ADVANTEST

ADVANTEST CORPORATION

Q8344A

Optical Spectrum Analyzer

Operation Manual

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that Advantest bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by Advantest, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to Advantest products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

  Symbols of those warning labels are shown below together with their meaning.

  DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

  WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

  CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

- **Basic Precautions**

  Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

  - Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protected ground terminal.
  - Be sure to use fuses rated for the voltage in question.
  - Do not use this instrument with the case open.
  - Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

- **Safety Marks on the Product**

The following safety marks can be found on Advantest products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated lifespan for the parts listed below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the Advantest sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Floppy disk drive	5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations.
  An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batteries

Environmental Conditions

This instrument should be only be used in an area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

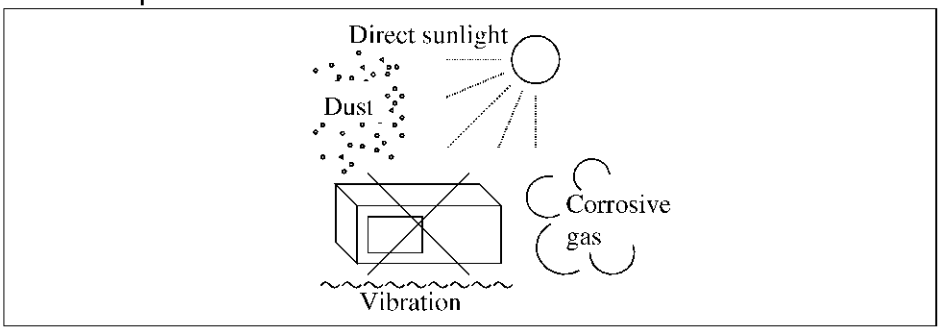


Figure-1 Environmental Conditions

- Operating position

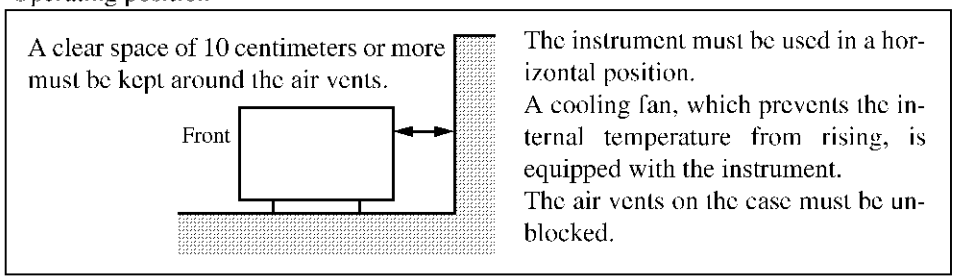


Figure-2 Operating Position

- Storage position

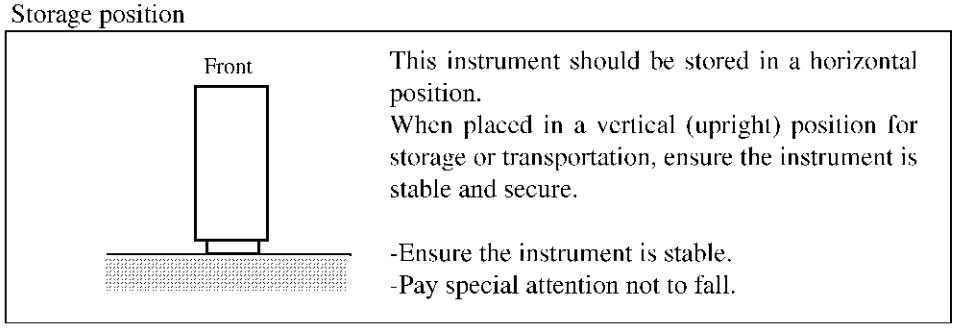


Figure-3 Storage Position

- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

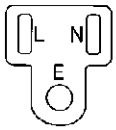
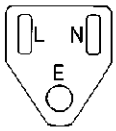
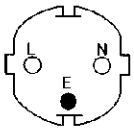
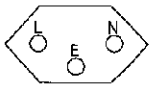
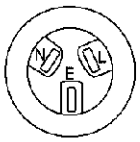
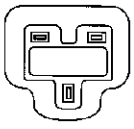
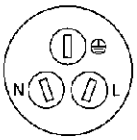
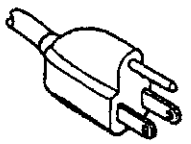
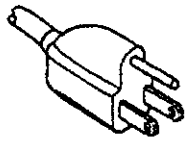
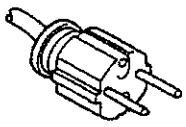
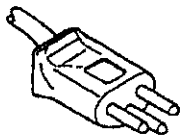
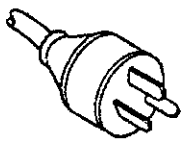
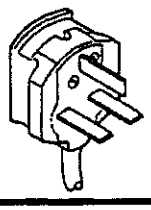
Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC:China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

Table of Power Cable Options

There are six power cable options (refer to following table).

Order power cable options by Model number.

	Plug configuration	Standards	Rating, color and length	Model number (Option number)
1		JIS: Japan Law on Electrical Appliances	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
2		UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
3		CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
4		SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
6		BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417

⚠ CAUTION

The Q8344A contains a Michelson Interferometer. This precision mechanism is sensitive to vibration and shock when transported.
To prevent damage in transportation, the Michelson Interferometer is locked at the factory.
Before use, release the manual lock by the following RELEASE procedure. *1
(The Q8344A equips an auto lock mechanism inside. To reinforce safety in transportation, this manual lock is set.*2)
In transportation, set this manual lock by the following SET procedure.

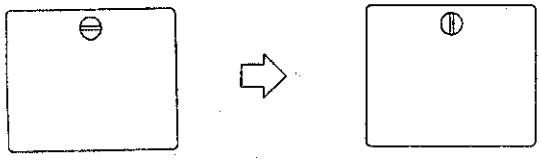
*1: The error occurs when self test is executed if the power is turned on with the manual lock mechanism not released. (code: 3001)

"MOTOR locked !! > Please release the LOCK, and power-on again. "

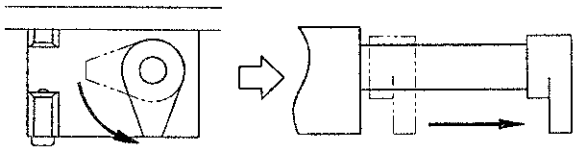
*2: It is not necessary to lock the manual operation when usually move (transportation by person in factory site etc.).

1. RELEASE (UNLOCK)

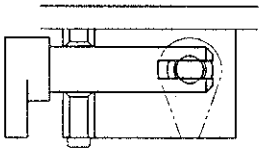
① Remove the cover on the rear panel by turning the cover key 90 degrees.



② Rotate the lock lever counterclockwise by 90 degrees, and draw the lock lever out.



③ Push the lever left, to lock into the storage position.



④ Replace the cover.

Please turn over.

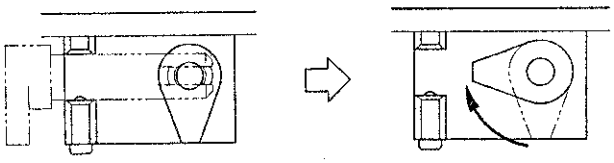
2. SET (LOCK)

Be sure to lock in the state of power ON.
The lever is able not to be pushed by an internal auto lock's working at power OFF.

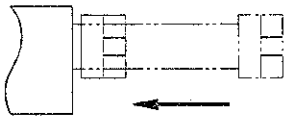
① Turn power on, and wait until the measurement screen is displayed.

② Remove the cover on the rear panel by turning the cover key 90 degrees.

③ Pull out the lock lever, and rotate clockwise by 90 degrees.



④ Push the lock lever into the lock position.
(It makes clinking noise if successful)



⑤ Replace the cover, and turn power off.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1. GENERAL

This chapter explains how to use this instruction manual, the outline of the Q8344A optical spectrum analyzer, precautions when using it and the procedure for setting it up.
Be sure to read this manual carefully before starting measurement.

1.1 How to Use This Instruction Manual

This instruction manual consists of nine chapters and an appendix.
If you are about to use a spectrum analyzer for the first time, you should not skip any of the chapters. When you come across an unknown term, refer to the glossary at the end of the manual.
Those who have used an analyzer more than once or who are familiar with one should have no difficulty finding the appropriate section or paragraph.

1. General	.....	Be sure to read this chapter before using the analyzer. Chapter 1 explains the outline of the analyzer, precautions when using it and the procedure before starting measurement.
2. Panels	.....	Chapter 2 provides brief information on the panel configurations along with the names and functions of switches.
3. Basic operation	.....	Chapter 3 explains the preparations for starting measurement up to data output. Those using an analyzer for the first time should become familiar with the outline of the operation.
4. Panel operation	.....	Chapter 4 explains the seven panel sections, including the function and operation of each one.
5. Key functions	.....	Chapter 5 provides a list of the Softkey menus and briefly explains the key functions.
6. GP-IB interface	.....	Chapter 6 explains the program code and data output format when the analyzer is controlled via the GP-IB interface, giving some program examples.
7. Examples of measurement	.....	Chapter 7 offers some typical measurement examples using the Q8344A.
8. Principle of operation	.....	Chapter 8 shows the internal blocks and briefly explains their operation.
9. Performance	.....	Chapter 9 lists the specifications of the analyzer.
Appendix	.....	Glossary of technical terms. Refer to this as required.
External view	.....	External dimensions are shown on the drawings. Illustrations of the front and rear panels are enlarged.

1.2 Outline of the Analyzer

The Q8344A is an optical spectrum analyzer employing a Michelson interferometer. Its main features are given below.

Features

① Coherent length can be measured.
The coherent length which cannot be measured by dispersion spectroscopy using a grating can be measured by the Q8344A using the interference method. Therefore, the Q8344A can easily determine the noise suppression performance of the CD/VD laser diode due to the reflected light. The analysis range is as wide as 10mm.

② High-speed measurement
As the analyzer employs Fourier spectroscopy using an interference meter, measurement can be performed in a definite time independent of the setting of the measurement wavelength span.
Even when the GP-IB interface is used, the entire procedure from the measurement start trigger to data output can be carried out in less than 1.5 seconds.
(Providing the wavelength range is in either the short or long wavelength.)

③ ±0.1nm wavelength measurement accuracy
As a He-Ne laser is used as the internal reference light source, a high wavelength accuracy of 0.1nm is realized. Wavelength calibration is not required.

④ Easy operation
Various aspects have been taken into consideration to make measurement easier.
The panel key arrangement, Softkey menus and basic key functions can be specified in the first hierarchy.
The Q8344A has a built-in level meter which greatly facilitates adjustment of the measurement light coupling.

⑤ Zoom function
The measurement data can be analyzed again and displayed with the zoom function.
Data can be displayed from wide to narrow span without repeating measurement.

⑥ Various processing functions
Various processing functions are available. They include four types of spectral width measurement functions, an automatic peak function, four types of cursor indication modes, and 32 data memory areas.

⑦ Built-in high-speed printer (optional)
Measurement data can be easily output using a high-speed thermal printer having a printing speed of less than 8 seconds.

1.3 Before Using the Analyzer

Upon taking delivery of the analyzer, check whether any part of it has been broken during transportation. Then, check the quantity and specifications of the standard accessories against Table 1-1.
If any part is broken or accessory missing, contact the sales dealer and the support offices.
The addresses and phone numbers of the support offices are given at the end of this manual.

1.3.1 Checking the exterior and accessories

Pay attention to the corners of the analyzer when checking its exterior.
Check the number and specification of the accessories against to the table below.

Table 1-1 Standard Accessories

[Q8344A]

Name	Type	Parts code	Q'ty	Remarks
Power cable	A01402	——	1	With two-pin adapter
Power fuse	EAWK4A	DFT-AA4A	2	For 90 to 250VAC
Instruction Manual	——	JQ8344A	1	Japanese version
	——	EQ8344A		English version

[Optional 01: Printer]

Name	Type	Parts code	Q'ty	Remarks
Printer paper	A09075	——	5	114mm-wide thermal paper

Note: When ordering additional accessories, do not forget the parts code (Type).

1.3.2 Environment and Precautions

(1) Do not use this analyzer in a dusty place or expose it to direct sunlight or corrosive gases.

(2) A cooling fan is provided in the analyzer to prevent abnormal temperature rise. Since the fan blows air outside, make sure that the area around the analyzer is well ventilated. Do not place any other device up against the rear panel. The fan filter should be cleaned periodically.

