



Classical 3100

USER'S MANUAL

Operation Manual

for RID3110 Refractive Index Detector

V1.0.0

Statement

The manual describes various contents of RID3110 refractive index detector. It is intended to help users to understand, use and maintain the instrument of RID3110. Our company. does not assume the responsibility caused by the manual.

The manual is subject to change without notice.

This manual has been published after careful review. It is believed to be accurate and complete. Our company is not responsible for any error that may appear in the manual and the resulting incidental or renewal of harm.

In any case, Our company. is not responsible for the impact caused by the use of the manual and equipment.

The copy right of this manual is owned by Our company. Without the authorization of the company, any unit and individual shall not copy, reprint or reproduce it in whole or in part.

Precautions

Thank you for your continue patronage. Observe the following precautions in order to ensure correct and safe use of the instrument.

According to the level of danger and harm, safety signs here are divided into the following three categories:



[Warning] Failure to properly follow the instructions and precautions indicated by this sign can result in serious injury or damage to health and property. The property damage includes the environment around and the instruments.



[Caution] Failure to properly follow the instructions and precautions indicated by this sign can result in slight injury or damage to health and property. Slight injury means no hospitalization is needed to the wounded. Slight property damage means the instruments can be recovery through simple maintenance.



[Note] The sign is used wherever information is given to ensure optimal performance of the instrument.

1. Precaution for usage



[Warning] RIRID3110 refractive index detector should only be used as a part of liquid chromatography. Do not use it for any other purpose. Except for special instructions, the instrument does not have explosion-proof function.

2. Ambient Conditions



[Warning] When the organic solvents are used, it is recommended that interior must be well ventilated and the firework should be prohibited. Also, a sink or equipment for washing eyes should be installed nearby in case of the organic solvent contacting with the eyes or skin.



[Note] In order to ensure high efficiency, keep the instrument away from caustic gas and dusty environment. The worktable should be neat, smooth, firm, and big enough. Ambient should be between 10°C to 30°C with a small fluctuation, and RH should be between 45% to 85%. Keep it away from cold or hot source as well as direct sunshine. The system should not be close to strong magnetic field.

3. Precaution for installation



[Warning] The instrument should be installed following the instructions strictly by professionals, make sure that the voltage of the power sockets the same as the power supply voltage indicated on the instrument. Using the wrong power voltage could result in danger and fire.

The accessory power cable should be used to connect the instrument to the power socket. Other cable should not be used.

Make sure the line cord is connected to a properly grounded power receptacle to prevent static and electric leakage.



[Caution] The instrument is so heavy, you should move it carefully and watch your hands at the same time.



[Note] The instrument should be connected following the instructions strictly. Wrong connection could cause communication error.

4. Precaution for use



[Warning] Do not use the instrument in places where heat resource, fire seat, magnetic resource, strong vibration exist or may exist. It is prohibited to play flammable nearby.

The bottle for storing the mobile phase should have pore in cap to prevent danger caused by negative pressure in the bottle.

A gap between waste tube and the cork of waste bottle is necessary to prevent the waste bottle bursting when it is overfilled. The gap should be smaller to insure less evaporate of hazardous solvents. Even though, the waste needs to be clean up promptly.



[Caution] When using organic solvents, please wear safety goggles, special lab coats, gloves mask etc. If your body is exposed to toxic solvent accidentally, wash it immediately, and then go to hospital for specialized treatment.



[Note] When preparing mobile phase, please use HPLC-grade or equivalent at this level solvents. Solvents must be prefiltered by the manufacturer with 0.45 μ m (or smaller) filter paper. Degas all mobile phase before using it. Degassing can help to ensure a stable baseline and consistent analytical results.

Before first use, rinse the entire piping system according to the requirements of the manual, direct use is likely to block pipeline.

Before sample test, ensure that the pipeline in the system is filled with mobile phase without any bubble, otherwise it will affect the reliability of test results.

If an eluent is replaced with another eluent in which is insoluble, such as positive mobile phase (hexane) and reverse phase (methanol), be sure to operate according to the specified method in the manual, otherwise it will cause serious pipeline jam, and even system paralysis.

Do not use the following solvent: concentrated sulfuric acid, nitric acid, dichloroacetic acid, methylene chloride, chloroform, chloroform, dimethyl sulfoxide, acetone, tetrahydrofuran, etc. Such solvents always reduce the strength of the PEEK material, make it become fragile and broken, but the impact of short-term use of aqueous solution of acetone(lower than 0.5%) in gradient performance, the impact is receptive.

When using PEEK pipes, the pressure of system should be lower than the tolerance pressure of peek material, otherwise it may burst.

The bending radius of peek pipe should be more than 10mm, make the peek pipe natural relaxation during installation.

The PEEK pipe should be intercepted with professional tube cutter in order to make the pipe more smoothly. Pay attention to that there should be no cutting debris left in the pipe.

5. Repair, maintenance and parts replacement



[Warning] Before repair, maintenance and parts replacement, please turn off the power in case of leakage and electric shock.

There is no need to open the host cover while daily maintenance and repair. If the repair needs to open the host cover please entrust agents or communicate with us.

Use dry cloth to wipe the instrument. Do not use water or alcohol. The use of these liquids may erase characters or color on the panel.

Do not replace parts (e.g., fuses, deuterium lamp, etc.) from other company or other type, all accessories are required to be specified to prevent danger.

6. Precaution for static electricity



[Warning] As the system may use a lot of flammable, explosive organic reagents which can contaminate laboratory air. When the reagent concentration is too high, any spark or flame could cause fire or explosion accidents. Do not use the instrument near any fire resource, hot resource, and static electricity resource. To reduce static electricity, please take the following measures:

- 1) Make the instrument grounded. It is very important, please pay attention to it.
- 2) Maintain proper indoor humidity (humidity is greater than 65% can prevent static electricity effectively) and keep the environment clean.
- 3) Metal waste bottles (external conductive) should be grounded (no ground insulation). When using other materials container, you can insert one end of the wire into liquid in the bottle and make the other end earthed.
- 4) Replace a larger I.D. pipe when the flow of mobile phase flow is higher.
- 5) Wipe the instrument regularly.
- 6) Staffs should wear anti-static clothing. An anti-static bag is needed on the floor.
- 7) People and objects with static electricity is prohibited to touch the instruments.

7. Warning label instructions

To ensure the safety of staffs, we attach warning labels on the equipment where are dangerous. If the label is missing, please request new ones from the company, and attach to the correct position.

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1. Chapter One: Introduction

EClassical RID3110 Refractive Index detector (The following is referred to RIRID3110 detector.) is developed for the market demand, as a result of 20-year wisdom collection of Our company. It can easily be used with other units such as LC pump, autosampler, column oven etc. Also it can be used as a detection tool.

In a refractive index detector of the deflection type, the light beam undergoes a deflection in proportion to a difference in refractive index between one liquid and the other as it passes through the two compartments of the flow cell, each being filled with a different liquid. The deflection of the light beam is taken as a displacement on the light-receiving element and is displayed as a difference of the refractive index.

EClassical 3100 HPLC Series include P3100 constant flow pump, high pressure injector, LC column, data workstation etc. For more information, please contact Our company.

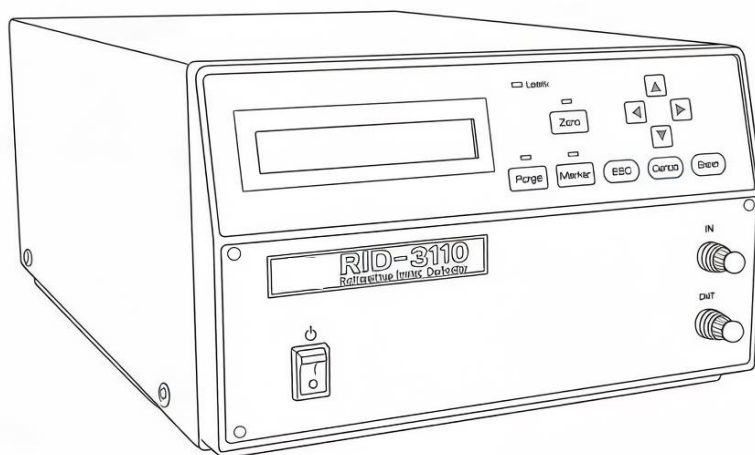


Figure1-1 EClassical RIRID3110 Refractive Index detector

1.1 Features and Functions

Stability

The double temperature control system provides for a very fast start up time and excellent stable baseline performance.

Safety

Solvent leak sensor generates an output signal that stops pump flow in case of an eluent leak within the detector.

Integration

Well-organized Output signal terminals and LAN communication port guarantee

High-level integration and automation in conjunction with your HPLC system.

1.2 Performance Specification

Table 1-1 Performance Specification of RIRID3110 detector

Items	Specifications
Light source	tungsten lamp
Response time	0.1 , 0.25 , 0.5 , 1.0 , 1.5 , 2 , 3 , 6 sec
Construction	Deflection type
Refractive Index Range	1.00-1.75
Range	0.25-512 μ RIU
Linearity	600 μ RIU
Auto Zero	Full automatic(Optical & Electrical Auto-Zero)
Base line shift	Range; 0 $\sim$ 10000 nRIU, Resolution; 50 nRIU
Integrator Output	0 $\sim$ 1V / FS (Sensitivity : 2mV / μ RIU , 8mV / μ RIU)
Recorder Output	0 $\sim$ 10mV / FS
External Signal Output	(1) Ready(Temperature control stable) (2) Solvent Leak (3) Error (One of following error occurred) ROM/RAM/Parameter Home Position Over heat Optical Balance Intensity (Contact Capacity : DC24V 0.1A max.)
Temperature Control	OFF , 30 $\sim$ 50 $^{\circ}$ C (1 $^{\circ}$ C increment) : 77 $^{\circ}$ C Temp. Fuse (Note) External temperature control is set to a temperature 5 $^{\circ}$ C lower than the set temperature. a
External Communication	LAN
Cell Volume	8 μ L
Maximum Flow Rate	10 ml/min (mobile phase : pure water)
Pressure Rating	50 kPa (0.5 kgf/cm ²)
Internal Volume	Inlet Port / Flow Cell : approx. 60 μ l Flow Cell / Outlet Port : approx. 600 μ l Total : 670 μ l
Wetted Material	SUS316, Teflon, Quarts Glass
EMC Standards :	EN61326-1
Safety Standards :	EN61010-1

1.3 Physical Specifications

Table 1-2 Physical Specification for RIRID3110 detector

Weight	Approx. 12 kg (27 lbs)
Dimensions	260 mm (W) x 150 mm (H) x 400 mm (D)
Power Requirement	AC 100 ~ 240 V $\pm 10\%$ 50 / 60 Hz
Power Consumption	150 VA (maximum)

2. Chapter Two: Installation and transport

2.1 Standard Accessories

RID3110 detector is packaged with corrugated boxes and foam lined structure. When you receive the instrument, check the packaging first. If the packaging is damaged, please contact with Our company. or local dealer.



