and labor charges, provided that (a) the defective unit is returned to Santec Corporation of Japan, if required, or a specified Santec repair facility; (b) all shipping/customs costs to Japan are paid by the owner of the defective product; (c) the defective unit has not been damaged by power failures or power surges, fire, water, pest or rodent infestation, an act of war, or any other act of nature; and (d) the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair will render this warranty VOID. Santec will not be responsible for the product when the seals have been broken or damaged.

This warranty is effective only for the original purchaser of this product and is NOT transferable.

All other expressed warranties are disclaimed and all implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose, are limited in duration to a period of one year from the date of delivery. In no event shall Santec Corporation of Japan nor any subsidiary of Santec nor any distributor of Santec's products be liable to the customer for any damages, including lost profits, or other incidental or consequential damages arising out of the use or inability to use this product.

All requests for repair or service under this warranty must be made as soon as possible after the defect has been noticed and must be directed to the original seller of the product, whether a distributor of Santec's products, a subsidiary of Santec Corporation, or Santec Corporation of Japan.

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