(3) Since the analyzer is a precision instrument, do not subject it to vibration or use it on a table where it was overturn.
When transporting the analyzer, use the box and shock-absorbing material used when shipped from the factory. If the box has been discarded, use another one 5 to 10 cm larger than the analyzer and pack it with a sufficient amount of shock-absorbing material.

(4) To eliminate the danger of electric shock, connect the power cord to a 3-pin socket. If no 3-pin socket is available, connect the GND terminal on the rear panel to the ground.

(5) Never connect the power cable to an AC line when the power switch is ON.

(6) Before using the power cable, confirm that the power source is within the voltage specified on the rear panel.
Do not forget to set the power voltage switch to 100V or 200V to suit the power source being used.

(7) The analyzer should be placed horizontally (up to 10° inclination is permitted.) Due to its internal configuration, the analyzer may not indicate the correct value if inclined to much.

1.3.3 Power Source and Fuse

(1) Power cable
The power cable plug used is a 3-pin type and the round pin in the center is used for grounding. When the plug is connected to a triple-pole socket, the center pin is grounded.
When using a 2-pin adapter, connect the power cable to the socket and the ground line of the adapter Fig. 1-1 (a) or the GND terminal on the rear panel of the analyzer to the external ground.
The A09034 2-pin adapter provided meets electrical device regulations.
As illustrated in Fig. 1-1 (b), the two poles of the A09034 adapter are not identical in width. When inserting them into the socket, check the direction of the plug and the socket.
If the adapter cannot be connected to the socket using the A09034 because of the pole width, use a KPR-13 adapter sold separately.

Note

When connecting the power cable to the socket using the adapter provided, make sure that the ground line from the adapter does not come into contact with the AC line.
If it does, the analyzer may be damaged along with other devices.

(2) Power source

Before connecting the power cable, make sure that the analyzer power switch is OFF (set to the front position).

The analyzer operates within the range of 90 to 132VAC or 198 to 250VAC. Set the switch on the rear panel to suit the correct power source voltage. This switch should be set before the power cable is connected.

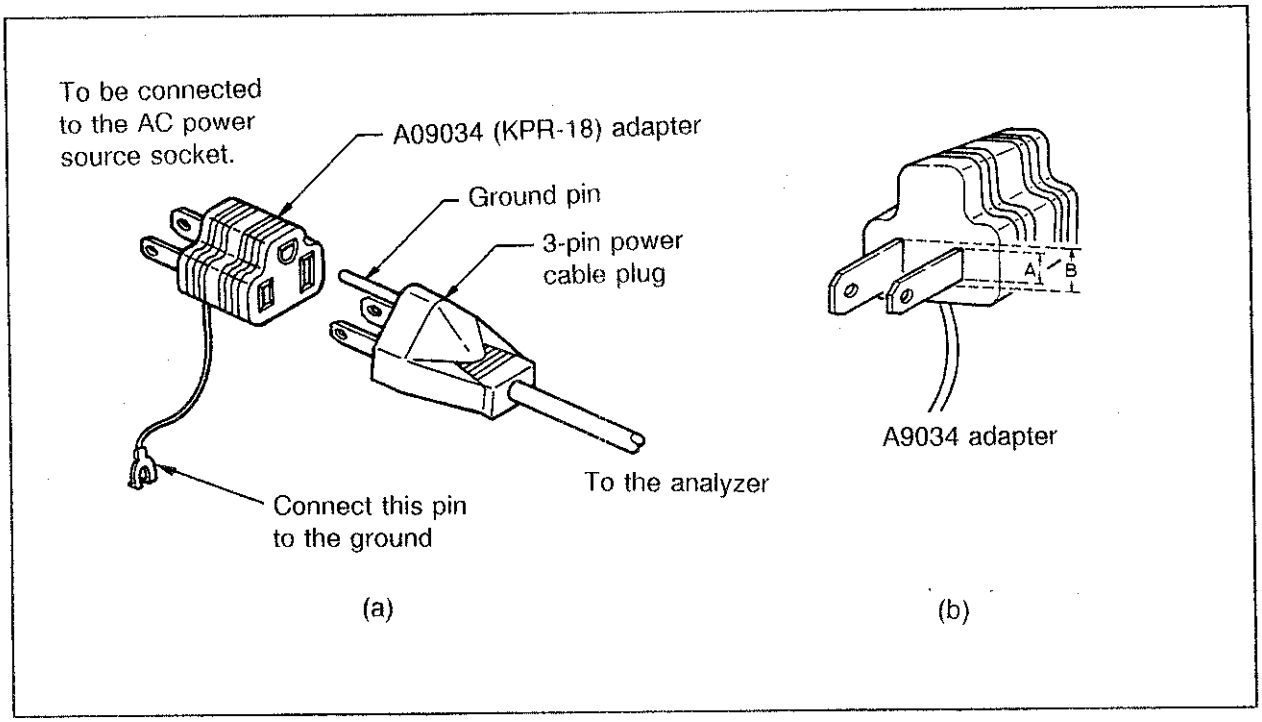


Fig. 1-1 Power cable plug and adapter

(3) Fuse

- Fuse replacement

① Remove the power cable from the AC line connector.

② Remove the fuse holder from the AC line connector.

③ Confirm that the fuse has blown and replace it with a new one.
(The fuse capacity is identical to the power voltage range which can be used.)

Table 1-2 Specifications of the power source voltage and fuse

Power source voltage	Applicable fuse (Parts code)	Nominal current
AC 90V to 132V	EAWK4A (DFT-AA4A)	4A
AC 198V to 250 V	EAWK4A (DFT-AA4A)	4A

1.3.4 Damage to circuit element due to power line CMV loop

The analyzer can be used in combination with peripheral devices such as a desk-top computer and plotter.

When connecting a peripheral device, pay special attention to the CMV (common mode noise voltage) which may be caused by wiring failure of the power source grounding.

If a power line is used without grounding, an AC voltage (CMV) of about 50V is generated between terminals a1 and a2, and b1 and b2, by the loop illustrated in Fig. 1-2.

In this case, if the a1 signal terminal is connected to a2, leaving ground terminals b1 and b2 open, the input/output circuit elements of circuits 1 and 2 may be damaged or deteriorated. To eliminate this, it is necessary to use a power line connected to ground wiring. CMV is instantaneous if the power is turned ON or OFF using the power source plug. The power source must be turned ON or OFF using the power source switch.

If the power source line is to be used without ground wiring, connect ground terminal GND1 to GND2 before connecting the signal cable. Then inset the power plug and turn the power switch ON.

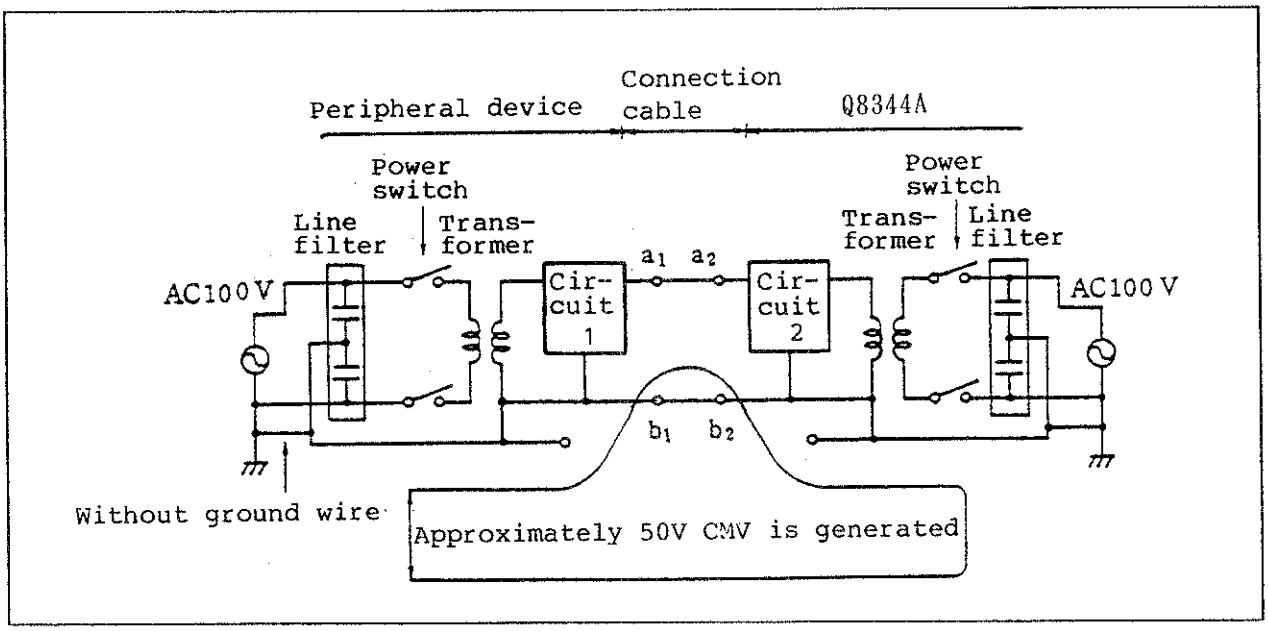


Fig. 1-2 Power line CMV loop

1.3.5 CRT display

Adjust the brightness of the CRT display to suit the ambient brightness using the brightness adjustment knob located at the lower center of the front panel.

Adjust to desired brightness. Note that the CRT will become burnt if used on high brightness for a long time.

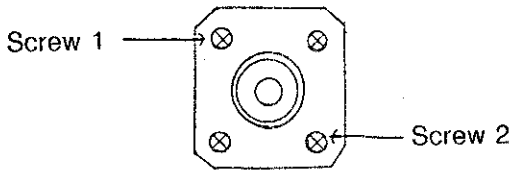
1.3.6 Cleaning the input optical connector

If the end of the internal optical connector in the optical input section of the analyzer is not clean, normal level may not be displayed or spectrum distortion result.
When connecting an optical connector to the analyzer, confirm that the end is sufficiently clean. Also, do not forget to clean the end of the internal optical connector in the optical input section of the analyzer.

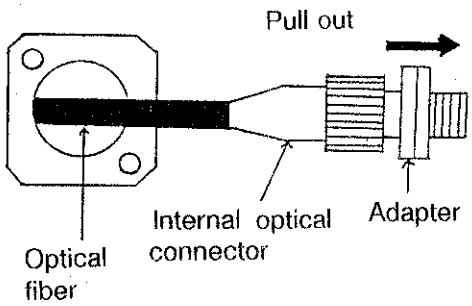
<Cleaning the end of the internal optical connector>

(1) Removing the optical input section

① Remove screws 1 and 2 using a 2mm screwdriver.



② Slowly pull the optical input section out. (Pull out about 3 to 5cm.)

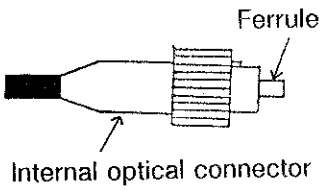


Note

Take care not to break the fiber.

(2) Cleaning the end of the internal optical connector

③ Remove the connector from the adapter and clean the end and sides of the connector ferrule using an absorbent gauze moistened with alcohol.



④ Lightly dab the end of the connector with the alcohol-moistened gauze and wipe off excess alcohol with a piece of dry gauze.

Note

Take care not to rub the fiber too vigorously to avoid scratching the surface.

(3) After cleaning

⑤ After drying the end of the fiber, mount the internal optical connector on the adapter and slowly set it in its original position. Fix the adapter with the two screws.

1.3.7 Operation when power is turned ON

When the power is turned on, all the LEDs on the panel will light and self-diagnosis is executed automatically.
If the diagnosis results are normal, the measurement data display screen appears in about 20 seconds, a buzzer sounds and the system enters the ready state.
Fig. 1-2 shows the initial screen when the power switch is turned on.
The analyzer has a built-in Ni-Cd (nickel-cadmium) battery to keep the stored setting conditions and measurement data while the power is off. The battery is automatically charged while the power is on and the data can be retained for about six months when fully charged. If the power remains off for more than six months, the setting conditions and measurement data may be lost. (In this case, FAIL appears against the backup RAM item on the self-diagnosis screen. The setting conditions are initialized and all data saved is cleared. When this state occurs, turn the power switch on to charge the battery. About 15 hours are required for fully charge the battery.)
If an error is found during self-diagnosis, "FAIL" appears in the corresponding column along with an error code indicating the type of error. If the error is other than backup RAM, contact the dealer or support office.
The addresses and phone numbers of the support offices are listed at the end of this manual.

Note: When a backup RAM error occurs self-diagnosis is executed without stopping operation. In this case, a buzzer sounds three times upon completion of the diagnosis buzzer sound is heard three times and the following message appears on the screen.

"backup memory destroyed!! > press any key to continue."

To specify the measurement screen, press one of the panel keys.