[Warning] If there is any damage to the instruments when you receive it, please don't try to install it. You can ask Our company to inspect and assess it.

2.1.1 Demolition of the Packing

Put the detector on level ground with the face of the packing box up. Cut the tape on the top, take out the pump and accessories package, place it on the table. then, remove foam, open the instrument protective film.



[Warning] The detector is heavy, it is suggested that installation operation requires at least two people to prevent instrument slide.

2.1.2 Deliver Checklist

Before installing, please check the deliver list carefully, if one or several of them omissions, please communicate with Our company. Or local distributors as soon as possible.

Table 2-1 Deliver list of RID3110 detector

NO.	Items	Quantity
1	RID3110 Refractive Index detector	1 pc.
2	RID3110 Refractive Index detector Startup Package	1 pc.



[Note] If there is discrepancies between the packing list in the box and in the specification, please refer to the packing list in the box, It is subject to change without prior notice.

2.2 Installation Requirements

2.2.1 Site Requirements

Environment

RID3110 detector need to work under ambient conditions in Table 2-2 below:

Table 2-2 Environment requirements

Items	Specifications	Requirements
1	Work environment	Room should be free of dust, inflammable and explosive materials, good ventilation is also important
2	electromagnetic field	No electromagnetic noise nearby
3	Operating temperature	4~40℃(39~104°F)
4	Humidity	20%~80%, non-condensing
5	Temperature fluctuation	< ± 2℃ /hour



[Caution] Do not use the detector under conditions of temperature fluctuations. If the ambient temperature is too low, make the room temperature increase slowly to avoid condensation inside caused by rapid heating.

Bench space

The RID3110 detector can be placed on any normal laboratory bench. If you want to display the complete EClassical 3100 system on the bench, make sure that the table can bear the weight of all components. It needs additional space of 50mm on the left, 150mm on the right, 150mm on the back to facilitate the circulation of air and electrical connections.



[Warning] The instruments should be placed on a horizontal position, otherwise there is a danger of falling!

2.2.2 Power and Power Line

Connect the detector to the power source according to the following procedure:

- 1) Confirm that the type of the power socket into which the detector power cable is plugged is of a 3P type with a grounding terminal.
- 2) Confirm the voltage of the power socket into which the detector power cable is plugged is the same as the voltage indicated on the rear panel of the detector.

- 3) Turn off the power switch □ 1 of the detector.
- 4) Connect the detector to the power source using the accessory power cable.



[Warning] Prior to connection, make sure that the voltage of the power socket into

which the detector power cable is plugged is the same as the power supply voltage indicated on the detector.

The type of the power socket into which the detector power cable is plugged should be of a 3P type with a grounding terminal. Other type of power socket should not be used.

The accessory power cable should be used to connect the detector to the power socket. Other cable should not be used.

Do not use the detector in places where combustible gas or any source of fire or of spark exists or might exist.

As the detector is readily affected by the ambient temperature, use it in places where there is little wind or change in the ambient temperature.

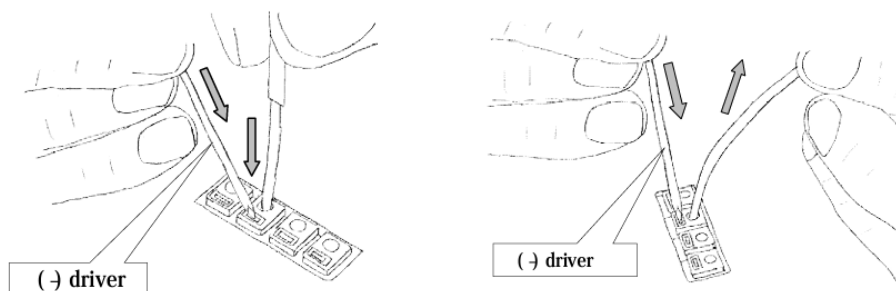
Do not use the detector near any source of vibration, electrical noise or in places where corrosive gas and a lot of dust exist.

Please do not set other equipments on this detector because of avoiding enlarging the baseline drift and uncontrolling the temperature.

2.2.3 Communication Connection

Make correct connections using the provided signal cables in accordance with the figures below.

Connect red wire to ”+” terminal, white wire to ”-“ terminal and clear wire to “FG”. External input/output (Auto Zero-In, Marker-In, Purge-In, Ready-Out, Leak-Out, and Error-Out) are for contact closure. Never apply voltage to those.



Inserts the end of lead wire while pressing the button with (-) driver.

<connect the wire>

For the contact signal out (Ready, Solvent Leak, and Error) cable connection, please use duplex lead wire.

Then, remove the (-) driver to lock the wire. Make sure the wire is firmly grabbed.

<disconnect the wire>

2.3 Tube Connection

In addition to the column system, piping, fittings and injector, detector volume are likely to cause bands broadening. Inappropriate tube material also leads to band broadening, even to degeneration of the sample. Please connect the tubes with instruments correctly to improve efficiency. The tips are as follows:

2.3.1 Tube Material

Different material of tube is required according to the working pressure, the kind of mobile phase and the nature of sample. The commonly used tube materials are as follows: stainless steel, polyetheretherketone (PEEK), polytetrafluoroethylene, polyethylene or polypropylene. The most commonly used material is stainless steel. The outer diameter of LC connection tube is 1.59mm (1/16 "), the inner diameter of LC tube are 0.175mm (0.007"), 0.25mm (0.01 "), 0.5mm (0.02"), 0.75 (0.03 ") mm and 1.0mm (0.04") etc., user can choose from them. Stainless steel tube is generally used for high-pressure part.

Polymer tube can be used in low-pressure part of LC System, such as from reservoir bottle to pump, detector outlet, injector discharge port, etc. The polymer tube is the most common connection tube in LC system.

PEEK tube can withstand about 30MPa pressure, it is more inert than stainless steel pipe which means it is a good choice for separation, analysis and preparation of biological samples. In bio-separation system, PEEK is alternative materials for stainless steel.

2.3.2 Cleaning the Connection Tube

Please wash new pipeline with solvent before use. Cleaning order: chloroform - methanol (ethanol) - Water -1 mol/L nitric acid - water - methanol – dry nitrogen stream. Also, silicone tube should be rinsed with methanol before use.

2.3.3 EClassical 3100 System Connection Instance

When connecting this detector to a high performance liquid chromatograph through tubes, wash the chromatograph and columns thoroughly with the eluent in use and make sure that the eluent is clean before connecting the tube.

- 1) Connect the eluent inlet joint □11 to the outlet of the column to be used through the provided IN TUBE. When fastening the stainless steel set screw of the IN TUBE, grip the eluent inlet joint □11 with a spanner.
- 2) Connect the supplied OUT TUBE to the eluent outlet joint□12 .efore connecting the tube. Connect the tubes in accordance with the following procedures :

2.4 The Front Panel

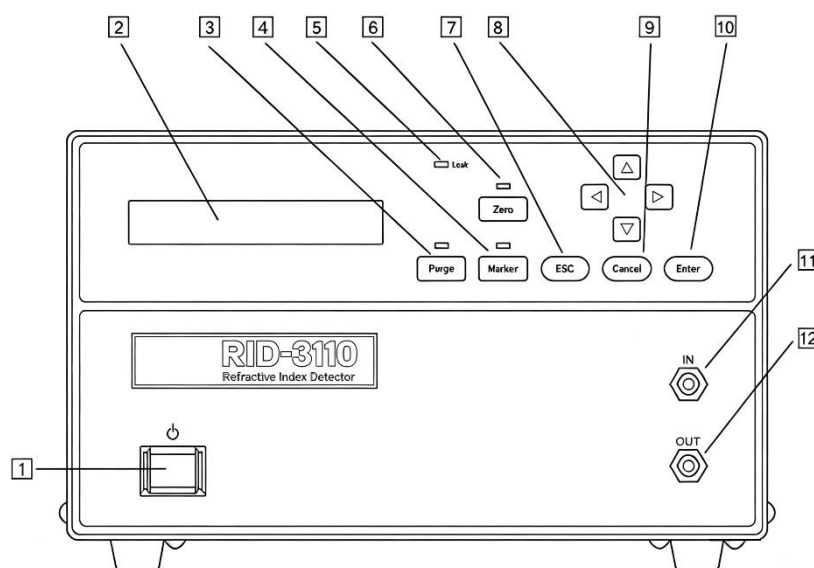


Fig.2-1 RID3110 Front panel

Table 2-3 Front panel Function

No.	Key	Function
1	Power Switch	Press this key once to turn on or off the unit.
2	LCD Display	A 24-digit 2-row character display panel. This is used for displaying or setting various parameters.
3	Purge Key [Purge]	Press the Purge key to turn the purge valve on or off to change the □ 3 flow path. When the valve is on, the LED above the key will be lit and the eluent will flow through the reference cell chambers. Press Purge to turn off the valve
4	Marker Key [Marker]	Press Marker key to generate an event marker signal and add it to the recorder output. During this function, the LED above the key will be lit.
5	Leak LED[Leak]	Illuminated when solvent leak is detected.
6	Auto Zero Key [Zero]	Press the Zero key to activate "Auto-Zero". The display shows "AUTO ZERO" when Auto Zero is active.
7	ESC Key[ESC]	Press the ESC key to cancel an operation and return to the normal screen.
8	Arrow Keys [▲▼▲▼]	Press Arrow keys to move cursor or to edit values.
9	Cancel Key[Cancel]	Press Cancel key to cancel change and to stop beep.
10	Enter Key[Enter]	Press Enter key to finalize operations or settings.
11	Inlet Port[IN]	Connects tubing from separation column outlet.
12	Outlet Port[OUT]	Eluent passing through the flow path is discharged from this port.