Note

(a) If the power switch is turned on after remaining off for more than 5 minutes, the CRT display appears in about 10 seconds.
(b) When the power switch is turned on, a mechanical sound is hear. This is the sound of mechanical relay switching and is not a problem.

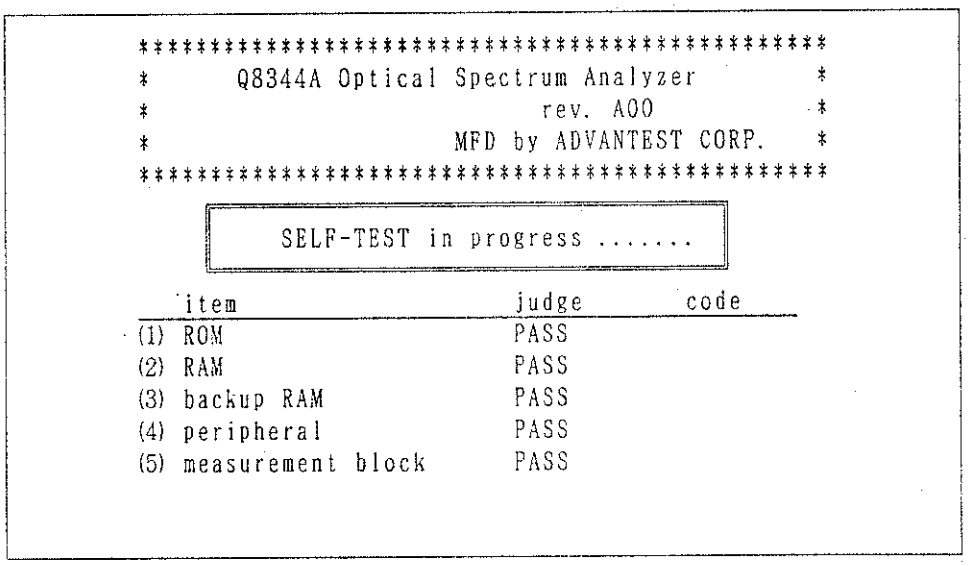


Fig. 1-3 Initial screen at power on

Note: The "rev. A00" in the above screen indicates the revision of the internal software. It may be modified when the function is improved.

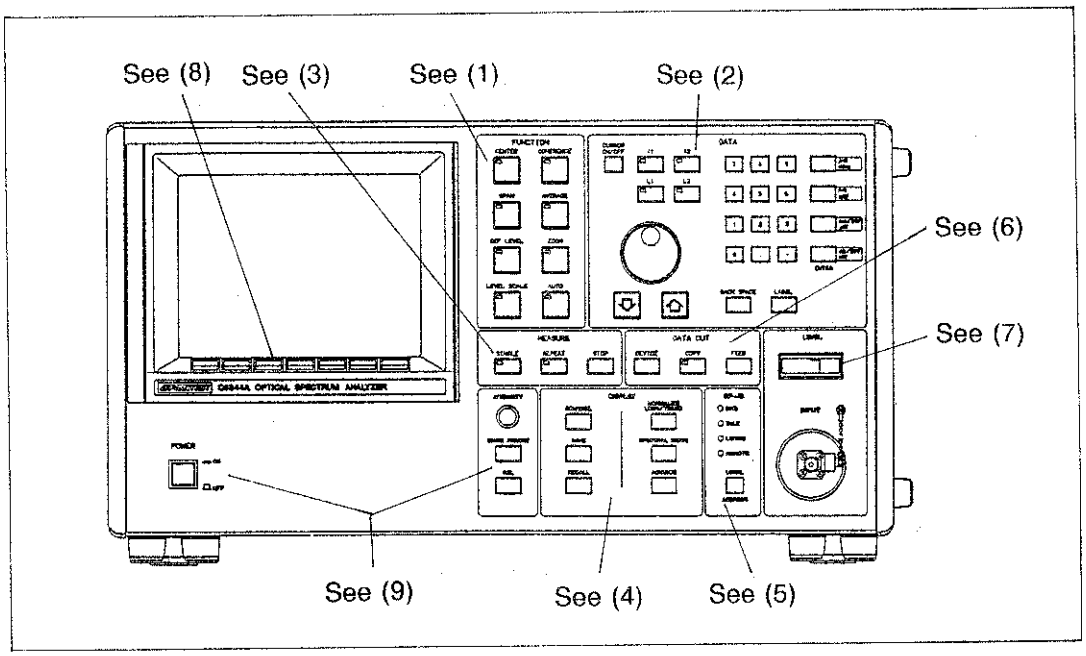
1.3.8 Setting the print paper

Mount the paper in the internal printer (optional-01) as illustrated on the rear of the printer cover.

2. PANELS

This chapter briefly explains the functions of the keys and switches on the analyzer panels.

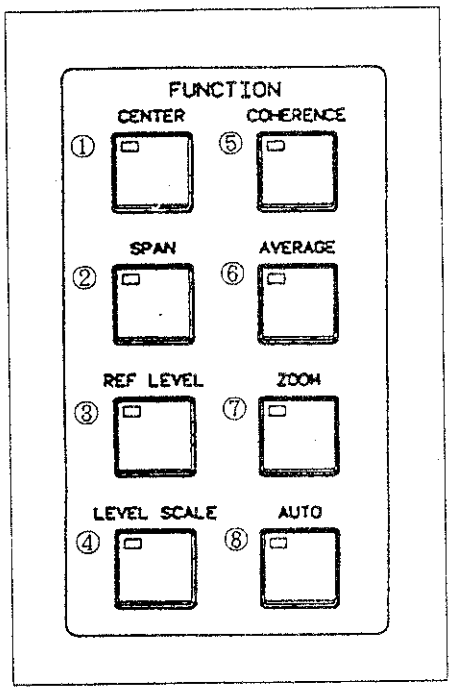
2.1 Front Panel



The front panel switches are explained below in the sequence shown above.

(1) FUNCTION section

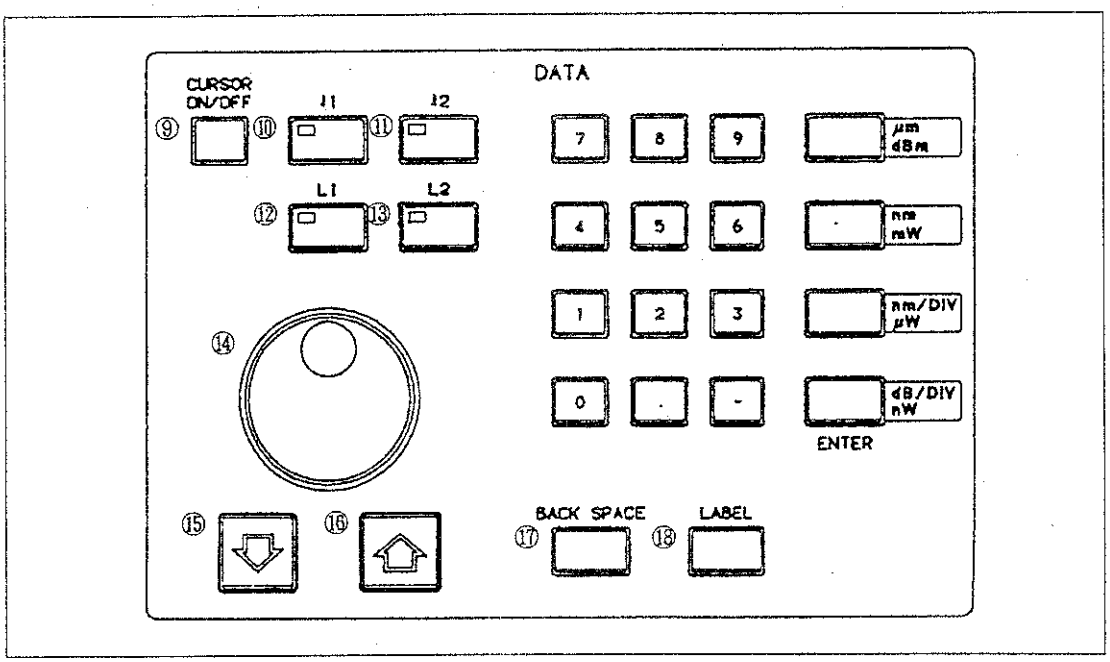
Basic measurement conditions are specified using this section.



①	CENTER key	:	Specifies the center wavelength.
②	SPAN key	:	Specifies the wavelength span, the start/stop wavelengths and the coherent analysis range.
③	REF LEVEL key	:	Specifies the input sensitivity.
④	LEVEL SCALE key	:	Selects the level axis (lin/log) and specifies the scale.
⑤	COHERENCE key	:	Selects coherence or spectrum analysis.
⑥	AVERAGE key	:	Specifies the averaging function ON/OFF and number of processings.
⑦	ZOOM key	:	Selects and executes the zoom function to re-analyze the measurement data in a different span.
⑧	AUTO key	:	Executes the automatic setting functions for wavelength range and input sensitivity.

(2) DATA section

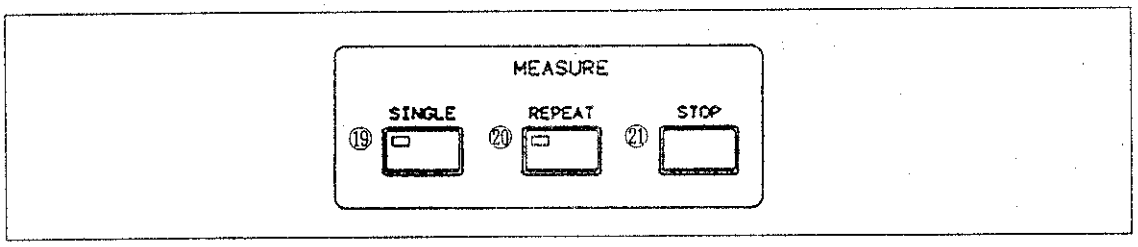
This section is used to enter the setting values and control cursor display.



⑨	CURSOR ON/OFF key	:	Controls ON/OFF of all cursors and the cursor display mode.
⑩	λ 1 key	:	Selects display and erases wavelength cursor 1.
⑪	λ 2 key	:	Selects display and erases wavelength cursor 2.
⑫	L1 key	:	Selects display and erases level cursor 1.
⑬	L2 key	:	Selects display and erases level cursor 2.
⑭	Rotary knob	:	Moves the cursor selected and continuously changes the data set.
⑮	Arrow keys	:	Used to move the cursor selected and change the data set, step by step.
⑯	Numeric keys	:	Used to specify values for condition setting.
	Unit key	:	Specifies the unit (input terminator).
	Enter key	:	Setting terminator of other than the unit key.
⑰	BACK SPACE key	:	Deletes a character from the input data.
⑱	LABEL key	:	Specifies the label data.

(3) MEASURE section

This section controls measurement operations.



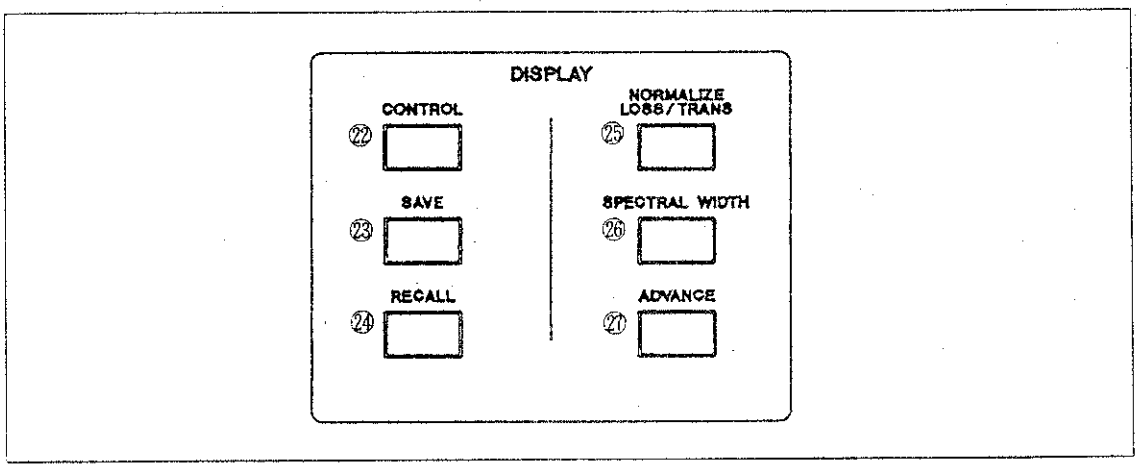
⑲ SINGLE key : Executes measurement.

⑳ REPEAT key : Executes measurement repeatedly.

㉑ STOP key : Stops measurement.

(4) DISPLAY section

This section is used to select display and analysis functions.



㉒ CONTROL key : Specifies the display mode (superimpose, dual-screens, three-dimensional).

㉓ SAVE key : Saves the measurement data and setting conditions.

㉔ RECALL key : Recalls the measurement data and setting conditions.

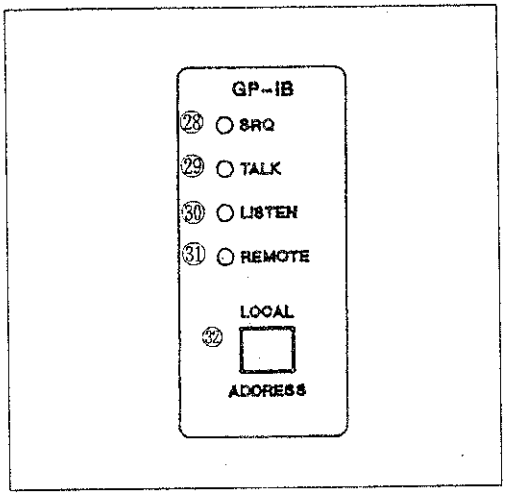
㉕ NORMALIZE key : Executes measurement data normalization and measurement of loss and transparency characteristics.

㉖ SPECTRAL WIDTH key : Calculates the spectral width.

㉗ ADVANCE key : Specifies higher level analysis.

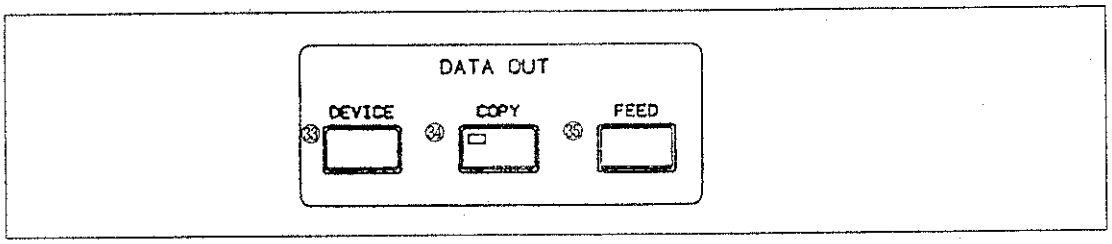
(5) GP-IB section

This section is used to display the GP-IB status and switch Remote/Local.



㉘	SRQ lamp	:	Lit while service request is transmitted.
㉙	TALK lamp	:	Lit when the data transmitabled status is set.
㉚	LISTEN lamp	:	Lit when the data receivabled status is set.
㉛	REMOTE lamp	:	Lit while the system is under external control.
㉜	LOCAL key	:	Specifies the local mode to make the panel keys valid (when the REMOTE lamp is lit).
	ADDRESS key	:	Specifies the GP-IB address (when the REMOTE lamp is off).

(6) DATA OUT section
This section controls data output.

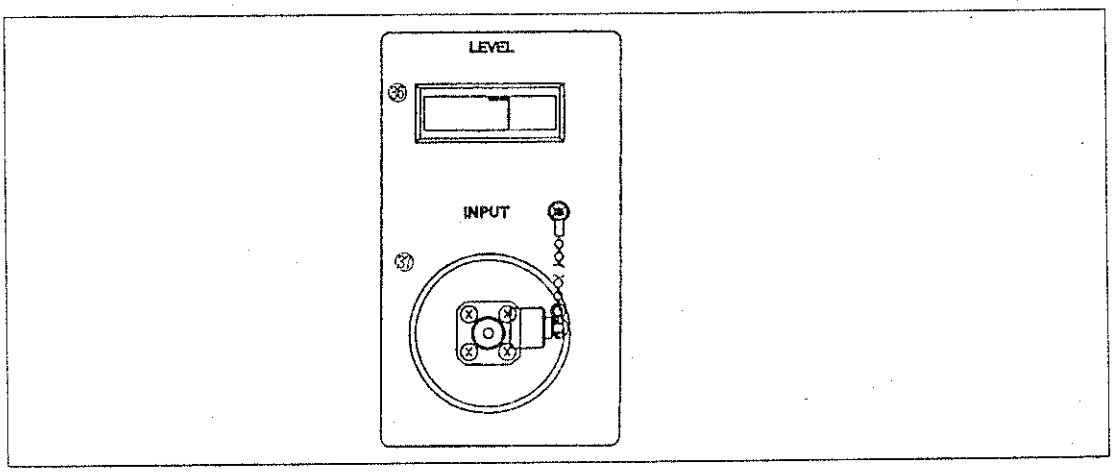


㉝ DEVICE key : Specifies a device (plotter, printer (optional), clock or Buzzer).

㉞ COPY key : Executes data out processing.

㉟ FEED key : Feeds paper to the printer (optional).

(7) INPUT section
This section is for optical signal input.

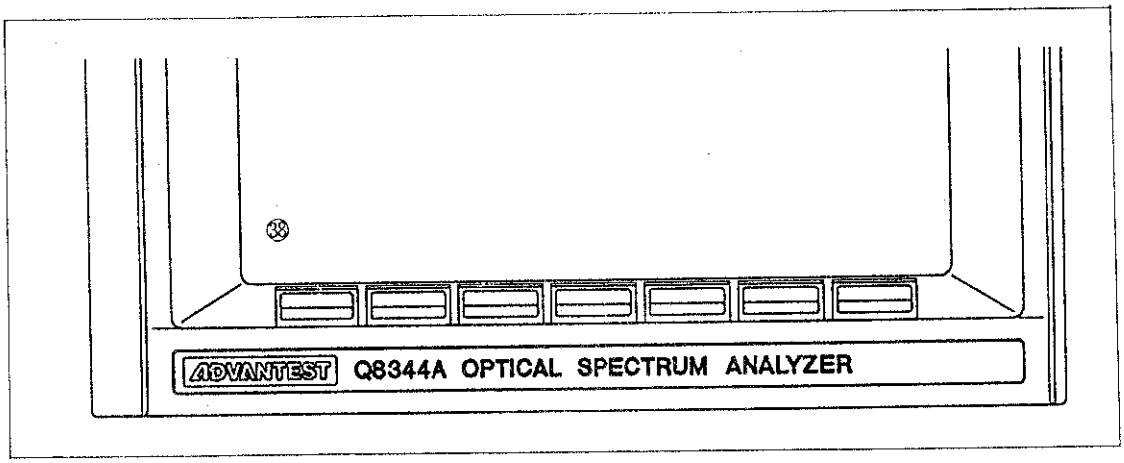


㊱ Level meter : The input light can be monitored in real time.
This meter is useful for adjusting the optical axis.
It has three internal ranges (-15dBm or below, 0dBm or below and 10dBm or below). The range is automatically specified according to the REF LEVEL on the panel. (The range is changed when measurement is executed at the specified REF LEVEL.)

㊲ INPUT terminal : Input terminal for optical signals.

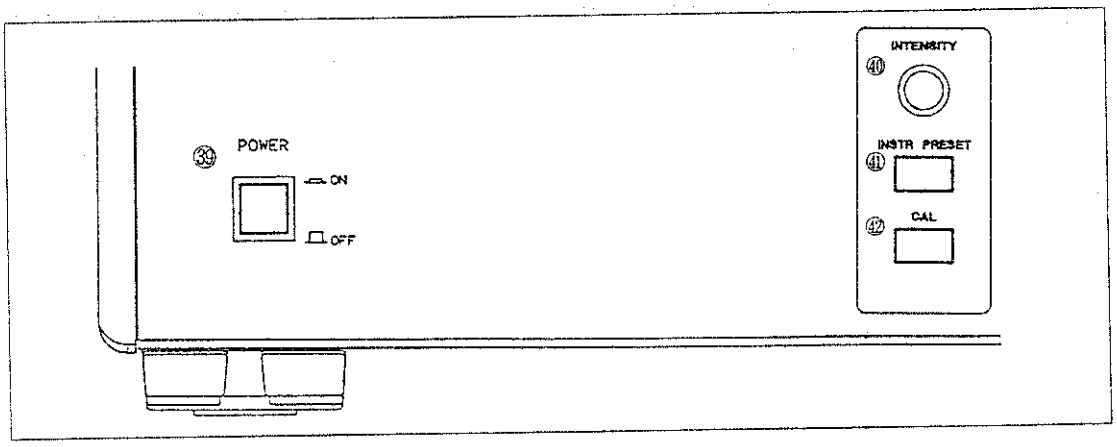
(8) Softkeys

The Softkeys are used to select and specify the Softkey menu displayed.



㊳ Softkeys : Each key executes the menu function corresponding to one of the seven keys.

(9) Others



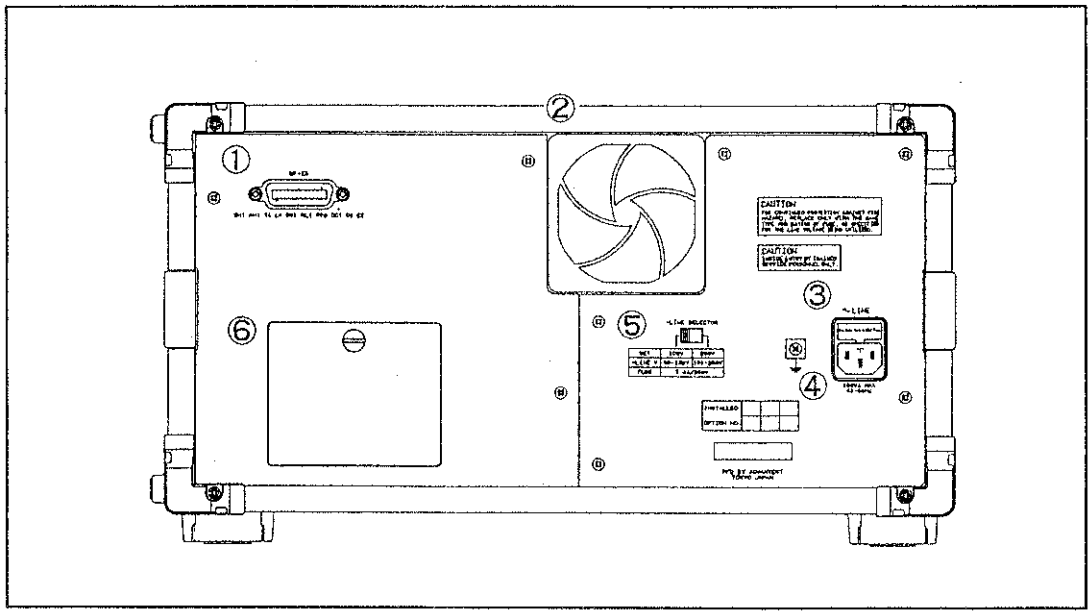
㊴ POWER switch : Turns power ON/OFF.

㊵ INTENSITY knob : Adjusts the CRT brightness.

㊶ INSTR PRESET key : Initializes the setting modes.
Executes self-diagnosis.

㊷ CAL key : Calibrates the level.

2.2 Rear Panel



① GP-IB connector
This connector is used when controlling the analyzer via an external controller with an GP-IB interface and when outputting data from the CRT to the plotter corresponding to the GP-IB.

② Fan
This is an intake type fan for cooling the internal circuit.

③ Fuse

④ AC power socket

⑤ Power voltage selector
Set this switch to suit the voltage of the AC power source to which the analyzer is to be connected.
Set the switch to 100V for a 100V power source (90 to 132VAC) to 200V for a 200V power source (198 to 250VAC).

⑥ Cover for interferometer lock mechanism
When the lock for the interferometer part is released and setted, remove this cover.

Note

If 200V power is supplied with the switch set to 100V, the internal circuits may be damaged. Before turning the power switch ON, confirm that the voltage selector is set correctly.

3. BASIC OPERATION <For those using an analyzer for the first time>

This chapter briefly describes the basic operations required for using the analyzer.

- Entering the measurement light
- Setting the measurement conditions
- Setting the display conditions
- Data output
- Data analysis

3.1 Entering the Light to be Measured

The FC connector located at the lower right of the front panel is used to enter the optical signals.
The block diagram of the input section is illustrated in Fig. 3-1. The light to be measured is fed to the internal interferometer of the analyzer through a GI fiber having a core diameter of 50 μm. (If optional 10 is specified, a 200 μm diameter GI fiber is used). The core diameter of the fiber to be connected to the FC connector should not exceed that of the internal fiber. If a fiber having a core diameter exceeding that of the internal fiber is used, not all the light to be measured is fed to the internal fiber and the measurement level is lowered.