2.5 The Side Panel

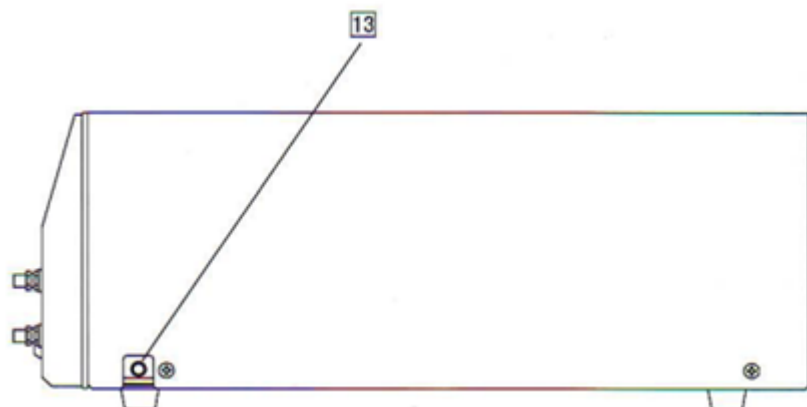


Fig.2-2 RID3110 side panel

Table 2-4 Rear panel function

No.	Components	Function
13	Drain Port	In case of internal eluent leak, the eluent will be discharged from this port. Connect the attached tubing as necessary.

2.6 The Back Panel

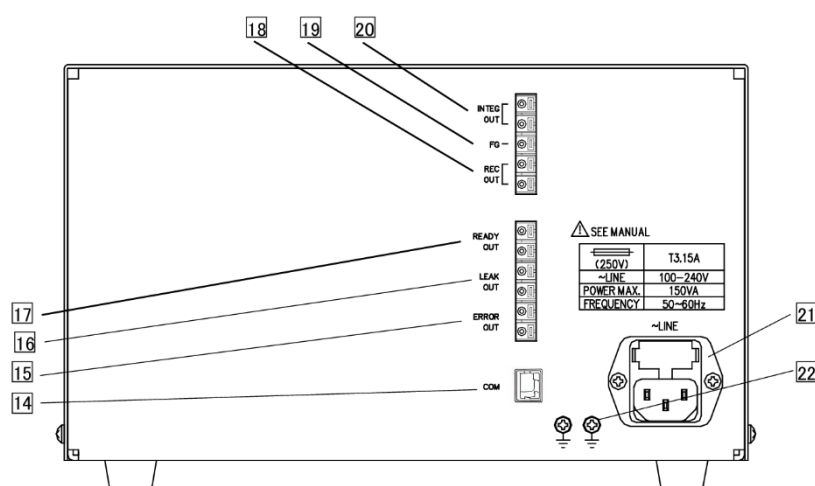


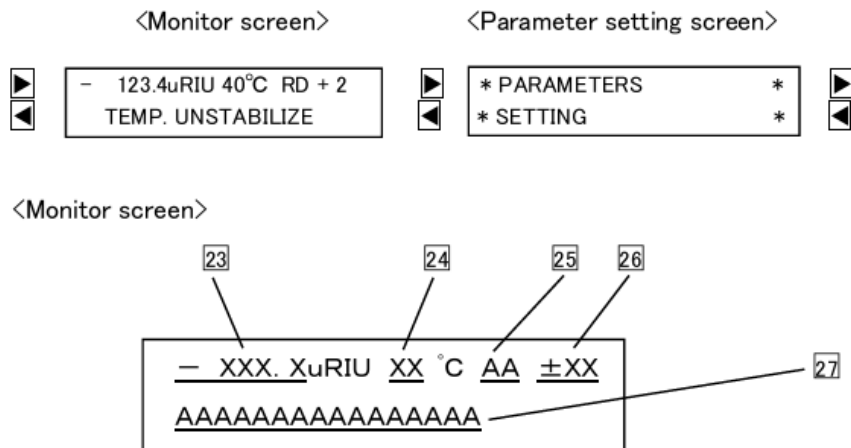
Fig.2-3 RID3110 back panel

Table 2-5 Rear back function

No.	Components	Function
14	Communication port [COM]	LAN communication port
15	Error out terminals [ERROR OUT]	A contact signal is sent out through these terminals when an error occurs. (ROM, RAM, Parameter, Home Position, Overheating, Optical Balance, Intensity)
16	Leak out terminals	A contact signal is sent out through these terminals when aneluent leak is detected.
17	Ready out terminals [READY OUT]	A contact signal is sent out through these terminals when 10 minutes have passed since the temperature of the optical system reached the designated value.
18	Recorder terminals [REC.OUT]	Signals to the recorder are sent out through these terminals. The sensitivity of the output signal is 10 mV/FS.
19	Ground terminal for the signal cable [FG]	The shield terminal of the signal cable should be connected to this terminal.
20	Integrator terminals [INTEG. OUT]	Signals to the data processing unit are sent out through these terminals. The sensitivity of the output signal is 2 mV/ μ RIU or 8 mV/ μ RIU with the integrator range of 512 μ RIU/V or 128 μ RIU/V, respectively.
21	Power connector [~LINE]	The included power cable should be plugged into this connector.
22	Ground terminals	These are the terminals to ground the main body of the detector.

2.7 Display

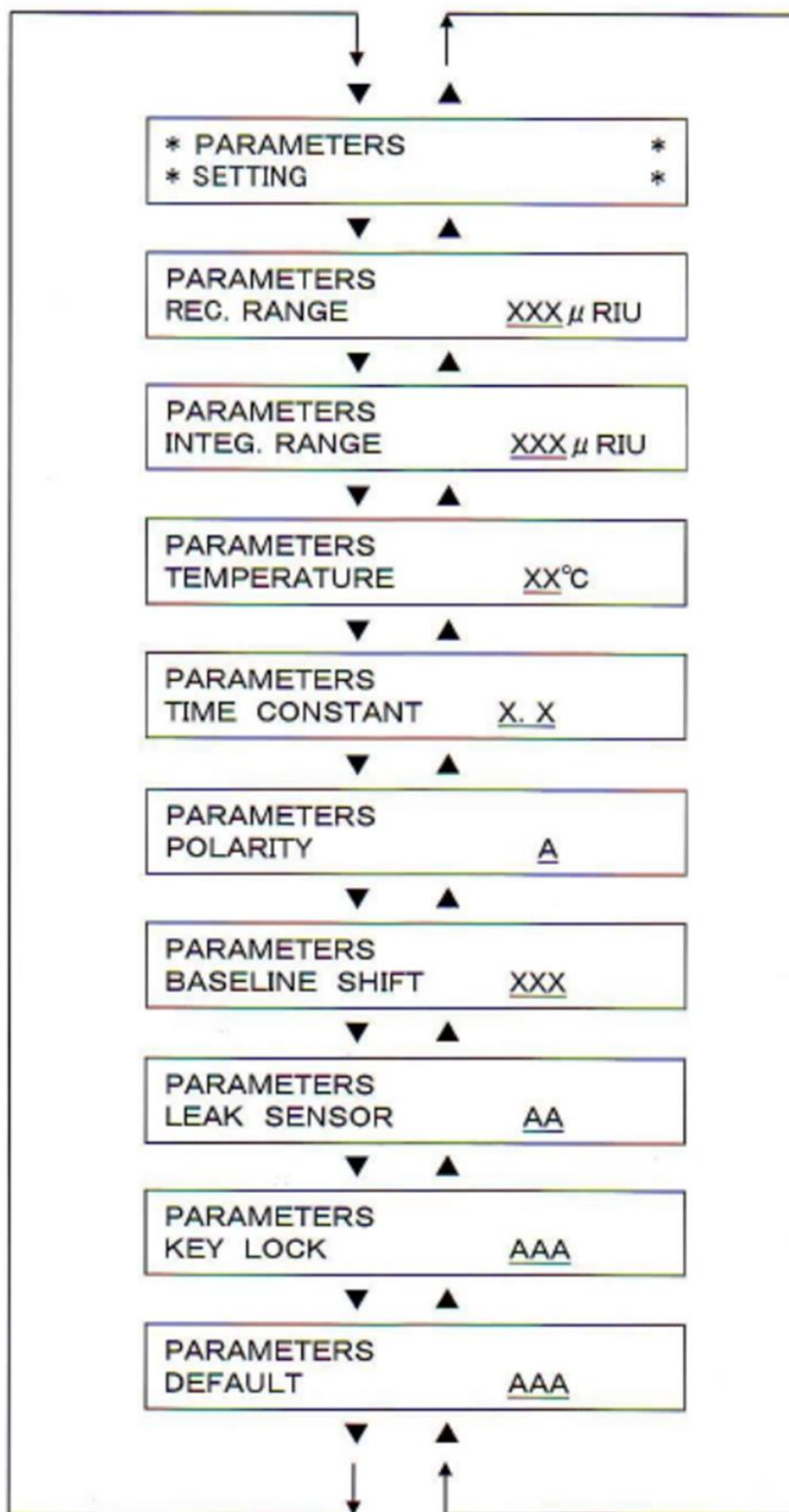
The display shows a “Monitor screen” when the detector is started and can be switched to a “Parameter setting screen” when the  key or the  key is pressed.



编号	功能
23	This indicates the refractive index in μ RIU unit.
24	This indicates the temperature of the optical system
25	One of the following is displayed in response to the detector status. (1) LK: Key Lock status (2) ER: Error status (3) RD: Stable temperature status
26	This indicates the current state of optical axis balance in a range of -99 to +99. Press Zero to display -3 to +3.
27	This indicates error or operation status. If there are multiple messages to be displayed, the priority message is displayed. (1) ROM: Is displayed when a ROM error has occurred. (2) RAM: Is displayed when a RAM error has occurred. (3) PARAMETER: Is displayed when a parameter memory error has occurred. (4) HOME POSITION: Is displayed when the optical axis is not adjusted correctly. (5) LEAKAGE: Is displayed when eluent leakage has occurred. (6) TEMP. ERROR: Is displayed when the temperature sensor has a problem. (7) OVER HEAT: Is displayed when the temperature is excessively high. (8) OPT. BALANCE: Is displayed when Auto Zero does not function correctly. (9) INTENSITY: Is displayed when the light intensity is low due to bubbles or dirt. (10) TEMP. UNSTABLE: After the detector is started, this remains displayed until the temperature remains within $\pm 1^{\circ}\text{C}$ of the set temperature for 10 minutes. (11) PURGE: Is displayed when the detector is in purge status. (12) AUTO ZERO: Is displayed when the Auto Zero function is active.