The fiber to be connected should have a clean end. If a fiber with dirty end is used, the level may not be indicated correctly or the spectrum may be distorted. End cleanness is also required of the fiber used inside the analyzer.
Clean the end of the fiber periodically. For the cleaning procedure, see paragraph 1.3.6 (Cleaning the input light connector).

The fiber to be connected should be fixed firmly so that it will not vibrate during measurement. If the fiber vibrates, the spectrum may fluctuate.

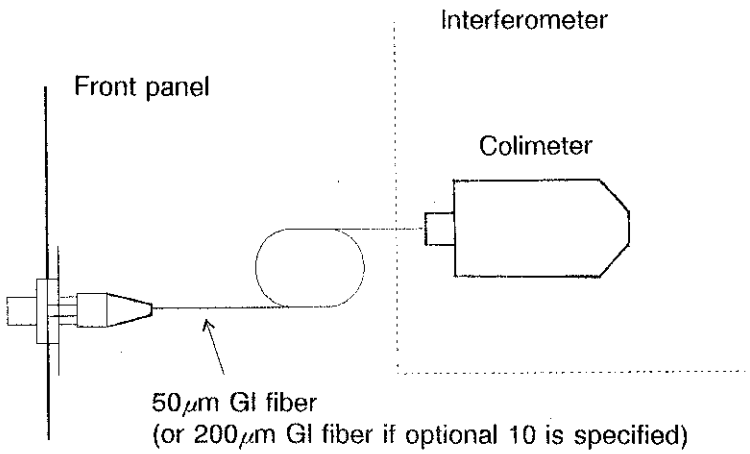


Fig. 3-1 Block diagram of the input section

3.2 Reading the CRT display

The Q8344A analyzer displays the measurement data along with the setting conditions and internal modes on the screen. Fig. 3-2 shows how to read the display.

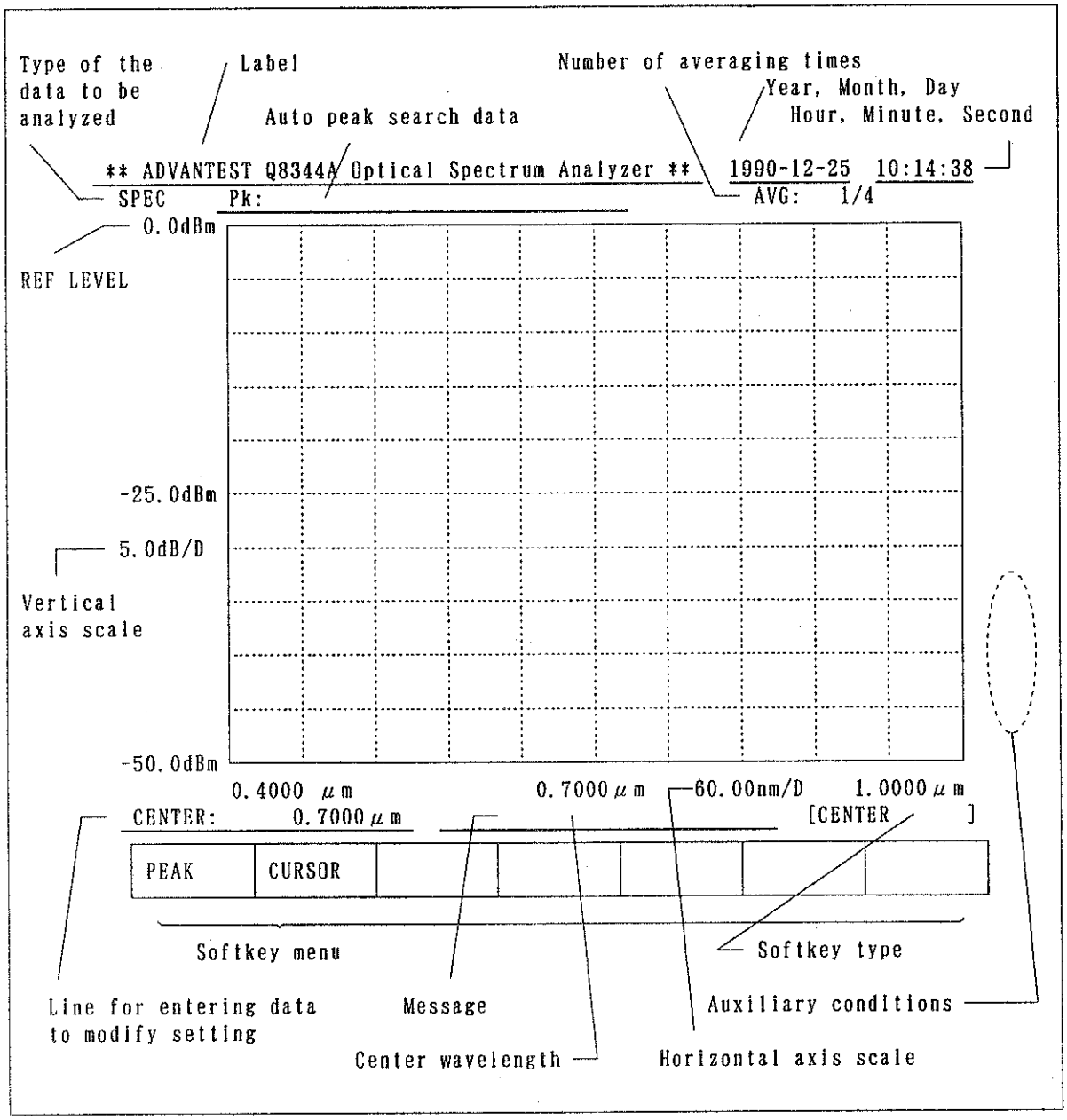


Fig. 3-2 Reading the CRT display

(1) Additional explanation on the CRT display

① Type of data to be analyzed

SPEC : Spectrum analysis
COH : Coherent analysis
P.NORM: Peak-normalized data
LOSS : Loss characteristics data
TRANS : Transparency characteristics data

② Displaying the peak search data

Spectrum analysis : Peak wavelength and peak level are displayed.
Coherence analysis : The second peak distance and level (α) and the intermediate distance and level between the first and second peaks (β) are displayed.

③ X-axis during coherence analysis

Center position : The center wavelength is indicated between parentheses ( ).
Left and right ends : The distance range specified as Xmm is indicated as −Xmm and +Xmm.

④ Message

If the analyzer's internal state or operation results in an error, message is displayed and an alarm sounds.
A list of messages is given in Table 3-1 on the next page.

Table 3-1 List of internal state and alarm messages

Message	Description
1) AVERAGE in progress	Averaging is in progress.
2) HOLD-ZOOM in progress	HOLD-ZOOMing is in progress.
3) AUTO function in progress	The AUTO function to determine the optimal measurement condition is in progress.
4) PRINT-out in progress	The data is being output to the built-in printer (optional).
5) PLOT-out in progress	Direct plotting (drawing with the plotter) is in progress.
6) input data out of range!!	The data entered to modify the setting exceeds the allowable range.
7) HOLD-ZOOM cannot execute!!	HOLD-ZOOM was tried on the recall data or data in the short and long wavelength range. This occurs when [START] is pressed.
8) AUTO function failed!!	The AUTO function did not operate correctly because the input signal level was improper.
9) superimpose cannot execute!!	The S.IMPOSE key was pressed when the measurement conditions in the upper and lower sections of the screen differed.
10) condition cannot change at 3D ON!!	Modification of the setting conditions was tried when the three-dimensional display was ON.
11) no REF or MEAS1 data!!	The LOSS/TRANS function was tried when no REF data or MEAS1 data was found in memory.
12) different condition at REF < > MEAS!!	The LOSS/TRANS function was tried between data having different measurement conditions.
13) no plotter!!	The plotter is disconnected or the plotter address is other than LISTEN ONLY.
14) no printer paper!!	The COPY key was pressed with no paper in the printer.
15) printer head up!!	The COPY key was pressed with the printer head was raised.
16) illegal level data input!!	A value exceeding the ±9.9dB range was entered during level calibration.

⑤ Auxiliary conditions

Auxiliary measurement and display condition items are displayed in three alphabetical characters. They are displayed at fixed positions.
(When a function is selected, the corresponding three characters appear. If no function is selected, no characters appear.)

The meanings and display positions of auxiliary conditions:

ⓐ RAU : "AUTO" mode has been selected for the REF level.

ⓑ ZCA or ZSA : "CTR AUTO" (ZCA) or "SPAN AUTO" (ZSA) has been selected for the ZOOM function.

ⓒ APC : APC (Auto Peak Center) function has been selected.

At the end of measurement, this function automatically sets the peak wavelength as the center wavelength.

ⓓ HSA or HSB or HAB : The Hi-sense mode effective for measurement of weak signals such as LED has been selected.

HSA: The Hi-sense A has been selected.
HSB: The Hi-sense B has been selected.
HAB: Both the Hi-sense A and Hi-sense B have been selected.

ⓔ SIM : "S.IMPOSE" (superimpose) has been selected.

ⓕ RCL : The data displayed is memory recall data. This disappears when the data is updated by measurement.

Display position: ⓐ
ⓑ
ⓒ
ⓓ

ⓔ

ⓕ

3.3 Setting the Measurement Conditions

Normally, the FUNCTION section keys are used for setting the measurement conditions. Basically, the measurement conditions can be divided into three types as follows:

1) Setting the wavelength conditions (center wavelength, span and others)
2) Setting the level conditions (input sensitivity)
3) Other settings (the number of averaging times, measurement light selection, and others)

Set the measurement conditions using the keys shown in Table 3-2.

Table 3-2 Measurement condition items and corresponding keys

Setting item	Item selection keys	Keys for modifying settings
① Center wavelength	CENTER	PEAK, CURSOR, AUTO PKC Numeric key , Knob, Arrow key
② Wavelength span	SPAN	FULL, 0.4 to 1.05, 0.8 to 1.75 Numeric key , Knob, Arrow key
③ Start wavelength	SPAN + START	Numeric key , Knob, Arrow key
④ Stop wavelength	SPAN + STOP	Numeric key , Knob, Arrow key
⑤ Coherent analysis range	SPAN	0.32 mm, 0.65 mm, 1.3 mm, 2.6 mm, 5.2 mm, 10.4 mm, AUTO Knob, Arrow key
⑥ Input sensitivity	REF LEVEL	TOTAL PWR, AUTO Numeric key , Knob, Arrow key
⑦ Selecting the light to be measured	REF LEVEL	LASER/LED, HI-SENS A, HI-SENS B
⑧ Selecting the type of the data to be analyzed	COHERENCE	SPECTRUM, COHERENCE
⑨ Number of averaging times	AVERAGE	2, 4, 8, 16, 32, 64, ON/OFF Numeric key , Knob, Arrow key

* [ ] : Panel key [ ] : Softkey

3.4 Setting the Display Conditions

In addition to the normal single screen display, dual-screen, superimpose and 3-dimensional displays are also available. Set the display conditions using the LEVEL SCALE and CONTROL keys.
Table 3-3 shows the display conditions and keys used to modify settings.

Table 3-3 Display conditions and keys used

Setting item	Item selection keys	Keys for modifying settings
① Display scale	LEVEL SCALE	LIN/LOG, 10dB/D, 5dB/D, 2dB/D, 1dB/D, 0.5dB/D, 0.2dB/D, Knob, Arrow key
② Grid display	CONTROL	GRID
③ Dual-screen display	CONTROL	DUAL
④ Superimpose	CONTROL	S.IMPOSE
⑤ 3-dimensional display ON/OFF	CONTROL + 3D	3D ON/OFF
⑥ Setting the 3-dimensional display conditions	CONTROL + 3D	INC ANGLE, DEC ANGLE, INC N, DEC N, N LOCK, ROLL
⑦ Recall and erase of 3-dimensional data	CONTROL + 3D	CSR NEXT, DELETE, CLEAR, RECALL

* : Panel key : Softkey
: Softkey (2nd line) : Softkey (3rd line)

3.5 Measurement and Data Output

Measurement is executed and the results output according to the measurement and display conditions described in sections 3.3 and 3.4.
Measurement is controlled using the three MEASURE section keys: for single measurement, repeated measurement and measurement stop.
The data displayed can be output to a printer (optional) or a plotter using the DATA OUT section keys.
Table 3-4 describes the keys used for measurement and data output.

Table 3-4 Measurement and data output items and keys used (1/2)

Item	Item selection and execution keys	Keys for modifying settings
① Executing a single measurement	SINGLE	———
② Executing a repeated measurement	REPEAT	———
③ Stopping measurement	STOP	———
④ Specifying the output device	DEVICE	PRINTER, PLOTTER, CLOCK, BUZZER
⑤ Executing data output	COPY	———
⑥ Paper feed to printer	FEED	———
⑦ Setting the plotter output conditions	DEVICE + PLOTTER	DATA: ALL, DATA: SIG, PAPER ADV, plot size, A4 (H1), H2, H4, V1, V2, V4
⑧ Setting the printer output conditions	DEVICE + PRINTER	MENU OUT

* : Panel key : Softkey
: Softkey (2nd line) : Softkey (3rd line)

Table 3-4 Measurement and data output items and keys used (2/2)

Item	Item selection and execution keys	Keys for modifying settings
⑨ Clock setting	DEVICE + CLOCK	ON/OFF, YEAR, MONTH, DAY, HOUR, MINUTE
⑩ Buzzer setting	DEVICE + BUZZER	BEEP, WARNING, QUIET

* : Panel key ; : Softkey ; : Softkey (2nd line) ; : Softkey (3rd line)

3.6 Analyzing the Measurement Data

Data analysis can be executed using the cursor, spectral width calculating, normalizing and other functions.

Table 3-5 describes the keys used for analyzing the measurement data.

Table 3-5 Measurement data analysis items and keys used (1/2)

Item	Items selection and execution keys	Keys for modifying settings
① Selecting the cursor display mode	CURSOR ON/OFF	NORMAL, △MODE, POWER, 2ND PEAK
② All cursors ON/OFF	CURSOR ON/OFF	———
③ λ1 selection ON/OFF	λ1	———
④ λ2 selection ON/OFF	λ2	———
⑤ L1 selection ON/OFF	L1	———
⑥ L2 selection ON/OFF	L2	———
⑦ Moving the cursor	λ1 / λ2 / L1 / L2	Knob, Arrow key
⑧ Executing the spectral width calculation/selecting the calculation type	SPECTRAL WIDTH	Pk. −XdB, RMS, ENVELOPE, Peak RMS
⑨ Specifying the spectral width calculation parameters	SPECTRAL WIDTH + parameter + XdB / YdB / K / Kr (RMS)	Numeric key
⑩ Executing the peak normalize function	NORMALIZE	Pk. NORM

* □ : Panel key ⬚ : Softkey

▣ : Softkey (2nd line)

Table 3-5 Measurement data analysis items and keys used (2/2)

Item	Items selection and execution keys	Keys for modifying settings
⑪ Loss characteristics	NORMALIZE	MEM NORM, LOSS, SAV REF, SAV MEAS1
⑫ Transparency characteristics	NORMALIZE	MEM NORM, TRANS, SAV REF, SAV MEAS1
⑬ Curve fit	ADVANCE	CURVE FIT

* : Panel key : Softkey

: Softkey (2nd line)

3.7 Operating Precautions (wavelength resolution/sensitivity)

The Q8344A is a Fourier spectroscopic type optical spectrum analyzer equipped with a Michelson interferometer. The definition of wavelength resolution as applied to this analyzer differs from that of the diffraction grating monochrometer type.
The input sensitivity varies according to the wavelength span specified.

(1) Wavelength resolution

In the case of the Q8344A, the wavelength $\lambda_{(i)}$ resolution is the difference from the wavelength of the next measurement point $\lambda_{(i+1)}$ on the spectrum measured. This value is determined by the relationship between the center wavelength and the span. Since the frequency spectrum obtained by FFT processing is internally converted into the wavelength, the intervals between the wavelength measurement points (resolution) are not identical (they become identical on the frequency axis).
Frequency to wavelength conversion is done using the following equation:

$$\lambda = (0.632991 \times 10^{-6} \times 256 \times 10^{+3}) / (4 \times f) = 0.040511 / f \quad \text{①}$$

0.632991×10^{-6} : Standard He-Ne wavelength (in vacuum)
$256 \times 10^{+3}$: Sampling frequency of A/D converter
4 : Sampling clock multiplication factor
(Note: When the START wavelength is 0.4 μm or below, the multiplication factor is 8.)

Since the frequency analysis range of the A/D converter is 100kHz and the number of points obtained by FFT processing is 800, the frequency resolution is 125Hz. Actually, an internal digital filter is used to increase this resolution up to the value multiplied by 64 at maximum (x2, 4, 8, 16, 32 and 64 multiplication factors can be selected to suit the span specified).

Example: When the center wavelength is 0.78 μm and the span is 50nm:

CENTER: 0.78 μm, SPAN: 50nm → START: 0.755 μm, STOP: 0.805 μm

Using the above equation, these values are converted into frequency as follows:
f_0 START-f = $0.040511 / (0.755 \times 10^{-6})$ = 53.6569 kHz
f_1 STOP-f = $0.040511 / (0.805 \times 10^{-6})$ = 50.3242 kHz
f_c CENTER-f = $0.040511 / (0.780 \times 10^{-6})$ = 51.9371 kHz

The multiplication factor of the digital filter is determined by the condition under which the number of measurement points is:
"400 < (f_0 - f_1) / △f≤ 800"
In this example, the value of △f which satisfies this condition is 7.8125Hz (multiplication factor 16) according to Table 3-6. The resolution △λ at the specified wavelength λ is determined by the following equation:

$$\triangle\lambda = (\lambda^2 \times \triangle f) / 0.040511 \quad \text{②}$$

Therefore, the resolution at 0.78μm is about 0.12nm.

Table 3-6 Digital filter multiplication factor and frequency resolution

Digital filter multiplication factor	1	2	4	8	16	32	64
Frequency resolution [Hz] △f	125	62.5	31.25	15.625	7.8125	3.9063	1.9531

According to equation ②, if resolutions of the same frequency are compared, the shorter wavelength has a higher resolution than the longer wavelength. That is, the measurement point interval on the spectrum is smaller at the shorter wavelength and becomes greater as the wavelength becomes longer.
If the START wavelength is 0.4 μm or below, the value 0.040511 in equations ① and ② is halved and the resolution becomes 1/2 of the normal value because of the frequency range of the internal A/D converter (measurement time is doubled compared to normal time).
Table 3-7 shows the relationship between resolution and span for main wavelength values.
Although 800-point data is constantly maintained internally, the number of points displayed varies according to the relationship between the center wavelength and the specified span.

Table 3-7 Relationship between resolution and span for main wavelength values

Unit: nm

Wave-length / Span	0.633 μm [64.00 kHz]	0.780 μm [51.94 kHz]	0.850 μm [47.66 kHz]	1.310 μm [30.92 kHz]	1.550 μm [26.14 kHz]
FULL	1.236 <1> [492] (0.4 to 1.05)	1.877 <1> [492] (0.4 to 1.05)	2.229 <1> [492] (0.4 to 1.05)	2.648 <2> [440] (0.8 to 1.75)	3.707 <2> [440] (0.8 to 1.75)
500 nm	1.236 <1> [440] (0.4 to 0.9)	0.939 <2> [594]	1.115 <2> [562] (0.55 to 1.05)	1.325 <4> [393]	0.927 <8> [593] (1.25 to 1.75)
200 nm	0.309 <4> [665]	0.469 <2> [434]	0.558 <4> [365]	0.331 <16> [609]	0.463 <16> [434]
100 nm	0.155 <8> [652]	0.235 <9> [429]	0.139 <16> [721]	0.165 <32> [607]	0.232 <32> [434]
50 nm	0.077 <16> [649]	0.117 <16> [428]	0.070 <32> [719]	0.083 <64> [606]	0.116 <64> [433]
20 nm	0.039 <32> [518]	0.029 <64> [683]	0.035 <64> [575]	↑ [242]	↑ [173]
10 nm	0.019 <64> [518]	↑ [342]	↑ [288]	↑ [122]	↑ [88]
5 nm	↑ [259]	↑ [171]	↑ [144]	↑ [62]	↑ [44]

Notes

1. Values in < > indicate the digital filter multiplication factor.
2. Values in [ ] indicate the number of points displayed.
3. Values in ( ) indicate the wavelength range.
   When the wavelength range is below the resolution, the wavelength range is used instead of the span of the specified wavelength center.
4. The data here is valid when REF LEVEL Hi-sense B mode is set to OFF.

(2) Sensitivity

The Q83344A is equipped with a built-in 16-bit A/D converter and FFT processing is executed according to the converter data. Since the REF level is fixed within a single measurement, dynamic range cannot be ensured unless the appropriate REF level is selected to suit the light to be measured (the measurement system has a dynamic range of approximately 45dB).
Set the REF level to suit the sensitivity required.
The sensitivity (noise level) is changed not only by the REF level but also by the multiplication factor of the internal digital filter (changed by the wavelength span).
The change in the noise level due to the digital filter multiplication factor can be determined as follows.
If the noise level is assumed to be 1 at a certain multiplication factor, then the noise level at that factor multiplied by N is:

- In LASER mode : $1/\sqrt{N}$
- In LED mode : $\sqrt{N}$

That is, if multiplication factor 1 is compared to 4, the noise level is halved (− 3dB) in laser mode and doubled (+ 3dB) in LED mode.

4. PANEL OPERATION

This chapter describes panel key operations along with the analyzer's functions.

4.1 FUNCTION Section

The FUNCTION section consists of eight keys used to specify the basic measurement conditions of the optical spectrum analyzer.

(1) CENTER key : Specifies the center wavelength.
(2) SPAN key : Specifies the wavelength span, the start stop wavelengths and the coherence analysis range.
(3) REF LEVEL key : Specifies the input sensitivity.
(4) LEVEL SCALE key : Selects the vertical axis scale (LIN/LOG).
(5) COHERENCE key : Selects coherence or spectrum analysis.
(6) AVERAGE key : Specifies the averaging ON/OFF and number of processings.
(7) ZOOM key : Selects and executes the ZOOM function to re-analyze the measurement data under different wavelength conditions.
(8) AUTO key : Executes the automatic setting functions for optimal measurement conditions.

4.1.1 CENTER key

The CENTER key is used to specify the center wavelength and the setting are carried out using the numeric keys, knobs, arrow keys and Softkeys. When the CENTER key is pressed,

CENTER: X.XXXXμm

appears at the bottom of the CRT and the Softkey menu illustrated below can be used.

Softkey menu

[CENTER]

PEAK	CURSOR				AUTO PKC	

Explanation on the Softkey menu

① PEAK
The wavelength of the peak level obtained by the Auto Peak Search function is specified as the center wavelength.

② CURSOR

The wavelength indicated by the X cursor is specified as the center wavelength.
If two X cursors are displayed, the wavelength of the intermediate position between the two cursors is specified as the center wavelength,.
If the X cursor is OFF, this key does not function.

③ AUTO PKC

This key sets the APC (Auto Peak Center) function for redisplay (internal HOLD-ZOOM execution) by automatically setting the measured peak wavelength as the center wavelength. The APC function is switched to ON/OFF alternately every time this key is pressed. When this function is set to ON, "APC" is displayed on the right bottom in the screen.

< <APC (Auto Peak Center) function> >

This function automatically performs reanalysis (using the HOLD-ZOOM function) by setting the measured peak wavelength as the center wavelength. This function works when the difference between the peak wavelength and center wavelength is more than about 1/100 of the set span.

For example, if the span is set to 100 nm and the center wavelength is 1.3 μm, the function works when the peak wavelength is outside the range from 1.299 to 1.301 μm.
This function works only in the spectrum mode.
When, in the dual-screen mode, both the upper and lower screens are active and the lower screen is in the spectrum mode, the peak wavelength searched on the lower screen is set as the center wavelength on the upper screen.
Otherwise, redisplay is made with the measured peak wavelength as the center wavelength. The APC function is not activated under any of the following conditions:

(1) The measurement condition for data to be peak-searched includes both short and long wavelengths.
(2) The measurement condition for data to be peak-searched is for coherence analysis.
(3) When both the upper and lower screens in the dual-screen mode are in the active mode, the wavelength ranges (short/long) differ between the screens.
(4) The LOSS or TRANS mode is set to ON.

If the AVERAGE function is set to ON, this function is executed only in the first measurement. This function is subject to back-up.

Key and knob functions

① Numeric keys

The current value specified is cleared and the values entered are displayed one by one. To load the entered value, press the Unit key (μm, nm) at the end.

Values which exceed the range of the measurement wavelength allowed (0.35 to 1.75μm) are ignored.

To cancel all the values entered, press the CENTER key before entering new values. To delete the value entered immediately before, press the BACK SPACE key.

② Knob

The value to be set increases when the knob is turned clockwise (to the right) and decreases when turned counterclockwise (to the left). The currently specified span is increased/decreased in about 1/100 steps.

③ Arrow keys

The value specified increases when the [↑] key is pressed and decreases when the [↓] key is pressed. The currently specified span is increased/decreased in about 1/500 steps.