To change parameters, perform the following procedures:

- (1) Display the relevant parameter.
- (2) Press the Enter key. The underlined digits will flash and the parameter can be changed.
- (3) Press the  key or the  key to change the parameter.
- (4) Press ENTER key to finalize the parameter.
- (5) Press ESC key to return to the monitor screen.



No	Parameter	Selectable value	Unit	Default
1	REC.RANGE	0.25, 0.5, 1., 2, 4, 8, 16, 32, 64, 128, 256, 512 (12 Steps)	uRIU/10mV	512
2	INTEG. RANGE	128 , 512	uRIU/1024mV	512
3	TEMPERATURE	OFF , 30~50 (1 Step)	°C	40
4	TIME CONSTANT	0.1 , 0.25 , 0.5 , 1 , 1.5 , 2 , 3, 6 (8 Steps)	sec	1.5
5	POLARITY	+ , -	-	+
6	BASELINE SHIFT	0~200(50nRIU increment)	-	0
7	LEAK SENSOR	ON, OFF	-	ON
8	KEY LOCK	YES, NO	-	NO
9	DEFAULT DATA	YES, NO	-	NO

2.8 Operation Procedures

Use the detector in accordance with the following procedures:

- 1) Set the parameter on operating parameter-setting screen .
- 2) Start pumping mobile phase solvent at flow rate 1 mL/min to reference cell (Purge On).
- 3) Press Purge key in every 10 seconds to on/off the purge valve for few minutes.
- 4) Keep pumping mobile phase solvent to reference cell for about 20 minutes from the above step 2).
- 5) Press Purge key to turn off the valve. Mobile phase solvent flows to sample cell.
- 6) Wait until the baseline is stabilized.
- 7) Press Zero key to do Auto Zero.



[Warning] When using organic solvent, wear safety goggles. It is recommended that a sink or the equipment for washing eyes be installed nearby in case the organic solvent in use comes into contact with the eye(s) or skin.



[Warning] When any abnormality, such as liquid leakage, is observed, turn off the power immediately. Unplug the detector from the main power source before opening the cover.



[Warning] When using flammable organic solvent as mobile phase, be sure making necessary arrangement to prevent an accidental ignition (firing) by static electricity.



[Caution] If any eluent freezes inside the detector, the flow line might break damaging the detector. If there is any chance of the eluent freezing during stoppage or storage of the detector, withdraw the eluent completely from the flow line of the detector.



[Caution] When using any eluent containing a salt of high concentration, make sure that the flow line is washed with water thoroughly after use. Failure to do so may result in the plugging of the line causing the detector to cease operation.



[Caution] If the detector is not to be used for more than one week, then, prior to storage, wash the flow line with pure water and acetone, and dry the line by allowing nitrogen gas to flow through.



[Caution] Do not use any eluent, including hydrochloric acid, which might corrode the material, such as stainless steel, that it comes into contact with. Use of such eluent might cause a base line drift and damage the detector.



[Note] Use a thoroughly degassed eluent. It is recommended that a degassing device be used to degas the eluent as it is easy to use and permits continuous degassing.



[Note] If an eluent is replaced with another eluent in which it is insoluble, after having withdrawn the old eluent from the line, wash the line with a solvent which is soluble in both eluents, then fill the line with the new eluent. For example, if water is replaced with chloroform, wash the line with acetone before filling the line with chloroform.



[Note] When replacing an eluent containing salt with an eluent containing organic solvent, wash the line with pure water and then acetone before filling the line with the organic-solvent-containing eluent. In contrast, when replacing an eluent containing organic solvent with an eluent containing salt, wash the line with acetone first and then pure water before filling the line with the salt-containing-eluent.

2.9 System Configuration

In normal instance, the instrument customers received have been tested and came with verification, the performance met our requirements in factory, users have no need to test and verify. If you have any doubt about the performance of the instrument, verify it refer to the following steps:

- 1) Take a chromatographic column, the positive phase system selected SiO_2 column, inverse system using C18 column.
- 2) Prepare mobile phase and samples according to evaluation report provided by the column manufacturer.
- 3) Empty air bubbles in the system, when the system is stable, detect it according to the testing requirement.
- 4) If the result and column efficiency is conformed to the information provide by column manufacturer within the error range, that means the HPLC is qualified.

2.10 Transportation

The detector is a precision instrument, please gently while long-distance transportation, severe vibration, drops are likely to cause damage to the internal parts of the instrument. The random original packaging can effectively protect the instrument. When the instrument is required to move or returned for service, please follow these steps for packaging.

Turn off the power.

Unplug the power cord and communication lines.

Removing the connecting pipe and other elements between components.

Remove the detector from chromatography system, put it into special sealed bag on a large platform.

Put the detector into the original packaging foam, fix it.

Placed the fixed detector and other accessories into original packaging carefully.

Tape the box sealed to prevent liquid from entering. Cover the packaging box with plastic wrap is recommended.

Transport packaged instrument.



[Warning] Before packing, please check the box, if the original packaging has been damaged, do not use it, you should consult your local dealer or Our company. customer service staff to solve!

3. Chapter Three: Working Principle

3.1 Optical System

In a refractive index detector of the deflection type, the light beam undergoes a deflection in proportion to a difference in refractive index between one liquid and the other as it passes through the two compartments of the flow cell, each being filled with a different liquid. The deflection of the light beam is taken as a displacement on the light-receiving element and is displayed as a difference of the refractive index.

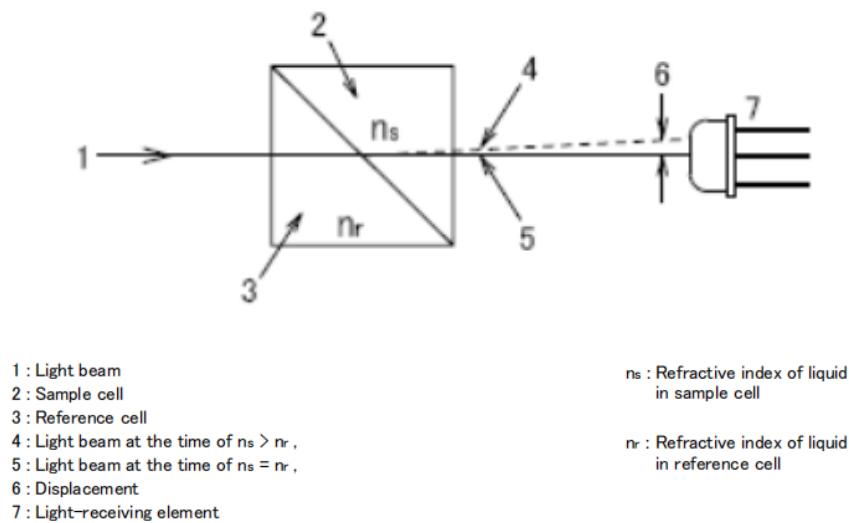


Fig.3-1: Principle of detection of the deflection type

A variety of ingenious devices are provided in the optical system to enhance its operational stability and make the detector more compact. The light beam from the light source passes the flow cell through condenser lens, slit No.1, collimator lens and slit No.2. The light is reflected by the mirror which exists just behind the flow cell and it forms an image of slit No.1 onto the photo sensor through the flow cell, slit No.2, collimator lens and null glass. The photo sensor has two light receivers placed side by side.

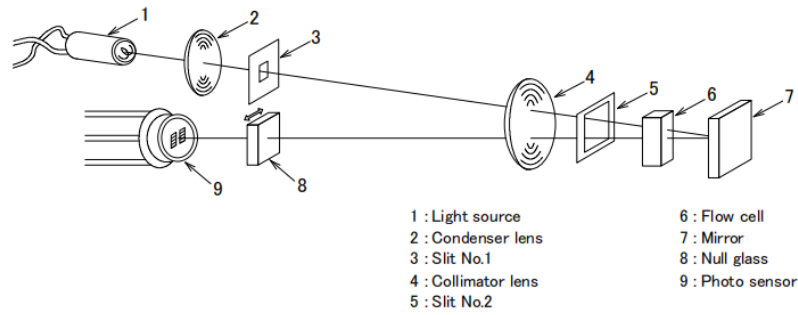


Fig.3-2: Optical System

When a difference develops in the refractive index between the sample and the reference in the flow cell ,the image on the photo sensor moves horizontally as illustrated in Fig. 3.3 below (moves from (a) to (b)). The electric signals emitted respectively from the photo sensor change in proportion to the extent of movement of the image. Thus, signal corresponding to the difference in refractive index can be obtained from a difference between the two signal outputs.

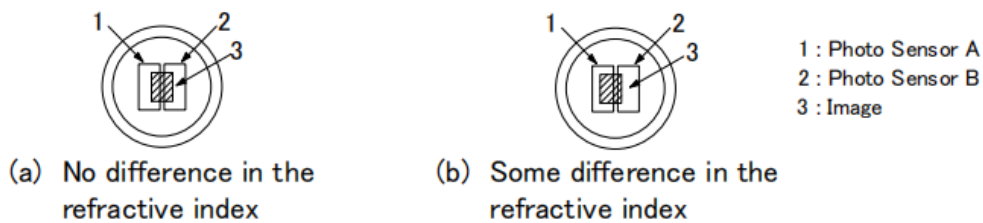


Fig.3-3: Movement of the image on the photo sensor

3.2 Flow line

As shown in Fig 3.4 below, the flow line is so designed as to enable replacement of a reference liquid by only pushing a button.