4.1.2 SPAN key

This key is used to specify the wavelength span, the start/stop wavelengths and the coherence analysis range. The specified values can be modified with the numeric keys, knobs, arrow keys and Softkeys. Operations differ depending on the data types (spectrum coherence analysis). When the SPAN key is pressed, the current values appear at the bottom of the CRT:

SPAN: XXXX.X nm (during spectrum analysis)
SPAN: XX.XX mm (during coherence analysis)

The Softkey menu which can be used is as follows:

Softkey menu

- For spectrum analysis

[SPAN (SPEC)]

SPAN	START	STOP	△λ→SPAN	0.4 to 1.05	0.8 to 1.75	FULL

- For coherence analysis

[SPAN (COH)]

AUTO	0.32 mm	0.65 mm	1.3 mm	2.6 mm	5.2 mm	10.4 mm

Explanation on the Softkey menu

For spectrum analysis

① SPAN
This key is used to specify the span (when the SPAN key is pressed, this key is selected). The specified value can be modified using the numeric keys, knob and the arrow keys.

② START
This key is used to specify the start wavelength. The specified value can be modified using the the numeric keys, knob and the arrow keys.

③ STOP
This key is used to specify the stop wavelength. The specified value can be modified using the numeric keys, knob and arrow keys.

④ △λ→SPAN
This is used to specify the interval between the two cursors as the span. When this key is pressed, the center wavelength is also modified simultaneously. This key is disabled if the X cursor is OFF or only one X cursor is enabled.

⑤ 0.4 to 1.05
This is used to specify the maximum span of the short wavelength range (0.4μm to 1.05μm). When this key is pressed, the center wavelength is also modified simultaneously.

⑥ 0.8 to 1.75
This is used to specify the maximum span of the long wavelength range (0.8μm to1.75μm). When this key is pressed, the center wavelength is also modified simultaneously.

⑦ FULL
This is used to specify the maximum span (0.35μm to 1.75μm). When this key is pressed, the center wavelength is also modified simultaneously.
Note that the measurement time is multiplied by four compared to normal measurement when this key is used.
(To measure the short and long wavelengths, the measurement time is doubled. Also, since a wavelength below 0.4 μm is maintained, measurement time is doubled as well. In total, measurement time multiplied by four is required.)

For coherence analysis

① AUTO
The distance range determined by the span during spectrum analysis is automatically specified. The distance range is depend not only on the wavelength span but on the center wavelength.
See Table 4-1.

② 0.32mm
The distance range for coherence analysis is set to ±0.32mm.

③ 0.65mm
The distance range for coherence analysis is set to ±0.65mm.

④ 1.3mm
The distance range for coherence analysis is set to ±1.3mm.

⑤ 2.6mm
The distance range for coherence analysis is set to ±2.6mm.

⑥ 5.2mm
The distance range for coherence analysis is set to ±5.2mm.

⑦ 10.4mm
The distance range for coherence analysis is set to ±10.4mm.

Note

1. If the wavelength range is set to 0.4 μm or less, distance range 20.4 mm cannot be set.
2. If Hi-sense B is set to ON, distance ranges 5.2 mm and 10.4 mm cannot be set.

Table 4-1 Relationship between the distance range for coherence analysis and the span for spectrum analysis

Center wavelength \ Distance range	10.4 mm	5.2 mm	2.6 mm	1.3 mm	0.65mm	0.32 mm
0.633 μm	≤15.2 nm	15.3 nm to 30.1 nm	30.2 nm to 58.9 nm	59.0 nm to 112.6 nm	112.7 nm to 206.8 nm	206.9 nm to 355.6 nm
0.78 μm	≤23.1 nm	23.2 nm to 45.5 nm	45.6 nm to 88.5 nm	88.6 nm to 167.5 nm	167.6 nm to 302.6 nm	302.7 nm to 506.9 nm
0.85 μm	≤27.4 nm	27.5 nm to 53.9 nm	54.0 nm to 104.6 nm	104.7 nm to 197.0 nm	197.1 nm to 353.2 nm	353.3 nm to 400.0 nm
1.31 μm	≤64.5 nm	64.6 nm to 126.0 nm	126.1 nm to 240.4 nm	240.5 nm to 440.4 nm	440.5 nm to 754.1 nm	754.2 nm to 880.0 nm
1.55 μm	≤89.9 nm	90.0 nm to 174.8 nm	174.9 nm to 331.0 nm	331.1 nm to 400.0 nm	——	——

(Note) This data is valid when HI-SENS B mode is set to OFF.

Key and knob functions

For spectrum analysis

① Knob and arrow keys

The specified value can be increased by pressing the [↑] key or turning the knob clockwise (to the right) and decreased by pressing the [↓] key or turning the knob counterclockwise (to the left). Both key and knob operation increases/decreases the value in 1 - 2 - 5 steps.

The maximum and minimum spans which can be specified are 1400nm and 1nm, respectively.

② Numeric keys

The value currently displayed is cleared and the values entered are displayed one by one. To load the entered value, press the Unit key (μm, nm, nm/DIV.) at the end.

Values which can be specified range from 1 to 1400nm. Values down to 0.1nm are also valid.

To cancel all values entered, press SPAN and enter. To delete the value entered immediately before, press the BACK SPACE key.

For coherence analysis

① Knob and arrow keys

The value specified can be increased by pressing the [↑] key or turning the knob clockwise (to the right) and decreased by pressing the [↓] key or turning the knob counterclockwise (to the left). Six ranges from 0.32mm to 10.4mm can be specified.

② Numeric keys

The value currently displayed is cleared and the values entered are displayed one by one. To load the entered value, press ENTER at the end.

Values ranging from 0.32 to 10.4 can be specified rounded up to the six types displayed in the Softkey menu.

Note

1. If a wavelength below 0.4 um is specified, the measurement time is doubled and the resolution is halved due to system limitations. Therefore, use the FULL span setting only when spectrum analysis below 0.4 um is required.

2. If a value over the short and long wavelength range (the START wavelength is below 0.8 um and the STOP wavelength exceeds the 1.05 um), the wavelength below 1.0 um is analyzed as the short wavelength and the one above 1.0 um is analyzed as the long wavelength. Consequently, the resolution differs below or above 1.0 um and the data display point interval becomes discontinuous.

3. Since a spectrum having identical intervals on the frequency axis is converted into wavelength when displayed by the Q8344A, the measurement points on the wavelength axis are not at identical intervals. The point of the center wavelength specified contains data while the points corresponding to the start and stop wavelengths determined by the span specification do not normally contain any data (data is contained at the position where distance equals resolution).
   Up to 801 points of spectrum data can be displayed. However, this number varies depending on the center wavelength and the span, (see section 3-7).

4.1.3 REF LEVEL key

This key is used to specify the measurement input sensitivity so that the level of the signal to be measured can be displayed under optimum condition. Modifications can be made using the numeric keys, knob, arrow keys and Softkeys.
When the REFLEVEL key is pressed,

REF LEVEL: XX.XdBm (when LOG is displayed)

or

REF LEVEL: XX.XxW (when LIN is displayed)

appears at the bottom of the CRT, and the Softkey menu described below can be used.

Softkey menu

[REF LEVEL]

TOTAL PWR		HI-SENS A	HI-SENS B		LASER/LED	AUTO

Note

As the Q8344A uses Fourier spectroscopy, power from the input light is completely radiated in the photo sensor section. In the case of a single spectrum with narrow line width, the peak level and the REF LEVEL setting can be made almost identical. In the case of an LED a with wide spectrum or LD with multiple spectra, an overload occurs if REF LEVEL is set for the peak level. In this case, specify a significantly greater REF LEVEL so that "OVERLOAD" message does not appear on the screen.

Explanation on the Softkey menu

① TOTAL PWR
The total (power) of the spectra measured is set as the REF LEVEL.

② HI-SENS A
This key is used to control ON/OFF of the "HI-SENS A" mode which decelerates the internal movable mirror to the half speed decreases the frequency range to half and lowers the noise level for measurement.
This mode is effective in micro weak optical measurement, but measurement time is doubled as compared with ordinary measurement.
The HI-SENS A mode is switched to ON/OFF alternately every time this key is pressed.
When this mode is set to ON, "HSA" is displayed on the right bottom in the screen. ("HAB" is displayed when HI-SENS B is also set to ON.)

③ HI-SENS B

This key is used to control ON/OFF of the HI-SENS B mode which sets the resolution to half as compared with ordinary measurement and sets the A/D sampling interval to half for increasing the signal-to-noise ratio (enlarging signal).

This mode is effective for measuring LED having wide spectrum, for example.

Since the resolution is decreased to half in this mode, the number of measuring points is also decreased to half. Measurement time is doubled as compared with ordinary measurement (because the clock frequency is multiplied by eight in all wavelength ranges)

If this mode is set to ON, the distance range for coherence analysis is up to 2.5 mm.

This mode is switched to ON/OFF alternately every time this key is pressed. (Each switching to ON/OFF erases measurement data from the screen.)

When this mode is set to ON, "HSB" is displayed on the right bottom in the screen. ("HAB" is displayed when HI-SENS A is also set to ON.)

④ LASER/LED

This key is used to select the type of light to be measured (LASER and LED modes are specified alternately).

Use the LED mode when measuring light having a large spectrum range (such as LEDs and white light sources), while use the LASER mode for a small spectrum range (such as laser).

In LASER mode, the level of the spectrum displayed corresponds to the power indication of the spectrum around the spectrum resolution (ENBW) during measurement. The unit is dBm or W. When the signal spectrum range is smaller than the spectrum resolution of the analyzer, the spectrum peak value corresponds to the power of the input signal.

In LED mode, the spectrum resolution of the analyzer is normalized to 1nm and the spectrum power density indicated. The spectrum resolution of the analyzer varies depending on the wavelength because of the measurement method. Therefore, select this mode when measuring a spectrum having a wide range.

⑤ AUTO

This key controls ON/OFF switching of the mode in which the REF LEVEL appropriate for the light power measured has been automatically set.

The optical input power increases when this mode is ON. When an overload occurs, a greater value is automatically set for the REF LEVEL.

When this mode is selected, the measurement time should be multiplied by three or more if the power of the input light varies.

Key and knob functions

① Knob

The value specified increases when the knob is turned clockwise (to the right) and decreases when the knob is turned counterclockwise (to the left).

The value is increased/decreased by 1/2 (0.5 div) when LOG is displayed and in 1-2-5 steps when LIN is displayed.

② Numeric keys

The currently displayed value is cleared and the values entered are displayed one by one. To load the entered value, press the Unit key (dBm, mW, uW, nW).

When dBm is specified by the Unit key, the LOG scale appears. Otherwise, the LIN scale appears.

To cancel the values entered, press the REF LEVEL key, and re-enter data. To delete a value entered immediately before, press the BACK SPACE key.

③ Arrow keys

The arrow keys are used to modify the REF LEVEL displayed (without modifying the input sensitivity).

The value can be increased by pressing the [↑] key and decreased by pressing the [↓] key. Values are modified in 1/2 (0.5 DIV) steps on the LOG scale and in 1-2-5 steps on the LIN scale.

If the REF LEVEL has been modified using the knob or numeric keys, the REF LEVEL set with the arrow keys is reset identical to the input sensitivity.

4.1.4 LEVEL SCALE key

This key is used to switch the vertical axis scale (LIN/LOG) and to set the LOG scale. Values can be modified using the numeric keys, knob, arrow keys and Softkeys.
When the LEVEL SCALE key is pressed,

LEVEL SCALE: XdB/DIV (when LOG is displayed)

or

LEVEL SCALE: LIN (when LIN is displayed)

appears along with the currently specified value, and the Softkey menu described below can be used.

Softkey menu

[LEVEL SCALE]

LIN/LOG	10dB/D	5dB/D	2dB/D	1dB/D	0.5dB/D	0.2dB/D

Explanation on the Softkey menu

① LIN/LOG
This key is used to switch the display scale to LIN or LOG.
LIN and LOG are specified alternately when the key is pressed.

② 10dB/D, 5dB/D, 2dB/D, 1dB/D, 0.5dB/D, 0.2dB/D
When the LOG scale is selected, the type can be selected from the values given in the menu: 10, 5, 2, 1, 0.5 and 0.2dB/DIV.
The grid scale is 6 if 10dB/DIV is selected, otherwise, it is 10.

Key and knob functions

① Knob and arrow keys
These are used to switch the LOG scale type (6 types from 10dB/div to 0.2dB/DIV).
The specified value can be increased by pressing the [↑] key or turning the knob clockwise (to the right) and decreased by pressing the [↓] key or turning the knob counterclockwise (to the left).