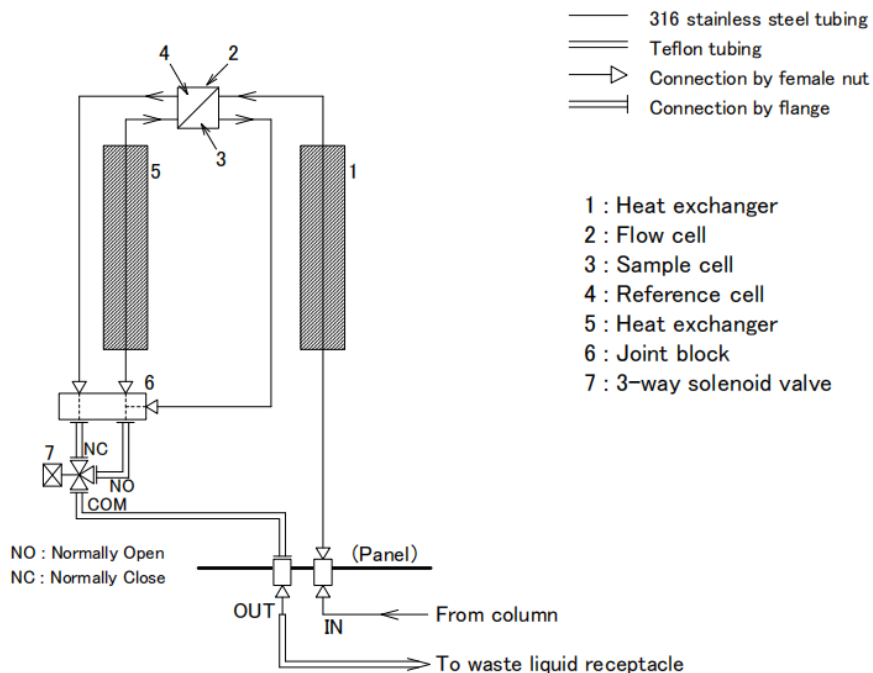


Fig.3-4 Flow line schematic

When the PURGE button (solenoid valve) is in the ON position, NC is open and NO is closed, thereby allowing an eluent to flow out of the sample cell to the waste liquid receptacle by way of the reference cell.

When the button is in the OFF position, NC is closed and NO is open, thereby allowing the eluent to flow from the sample cell directly to the waste liquid receptacle without going through the reference cell.

3.3 Electronics Circuitry

The electrical circuit of Shodex RID3110 consists of two I/V converters, a signal processing circuit (with display and keyboard), a temperature control circuit and a light intensity control circuit.

The temperature control circuit and light intensity control circuit are controlled by the signal processing circuit.

Fig. 3.5 shows electrical system block diagram of the RID3110.

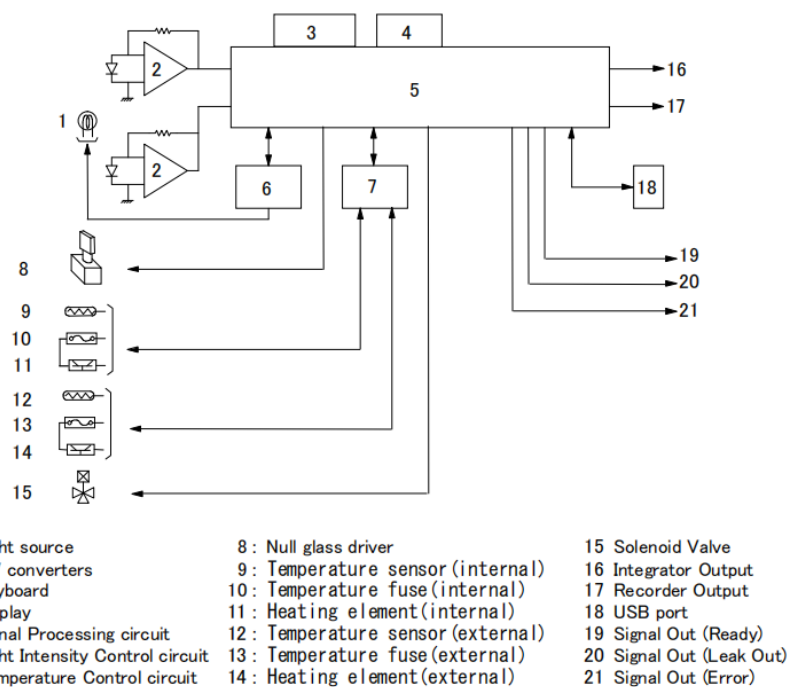


Fig.3-5 Electrical System

4. Chapter Four: Basic Operation

4.1 Power on and off

Power on: Please plug the power cord into the power outlet.



[Note] The power switch is turned off at this time (“O” position).

Turn on the power switch (“I” means on, and “O” means off, on the rear panel).

While the power indicator light, RID3110 begins power-on self-test.

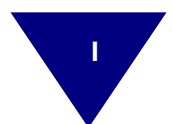
Power off: Turn off the power switch (“I” means on, and “O” means off), and then the power indicator and lamp status indicator will be off, as well as the cooling fans.



[Note] The detection wavelength, wavelength range and other parameters are set as the last shutdown status.

At the first time running, all parameters are default values for factory settings.

If the instrument is shutdown, an Interval of more than 10 minutes is need before it is turned on again.



4.2 Software installation

RID3110 detector control software is divided into two types: Kromstation chromatography data workstation (including RID3110 refractive index detector control module) and RID3110 detector control module

Users of our EClassical 3100 chromatographic system can use the Kromstation (including the RID3110 detector control module), which provides complete control of the instruments and refractive index detector in the system.

Other customers can use the RID3110 detector control module to control the detector.

4.2.1 Computer Requirements

Hardware Requirements

- Minimum hardware requirements: Intel Core 2 CPU, 2G RAM, 1G hard disk (PDA module ; requires more than 8 G);
- Minimum display resolution: 1024×800, 64K color (16 bits true color) ;
- Others: at least two USB ports and one network port;
- Network management requirements: it is recommended that used to connect to the HPLC computer without internet connection. If it is necessary to connect to the internet, please complete the connection under the guidance of engineers from Our company

Software requirement

- Kromstation workstation requires the operating system is Windows 10 or higher version of the operating system (such as Windows 10, 11) Windows.
- Confirmation for running Kromstation workstation's operating system for the original.
- Confirmation firewall closed
- Make computer operating systems "to sleep" option is set to "never".
- Set properties for the network adapter, identify the network adapter "power management" option in the "allow the computer to turn off this device to save power" in have not been selected.

- Computers used to connect to HPLC are not advised to install anti-virus software and touch other virus devices.

4.2.2 Computer Network IP Settings

Before installing the software, set up the computer network (take win10 OS as an example).

Right click the “Network ” on the desktop and left click the “Properties”.

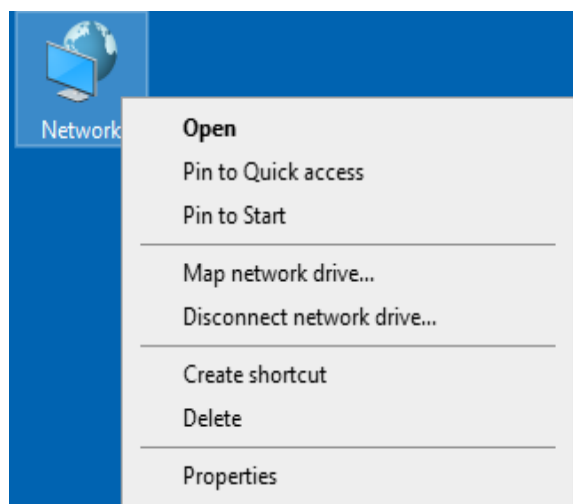


Fig.4-1 Set up Computer Network 01

After entering the “Network and Sharing Center” window, left click “Change Adapter Settings”.

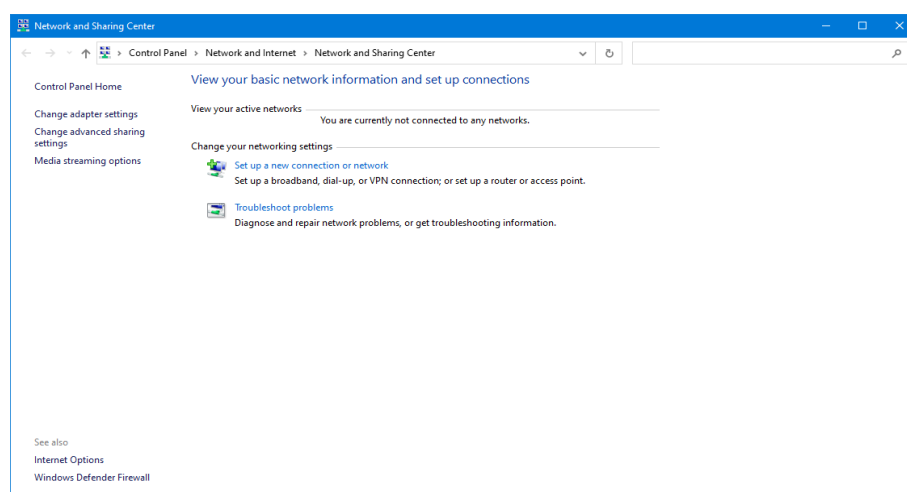


Fig.4-2 Set up Computer Network 02

After entering the “Network Connection Interface”, right click the

“Ethernet” and left click the “Properties”.

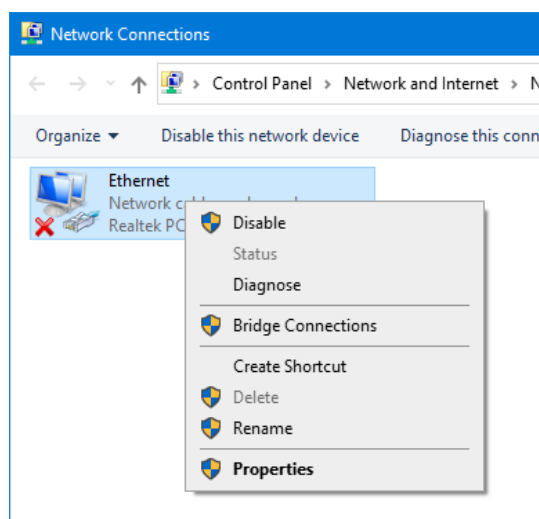


Fig.4-3 Set up Computer Network 03

Select the "Internet Protocol Version 4 (TCP/Ipv4)" into the "this connection uses the following items", and then click the "Properties".

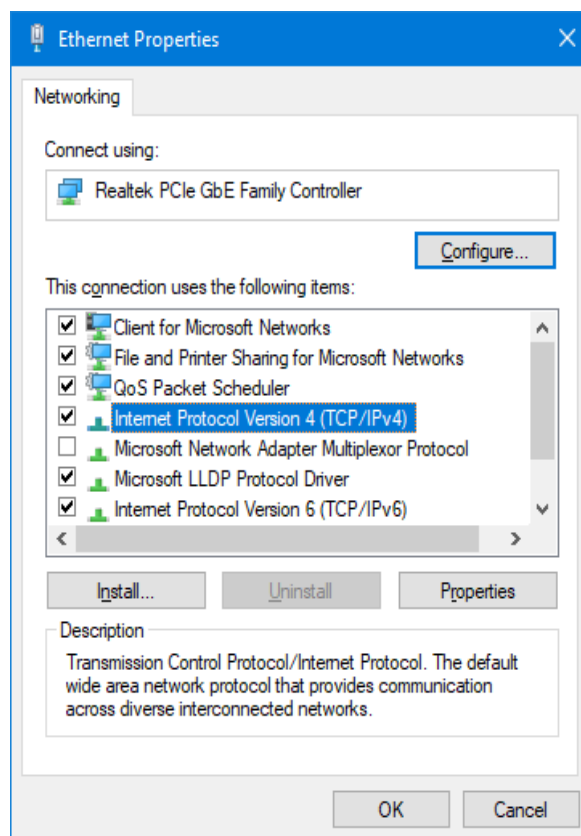


Fig.4-4 Set up Computer Network 04

After entering the "Internet Protocol Version 4 (TCP/Ipv4)"

Properties" dialog box, select the "Obtain an IP address automatically"

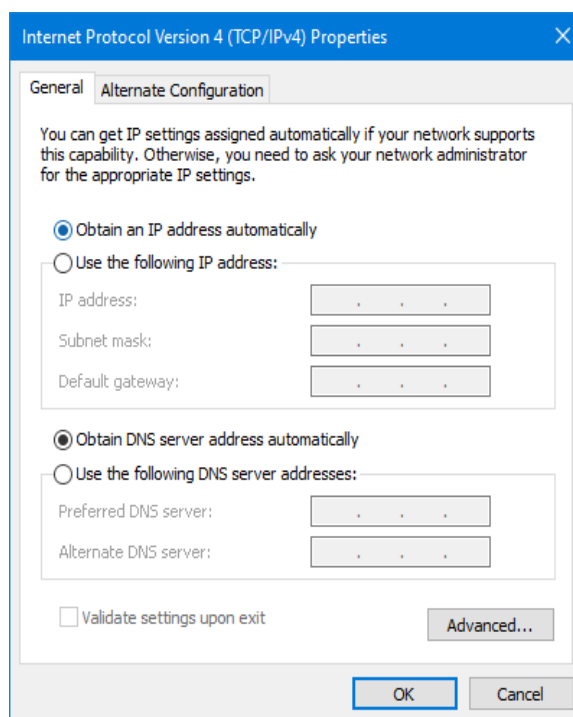


Fig.4-5 Set up Computer Network 05



【Note】

With LAN interface as the hardware communication mode, the client computer must be configd with network communication card and corresponding driver.

4.2.3Kromstation instal

For installation of the workstation, please refer to the instruction manual that comes with the Kromstation Chromatographic Data workstation software.

4.3 Workstation Structure

All the methods and most functions of the detector can be realized by the control of chromatographic data workstation. Fig 4-6 shows the structure of the chromatographic data workstation.

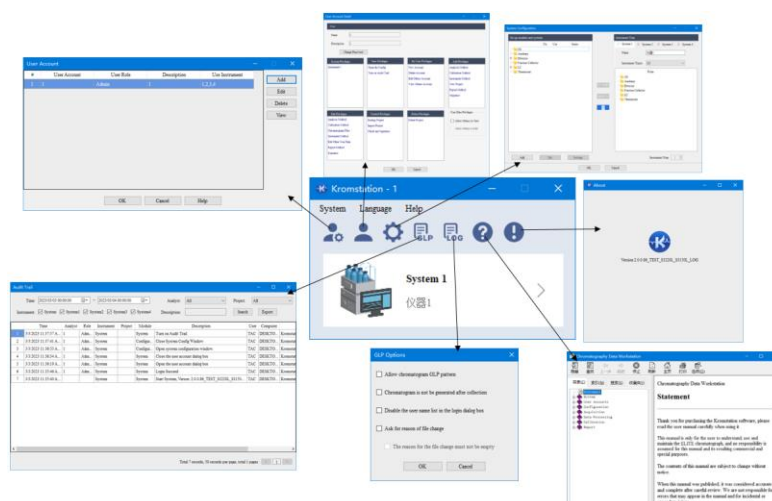


Fig.4-6 Kromstation workstation structure diagram

4.4 System Configuration

When using the RID3110 detector, add the RID3110 detector module on the configuration interface of the Kromstation workstation and enter the instrument IP. The specific operations are as follows:

- 1) Click "Configuration Interface":

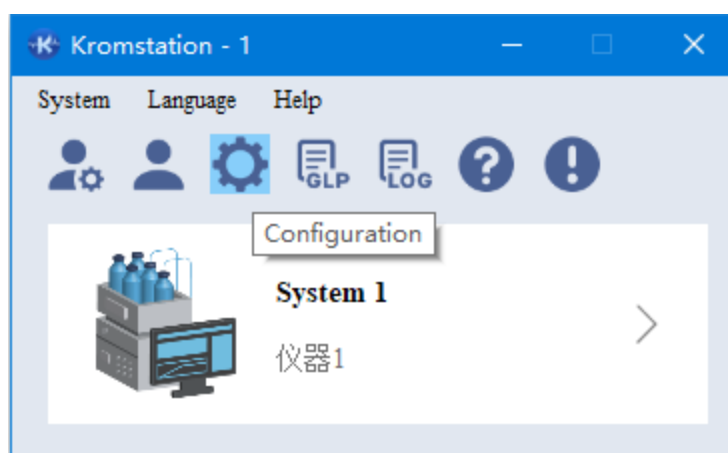


Fig.4-7 Configuration Interface 01

2) The system configuration interface is displayed. As shows in Fig 4-8:

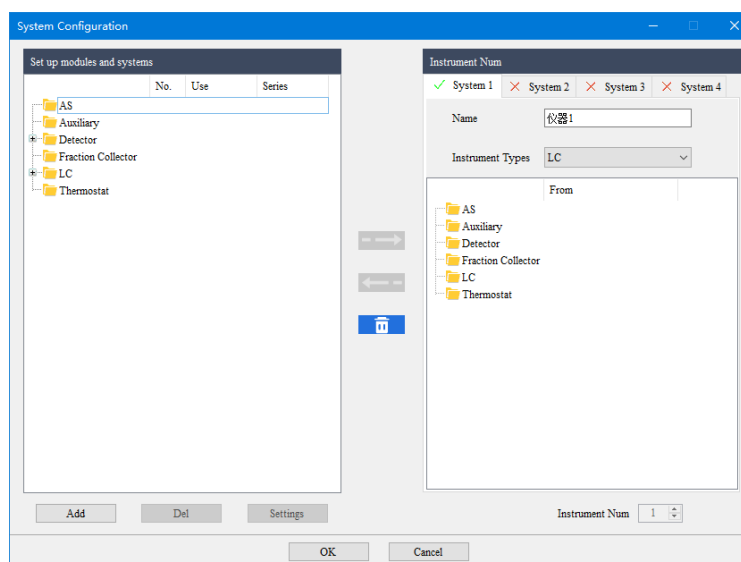


Fig.4-8 Configuration Interface 02

3) Click the "Add" button at the lower left corner of interface 4-8, and the interface as shown in Fig 4-9 will pop up:

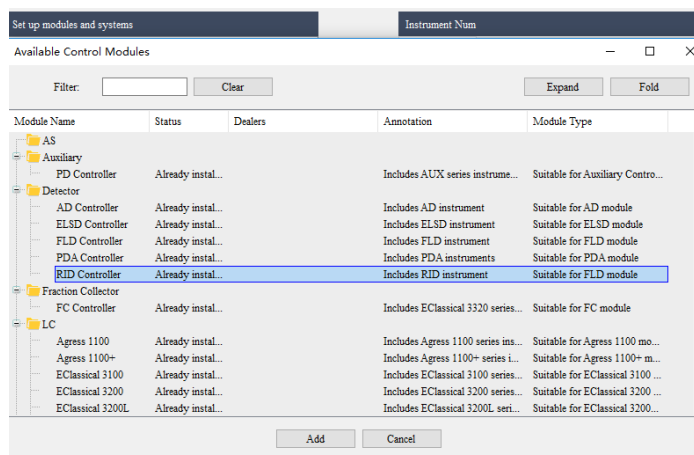


Fig.4-9 Configuration Interface 03

4) Select RID Controller, double-click to enter the configuration screen, and enter the IP address to verify the system.

4.5 Main interface introduction

The control module related to the detector has two main parts:

1) *Device monitor window*

Under "Analysis" in the instrument interface window, "Device Monitor" is

shown in Fig 3-10. Under this window, you can view the set instrument parameters, the parameters of the current operation of the instrument, the instrument status, etc. You can also send commands to the instrument through the control buttons in this interface, such as sending method, automatic return to zero, switching valves, etc.

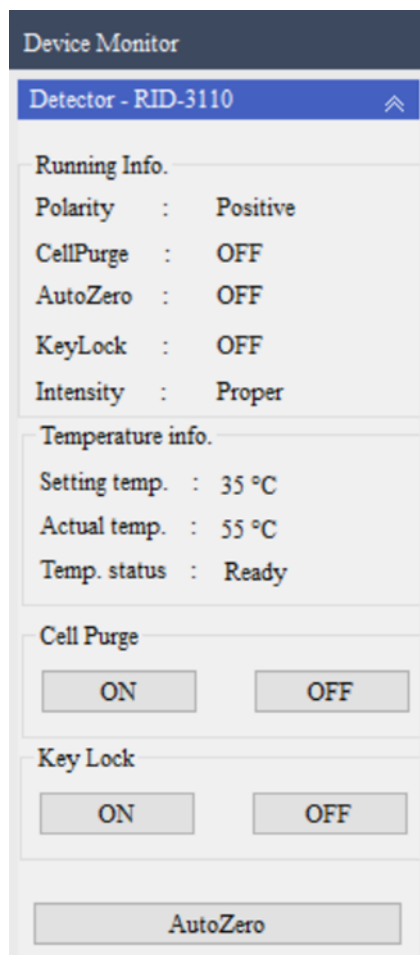


Fig 4-10 Device monitor window

2) *Instrument method setting*

Click "Instrument Method" to pop up the Instrument method setting dialog box, as shown in Fig 4-11. In the "Control Parameters" TAB, you can set evaporation temperature, atomization temperature, carrier gas flow rate, sensitivity, filtering level and other parameters.

The figure consists of two screenshots of the software interface for the RID3110 Refractive Index Detector.

The top screenshot shows the 'Single' method setup window. It has a 'Sequence' tab and buttons for 'Inst.Method', 'Analy.Method', 'Calib.Method', and 'Report Method'. The 'Inst.Method' button is selected. The window contains fields for 'Chromatogram File Name' (with a file icon), 'Counter' (set to 1), 'Sample ID', 'Amount' (set to 0), 'Bottle No.' (set to 1), 'Cal. Level' (set to None), and 'Comments'. There are also checkboxes for 'Use Autosampler' and 'Post Run' (with 'Print' and 'Print to PDF' options). A 'Save as' field is set to 'E:\软件\Kromstation\'. Buttons for 'Send', 'Run', 'Stop', and 'Abort' are at the top right.

The bottom screenshot shows the 'Inst. Method Setup - RID3110\1' window. It has tabs for 'LC Gradient(EClassical 3200)', 'Thermostat', 'AS', and 'Detector(RID-3110)'. The 'Detector(RID-3110)' tab is selected. The 'Control Parameters' section includes: 'Polarity' (set to + (default)), 'Rate(Hz)' (set to 2 (default)), 'Time Constant(s)' (set to 1.5 (default)), 'Setting Temperature(°C)' (set to 40), 'Offset(nRIU)' (set to 0), 'Cell Purge' (unchecked), and 'AutoZero' (checked). At the bottom, there is a 'Method Name' field (set to 1) and 'Save' and 'Cancel' buttons.

Fig. 4-11 Method setting surface



[Note]

You are advised to use the default parameters except the evaporation temperature.

4.6 Instrument preheating time

The purpose of preheating the detector is to make the parameters of the pump unit of the detector in the HPLC system reach a stable state before operation, so as to ensure the reliability of the test results and the service life of the instrument components.



[Note]

To reset to zero at stop is to make the detector enter the standby state after the collection is finished. It is not recommended to check this check box during continuous analysis.

4.7 Operation Method

After the detection method is set, click "Save" button to open the "Analysis" interface. Click "Send Method" button to send the current method to the detector and start the operation.

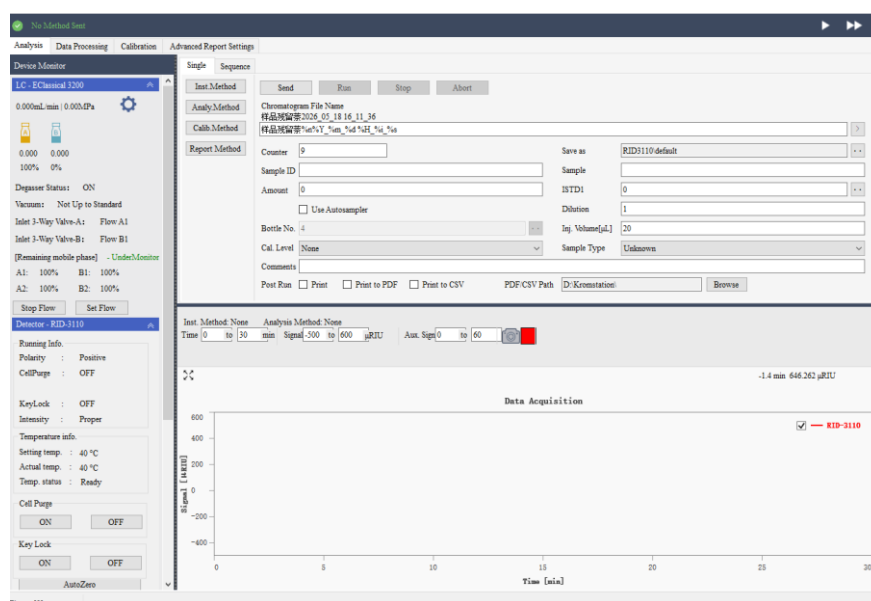


Fig. 4-12 Method Send surface

4.8 Baseline Auto Zero

Select "Analysis" in the system window, and click the "Auto Zero" button in the device monitor to reset the baseline automatically. As shown in Fig 4-13.

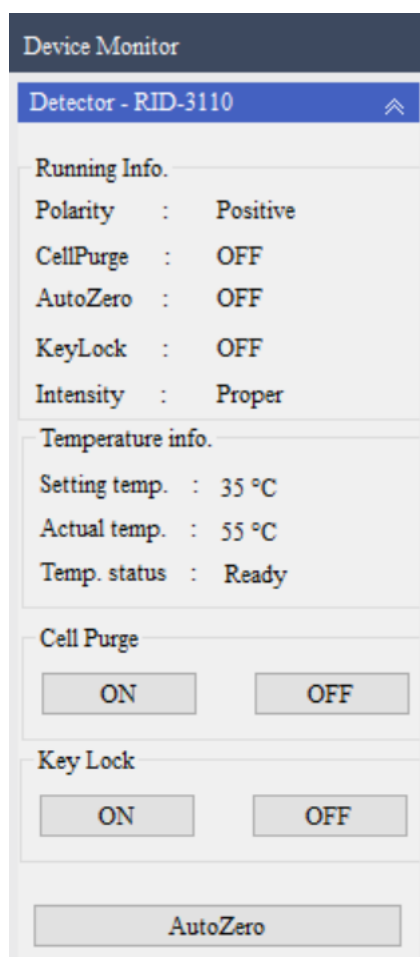


Fig. 4-13 Baseline auto zero

5. Chapter Five: Maintenance and Repair

5.1 Flow Line Cleaning

Depends on the solvents in use, the cleaning procedure is varied. Following is a procedure for typical.

- 1) Inject cleaning solution (acetone) by syringe from the inlet port (5 ml).
- 2) Inject deionized water by syringe from the inlet port (5 ml).
- 3) Inject nitric acid solution (15%) by syringe from the inlet port (5 ml).
- 4) Expel nitric acid solution completely by flowing deionized water adequately.
- 5) Exchange deionized water with the mobile phase solvent.

If buffers or solutions of high salt content have been in use, the cells may be contaminated by precipitated salt. Large amounts of distilled, deionized water, such as 1 ml/min,

for up to several hours, is the simplest clean-up procedure.

5.2 Replacing Fuse

When the fuse is blown, replace the following procedures:

- 1) Turn off the power of detector.
- 2) Remove the power cord.
- 3) Remove the blown fuses.
- 4) Replace new fuses.



[Warning] Replace only with same type and rating of fuse.



[Warning] If the fuse is kept blown off after being replaced, power off the detector

immediately and disconnect the power cord. Please consult our local representative in your area or Our company.

5.3 Clearing Of Detector Exterior

When the exterior such as top cover of front panel were stained or got wet for whatever reasons, please keep the detector clean and dry by wiping off it by soft cloths or tissue paper. If stains are hard to remove, try soft cloths absorbed a weak water solution of kitchen detergent.

[Caution] Use a dry cloth to wipe the detector. Do not use water or alcohol. Use of such liquids may damage the detector or erase characters or color on the panel.

6. Troubleshooting

If any abnormality occurs, try to solve the problem in accordance with the instructions below. Should the problem not be corrected even after taking the corrective actions below, contact the agent from whom you purchased the detector.

Problem	Possible cause	Solution
No power (Lamps and displays do not go on when the power button is turned on.)	1. Power cable is not connected. 2. Fuse is blown.	1. Connect power cable to power socket. 2. Replace fuse. (If new fuse blows soon after replacement, contact agent for repair.)
Baseline becomes jagged.	Bubbles are present in flow cell.	Pass thoroughly degassed eluent through at flow rate of about 1 ml/min.
Periodic noises are generated.	1. Pulsation by pump is large. 2. Existence of bubbles in the flow cell enlarges the pulsation by pump.	1. Install device, such as damper and resistance pipe to eliminate pulsation, close to delivery side of pump. 2. Pass thoroughly degassed eluent through at flow rate of about 1 ml/min. While pushing the PURGE button repeatedly into ON and OFF positions for sufficient period of time (until the baseline stabilizes). If an aqueous eluent is in use and the baseline does not stabilize even after passing the degassed eluent for more than one hour, it will be effective to perform one passage of methanol.

No periodic noises are generated.	1. Insufficient degassing 2. Flow cell is contaminated. 3. Salts separated in the tubing or flow cell. 4. Column is contaminated. 染	1. Pass thoroughly degassed eluent. 2. Refer to “ 7-1 flow line cleaning”. 3. Set PURGE button on and pump sufficient amount of eluent that dissolves the salts and wash with water. 4. Wash the column or use a new column.
Large baseline drift	1. Insufficient solvent replacement. 2. Room temperature fluctuates greatly. 3. Bubbles are present in flow cell. 4. Flow line is contaminated	1. Replace the solvent thoroughly.(Refer to the notes in 6-4.) 2. Use detector in places where changes in room temperature are small. 3. Pass thoroughly degassed eluent through to purge bubbles. 4. Wash flow line thoroughly.

Consumption parts

NO.	Describe	PN
1	Trigger line	18080168
2	FEP tube OD1/16"×0.2m	13010031
3	PEEK tube OD1/16"~ID0.007"	13010014
4	1/16"Stainless steeltwo-way joint	14990115
5	T2.0A/250V fuse	15080014
6	Power line	17000001
7	Cable(3m)	17000036
8	Cable(1m)	17000035
9	Pipe holder	14040755
10	Finger TightI (PEEK)	3215F-120X
11	Silicon Tube	13010033
12	Cable Router	15500027

Safety information

General safety information

At different stages of the instrument operation, maintenance and repair, everyone should abide the following general safety rules.Breaking these rules may cause damage to instruments or staffs,

Dalian Elite Analytical Instruments Co., Ltd. will not be responsible for the impacts caused by non-standard operation.

Standard of security

For marked with this symbol of the equipment, the user should refer to the instruction manual, so as not to cause harm to the operator and equipment damage.

Symbols	Descriptions
	Please do not operate beyond the scope of caution, unless you have been fully understand and meet the required conditions.
[Warning]	Casualties may appear. Please do not operate beyond the scope of warning, unless you have been fully understand and meet the required conditions.
[Caution]	Data loss or equipment damage may appear. Please do not operate beyond the scope of caution, unless you have fully understood and met the required conditions.
[Note]	Unsatisfactory experimental data and instrument failure may appear. Please do not operate beyond the scope of note, unless you have been fully understand and meet the required conditions.

Absorptive character of some typical functional groups

Name	Groups	$\lambda_{\max}$	$\epsilon_{\max}$	$\lambda_{\max}$	$\epsilon_{\max}$	$\lambda_{\max}$	$\epsilon_{\max}$
ether	-O-	185	1000				
thioether	-S-	194	4600	215	1600		
amine	-NH ₂	195	2800				
mercaptan	-SH	195	1400				
disulphide	-S-S-	194	5500	255	400		
bromide	-Br	208	300				
monoiodide	-I	260	400				

oximido	-NOH	190	5000				
nitrine	>C=N-	190	5000				
ethylene	-C=C-	190	8000				
keto-	>C=O	195	1000				
thioketone	>C=S	205	Strong	270-285	18-30		
aldehyde	-CHO	210	Strong				
acid	-COOH	200-210	50-70				
sulfoxide	>S→O	210	1500				
nitro	-NO ₂	210	Strong				
Nitrous acid ester	-ONO-	220-230	1000-2000				
	(no-loop)						
	-(C=C) ₃ -	260	25000				
	-(C=C) ₄ -	300	52000				
	-(C=C) ₆ -	330	118000				
	-(C=C) ₈ -	230-260	3000-8000				
	(annulate)						
	C=C-C≡C	219	6500				
	C=C-C=N	220	23000				
	C=C-C=O	210-250	10000-20000				
	C=C-NO ₂	229	9500				
benzene		184	46700	202	6900	255	170
biphenyl		246	20000				
naphthalene		220	112000	275	5600	312	175
anthracene		252	199000	375	7900		
pyridine		174	80000	195	6000	251	1700
quinoline		227	37000	270	3600	314	2750
isoquinoline		218	80000	266	4000	317	3500

【State】 When choosing the best absorption wavelength, the lowest wavelength getting through mobile phase ought to be considered at the same time(UV cutoff wavelength in the appendix 2). To sample who have multiple characteristic absorption wavelength, the wavelength corresponding to the biggest ϵ_{max} is the best choice.

Features of some organic solvents

	Solvent* 7<.5cP,<45	source	UV Cutoff	R.I. 25°C	boiling point °C	viscosity cP,25°C	p'	ea	w%	e	p'+ 0.25e
1	FC-78* FC-75(fluorous solvent) F-43	LC chara cter	210 (Opaque or below)	1.267 1.276 1.291	50 102 174	0.4 0.8 2.6	< -2 < -2 < -2	-.25 -.25 -.25		1.88 1.86 1.9	p' And the dielectric constant
2	isooctane*	LC	197	1.389	99	0.47	0.1	0.01	0.011	1.94	0.1
3	n-heptane*	LC	195	1.385	98	0.40	0.2	0.01	0.010	1.92	0.5
4	n-hexane*	LC	190	1.372	69	0.30	0.1	0.01	0.010	1.88	0.5
5	n-pentane**	LC	195	1.355	36	0.22	0.0	0.00	0.010	1.84	0.5
6	cyclohexane	LC	200	1.423	81	0.90	-0.2	0.04	0.012	2.02	0.5
7	cyclopentane	LC	200	1.404	49	0.42	-0.2	0.05	0.014	1.97	0.6
8	1-chlorobutane*	LC	220	1.400	78	0.42	1.0	0.26		7.4	2.8
9	carbon disulfide	LC	380	1.642	46	0.34	0.3	0.15	0.005	2.64	1.7
10	2- chloride**	LC	230	1.375	36	0.30	1.2	0.29		9.82	3.7
11	carbon tetrachloride	LC	265	1.457	77	0.90	1.6	0.18	0.008	2.24	2.3
12	n-butyl ether		220	1.397	142	0.64	2.1	0.25	0.19	2.8	2.4
13	triethylamine			1.398	89	0.36	1.9	0.54		2.4	2.4
14	bromoethane*			1.421	38	0.38	2.0	0.35		9.4	4.3
15	isopropyl ether*		220	1.365	58	0.38	2.4	0.28	0.62	3.9	3.2
16	methylbenzene	LC	285	1.494	110	0.55	2.4	0.29	0.046	2.4	2.9
17	P-xylene		290	1.493	138	0.60	2.5	0.26		2.3	3.0
18	chlorobenzene			1.521	132	0.75	2.7	0.30		5.6	4.1
19	bromobenzene			1.557	156	1.04	2.7	0.32		5.4	4.1
20	iodobenzene						2.8	0.35			
21	diphenyl ether			1.580	258	3.3	3.4			3.7	3.7
22	phenetole			1.505	170	1.14	3.3			4.2	4.9
23	diethyl ether*	LC	218	1.350	35	0.24	2.8	0.38	1.3	4.3	4.0
24	benzene	LC	280	1.498	80	0.60	2.7	0.32	0.058	2.3	3.6
25	phosphotriester(p- tolyl)			1.510	72	0.57	2.2			7.8	4.2
26	iodoethane			1.510	72	0.57	2.2			7.8	4.2
27	n-caprylic alcohol		205	1.427	195	7.3	3.4	0.5	3.9	10.3	5.8
28	fluorobenzene			1.46	85	0.55	3.1			5.4	4.6
29	benzyl oxide			1.538	288	4.5	4.1				
30	dichloromethane**	LC	233	1.421	40	0.41	3.1	0.42	0.17	8.9	5.6
31	anisole			1.514	154	0.9	2.8			4.3	4.6
32	isoamyl alcohol			1.405	130	3.5	3.7	0.61	92	14.7	7.3
33	2-Dichloroethane	LC	228	1.442	83	0.78	3.5	0.44	0.16	10.4	6.3
34	tert-butyl alcohol			1.385	82	3.6	4.1	0.7	Dissolved	12.5	
35	n-butyl alcohol	LC	210	1.397	118	2.6	3.9	0.7	20.1	17.5	8.3
36	n-propyl alcohol	LC	240	1.385	97	1.9	4.0	0.82	Dissolved	20.3	
37	tetrahydrofuran*	LC	212	1.405	66	0.46	4.0	0.57	Dissolved	7.6	
38	propylamine*			1.385	48	0.35	4.2		Dissolved	5.3	
39	ethyl acetate	LC	256	1.370	77	0.43	4.4	0.58	8.8	6.0	5.8
40	isopropyl alcohol	LC	205	1.384	82	1.9	3.9	0.82	Dissolved	20.3	

	Solvent* 7<.5cP,<45	source	UV Cutoff	R.I. 25°C	boiling point °C	viscosity cP,25°C	p'	ea	w%	e	p'+ 0.25e
41	chloroform*	LC	245	1.443	61	0.53	4.1	0.40	0.072	4.8	5.6
42	acetophenone			1.532	202	4.8				17.4	8.7
43	MEK*	LC	329	1.376	80	0.38	4.7	0.51	23.4	18.3	9.1
44	cyclohexanone		215	1.450	156	20	4.7			18.3	9.1
45	nitrobenzene			1.550	211	1.8	4.4			34.8	13.2
46	phenylcyanide			1.536	191	4.8				25.2	10.9
47	dioxane	LC	215	1.420	101	1.2	4.8		Dissolved	2.2	
48	tetramethylurea	LC	265	1.449	175		6.0	0.56		23.0	10.7
49	quinoline			1.625	237	3.4	5.0			9.0	7.4
50	pyridine			1.507	115	0.88	5.3		Dissolved	12.4	
51	nitroethane		380	1.390	114	0.64	5.2		0.9		
52	acetone*	LC	330	1.356	56	0.30	5.1	0.71	Dissolved		
53	phenethyl alcohol			1.538	205	5.5	5.7			13.1	8.8
54	tetramethyl guanidine						6.1	0.6			
55	methyl cellosolve	LC	210	1.400	125	1.60	5.5		Dissolved	19.9	
56	CIS Cyanide Oxide	GC					6.6				
57	1,2-Propyl carbonate	LC					6.1				
58	ethyl alcohol	LC	210	1.359	78	1.08	4.3		Dissolved	24.6	
59	diether	GC					6.8				
60	aniline			1.584	184	3.77	6.3			6.9	8.1
61	acetic acid			1.370	118	1.1	6.0		Dissolved	6.2	
62	acetonitrile*	LC	190	1.341	82	0.34	5.8		Dissolved	37.5	
63	dimethylacetamide	LC	268	1.436	166	0.78	6.5	0.88		37.8	
64	dimethylformamide	LC	268	1.428	153	0.80	6.4			36.7	
65	dimethyl sulfoxide	LC	268	1.477	189	2.00	7.2	0.62	Dissolved	4.7	
66	N-methyl-2- pyrrolidone	LC	285	1.468	202	1.67	6.7			32	
67	Hexamethylphosphoric triamide			1.457	233	3	7.4	0.65		30	
68	methyl alcohol*	LC	205	1.326	65	0.54	5.1		Dissolved	32.7	
69	nitromethane		380	1.380	101	0.61	6.0		2.1		
70	m-cresol			1.540	202	14	7.4			11.8	10.0
71	n-methyl formamide			1.447	182	1.65	6.0		Dissolved	182	
72	ethanediol			1.431	182	16.5	6.9		Dissolved	37.7	
73	methyl aldehyde			1.447	210	3.3	9.6		Dissolved	111	
74	water	LC		1.333	100	0.89	10.2			80	

【State】

1.Organic solvent have low boiling point($\leq 45^{\circ}\text{C}$), low viscosity ($\leq 0.5\text{cp}$) is easy to use. Marked with (*) number of organic solvents is preferred for high performance liquid chromatography (HPLC) mobile phase solvent. Marked with (**) is with very low boiling point and low viscosity solvent.

2.In the "source" column with LC means the mobile phase can be purchased from the following companies: Burdick & Jackson, Baker Chemical, Mallinkrodt Chemical, Fischer Scientific, Manufacturing Chemicals, inc.etc.

3. *In the "source" column with GC means the mobile phase can be used as gas chromatographic stationary phase, and can be purchased from the distribution company and GC column stationary phase*
4. *"UV Cutoff" — Mobile phase is ultraviolet transparent over the wavelength*
5. *"R.I .25" the index of refractive index (25 °C).*
6. *"p" the polarity parameters of mobile phase.*
7. *"ea" Flow intensity parameter when alumina is use for liquid - solid adsorption.*
8. *"w%" Water Solubility w% in 20 °C Solvent .*
9. *"e" Dielectric Constant ϵ_0*
10. *"p+0.25E" Electric constant function.*