② Numeric keys
The currently specified value is cleared and the values entered are displayed one by one.
To load the entered values, press the Unit key (dB/DIV) at the end.
If a value other than the six types is entered, the scale type nearest the value is specified.

4.1.5 COHERENCE key

In addition to normal spectrum analysis, this analyzer is equipped with the coherence analysis function using an interferogram obtained by a built-in interferometer. This key is used to switch between spectrum and coherence analysis.
For switching analysis data, only the Softkey need be used.
When the COHERENCE key is pressed, the Softkey menu described below can be used.

Softkey menu

[COHERENCE]

SPECTRUM	COHERENCE					

Explanation on the Softkey menu

① SPECTRUM
Spectrum analysis is selected.

② COHERENCE
Coherence analysis is selected.

Note

Coherence analysis cannot be specified under the following conditions:
The span is set to "AUTO" and the wavelength condition for spectrum analysis is one of the following:

- **The wavelength exceeds the short and long wavelength range.**
  (The start wavelength is below 0.8μm and the stop wavelength exceeds 1.05μm.)

< <Coherence Analysis> >

The interferogram obtained by the interferometer is sampled by the A/D converter at a definite distance interval (1/8 He-Ne laser wavelength of 0.633 um ≒0.080 um) and data at 1024 points are measured.
The interferogram is obtained by dividing the light to be measured into two fluxes to be fed through different routes and superimposed. That is, the interferogram indicates the degree of interference of the light to be measured.

1. The following are executed in coherence analysis.
   Interferogram ⟶ A/D converter ⟶ digital filter
   → Data of 1024 points at an identical interval containing phase information (real, image)
   (The distance intervals depends on the multiplication factor of the digital filter.)

2. For each of 513 points (difference in luminous route + direction data) among the 1024 points measured in step (a), the sum of squares is determined.
   $C_i = \sqrt{real_i^2 + imag_i^2}$

3. All data is normalized at the peak value (data of route difference 0) of the sum of the squares for each point (normalization is executed, assuming a peak value of 1).

4. The data is looped, assuming the peak value (data of route difference 0) as the center for obtaining data of 1025 points and the envelope of each point is determined.

In coherence analysis, α (distance and level of the second peak) and β (intermediate distance and level between the peak and second peak) are displayed in place of the peak data in spectrum measurement.

4.1.6 AVERAGE key

This key is used to specify ON/OFF switching and the number of averaging times needed to measure low power signals in a stable state. Values can be modified using the numeric keys, knob, arrow keys and Softkeys.
When the AVERAGE key is pressed,

AVERAGE: XXXX

appears on the screen along with the currently specified value, and the following Softkey menu can be used.

Softkey menu

[AVERAGE]

ON/OFF	2	4	8	16	32	64

Explanation of the Softkey menu

① ON/OFF
This key controls ON/OFF switching of the averaging mode. When ON, averaging is executed the specified number of times. While averaging is ON, measurement is executed the number of times specified using the SINGLE key. (The number of times is indicated by the X of X/N on the screen and the data updated with each measurement. The average of X times is then indicated. N is the number of averaging times specified. While averaging is in progress, the "AVERAGE in progress..." message appears. While averaging is OFF, the X of X/N remains 1.)

② 2, 4, 8, 16, 32, 64
These values specify the number of the averaging times.

Key and knob functions

① Knob and arrow keys
The specified value can be increased by pressing the ↑ key or turning the knob clockwise (to the right) and decreased by pressing the ↓ key or turning the knob counterclockwise (to the left). Values are increased/decreased in powers of 2, 4, 8, 16, 32 or 64. The minimum and maximum values are 1 and 1024, respectively.

② Numeric keys
Values from 1 to 1024 can be specified.
The currently specified value is cleared and the values entered are displayed one by one. To load the entered value, press the ENTER key at the end.
To cancel all the values entered, press the AVERAGE key and re-enter new values. To delete the value entered immediately before, use the BACK SPACE key.

Note

Averaging can be executed only for data obtained under identical wavelength and level measurement conditions. Averaging is cleared if one of the followings modifications occurs during processing:

- The center wavelength or span is modified.
- REF LEVEL is modified.
- Switching between spectrum coherence analysis is executed.
- The AUTO function is executed.
- The measurement data is recalled (in this case, the system automatically stops measurement).
- The display mode (dual-screen/superimpose/3-dimensional) is modified.
- HI-SENS B mode ON/OFF is switched.

4.1.7 ZOOM key

Press this key when using the HOLD-ZOOM function.

< <HOLD-ZOOM function > >

This function is used to re-analyze the measurement data under different wavelength conditions (spectrum analysis) at different distances (coherence analysis). Once measurement is executed, 128k of data are stored in the internal buffer independent of the center/span setting.
The execution time varies about 0.5 to 1.0 second, depending on the span setting. (The time becomes shorter when the span is wide and longer when the span is narrow.)
Note that this function is only valid when measurement has been stopped.

When this key is pressed, the following Softkey menu can be used.

Softkey menu

[ZOOM]

START	STOP			CTR AUTO	SPAN AUTO	

Explanation on the Softkey menu

① START
According to the measurement data obtained immediately before, re-analysis is executed under currently specified wavelength conditions or distance range.
While the HOLD-ZOOM function is in progress, the "HOLD-ZOOM in progress ..." message appears on the screen. This key is disabled under the following conditions.

Conditions under which HOLD-ZOOM processing is not executed.

- Measurement processing is in progress.
- The wavelength conditions of measurement data obtained immediately before or the current wavelength conditions exceed both the short and long wavelength ranges.
- The wavelength range (short/long) of preceding measurement data differs from the current wavelength range.
- The preceding data was found to be recall data from memory.
- Normalization (LOSS/TRANS) is ON.
- Averaging is ON.

② STOP
This key is used to stop the HOLD-ZOOM processing currently being executed.

③ CTR AUTO

This key selects automatic HOLD-ZOOM processing when the center wavelength setting is modified. In this mode, CTR AUTO is displayed in reverse state each time this key is pressed. The CTR AUTO and SPAN AUTO ④ described below are selected alternately.
The conditions under which HOLD-ZOOM processing is not executed are the same as those described in paragraph ①.

④ AUTO SPAN

This key selects automatic HOLD-ZOOM processing when the span setting is modified. In this mode, SPAN AUTO is displayed in reverse state each time this key is pressed. The SPAN AUTO and CTR AUTO ③ described below are selected alternately.
The conditions under which HOLD-ZOOM processing is not executed are the same as those described in paragraph ①.

Additional explanation on the HOLD-ZOOM function

The interferogram obtained from the interferometer is A/D converted at a definite shift interval of the moving mirror and subjected to FFT processing to display the spectrum.
FFT processing is executed on the time-axis data on 1024 points to obtain spectrum data on 800 points. Since the frequency analysis range of the internal A/D converter is 100kHz, the resolution by simple calculation becomes 125Hz.
To improve this resolution, the ZOOM function is used to enlarge the frequency around the wavelength of the light to be measured, using the internal digital filter. (The multiplication factor is 64 at maximum, corresponding to a frequency resolution of 1.953Hz.) The multiplication factor of the digital filter varies depending on the center wavelength and span settings. As the span becomes wider, the multiplication factor becomes smaller, and as the span becomes narrower, the multiplication factor becomes greater. (The relationship between a typical center wavelength and span are shown in Table 3-7.)
Since the digital filter requires sampling data of double the multiplication factor, up to 128K (64 x 2 x 1024) of A/D-converted data is used. The analyzer has a buffer large enough to store 128k of data. All the data required to analyze the entire short and long wavelength ranges at various spans does not exceed 128k.
In normal measurement, the center wavelength (center frequency) and multiplication factor are specified for the digital filter and the A/D converted data is input directly to the digital filter. When HOLD-ZOOM is ON, data from a particular buffer area (varies depending on the span multiplication factor) is input to the digital filter.

4.1.8 AUTO key

When this key is pressed, optimum measurement conditions are automatically specified in accordance with the input signals such as wavelength and level. This function is especially helpful when the wavelength and level are unknown.
While this function is in progress, the "AUTO function in progress..." message appears on the screen. This message disappears when the of optimum conditions are complete.
Since this function is executed internally based to the spectrum data, the distance range corresponding to the optimum span on the spectrum is specified when this function is used in coherence analysis mode.
When the AUTO key is pressed, the following Softkey menu can be used.

Softkey menu

[AUTO]

FULL	0.4 to 1.5	0.8 to 1.75				ABORT

Explanation on the Softkey menu

① FULL
Optimum conditions are determined, the entire wavelength range (0.35μm to 1.75μm) searched, and the wavelength and the level specified.
When this key is used, more time is required compared with ② and ③ because both the short and long wavelength ranges are searched.

② 0.4 to 1.05
Optimum conditions are determined, the short wavelength range (0.4μm to 1.05μm) searched, and the wavelength and level specified.

③ 0.8 to 1.75
Optimum conditions are determined, the long wavelength range (0.8 μm to 1.75 μm) searched, and the wavelength and level specified.

Note: When Softkey ①, ② or ③ is pressed, the display is reversed. It returns to normal upon completion of the AUTO function.

<< Precautions when using the AUTO function >>

- The AUTO function may not operate normally for light sources having a power level of less than −40dBm.
- While the AUTO function is in progress, only the "ABORT" key is enabled. To interrupt execution, press "ABORT".

4.2 MEASURE Section

This section consists of three keys for controlling measurement.

4.2.1 SINGLE key

This key is used to execute single measurement.
While measurement is in progress, the key LED lights. The LED goes off upon completion of measurement.
When averaging is ON, measurement is continuously repeated the specified number of times.
If this key is pressed while measurement is in progress (while the LED is ON), the current measurement is interrupted, and another measurement is started.

4.2.2 REPEAT key

This key is used to repeat measurement.
When this mode is selected, the corresponding LED lights until the SINGLE or STOP key is pressed.
If this key is pressed during measurement (while the LED is ON), the current measurement is interrupted and another measurement is started.

Note: When averaging is ON, the process is repeated the specified number of times.

4.2.3 STOP key

This key is used to stop measurement.
When this key is pressed, measurement stops abruptly and the LED in the SINGLE or REPEAT key goes off.
When measurement is stopped using this key, the analysis data currently displayed is saved in memory.

4.3 DATA Section

This section consists of numeric keys (keys representing numbers and units) used to modify specified values, cursor control keys and a LABEL key to modify line comments (labels).

4.3.1 Numeric keys, arrow keys and rotary knob

(1) Numeric keys

The 0 to 9 keys are used to enter numerics directly for setting modification.
In addition, the following "."and " – " terminator keys can be used to enter numerics ($\frac{um}{dBm}$, $\frac{nm}{mW}$, $\frac{nm/DIV}{uW}$ and $\frac{dB/DIV}{nW}$) and the BACK SPACE key for deleting a number or character entered immediately before.

(2) Arrow keys

The arrow keys are used to modify values in specific steps and also to move the cursor.
Values are are increased by pressing the ↑ key and decreased by pressing the ↓ key.
When the λ1, λ2, L1 or L2 LED is lit, the arrow keys are used for cursor movement.

(3) Rotary knob

Values can be modified continuously or in steps using the rotary knob. They are increased by turning the knob clockwise (to the right) and decreased by turning it counterclockwise (to the left).
When the λ1, λ2, L1 or L2 LED is lit, the rotary knob is used for cursor movement.

4.3.2 Cursor control

The "CURSOR ON/OFF" key is used to control ON/OFF switching of the four cursors and to specify the cursor display mode. Four keys, λ1, λ2, L1, L2, are used to select the four cursors separately.
When the ON/OFF key is pressed, the Softkey menu described below is displayed so that the cursor display mode can be selected.

Softkey menu

[CURSOR]

NORMAL	△MODE	2ND PEAK	POWER		LEFT PEAK	RIGHT PEAK

Explanation on the Softkey menu

The cursor data is displayed at the upper right of the CRT. The following display modes can be selected:

① NORMAL

Selects the "NORMAL" display mode. The data display format is as follows:

λ1	. . .	Indicates the wavelength of X cursor 1.
ℓ1	. . .	Indicates the level of X cursor 1.
λ2	. . .	Indicates the wavelength of X cursor 2.
ℓ2	. . .	Indicates the level of X cursor 2.
L1	. . .	Indicates the level of Y cursor 1.
L2	. . .	Indicates the level of Y cursor 2.

② △MODE

Selects the "△MODE" display mode. The data display format is as follows:

λ1	. . .	Indicates the wavelength of X cursor 1.
ℓ1	. . .	Indicates the level of X cursor 1.
△Λ	. . .	Indicates the wavelength difference between X cursor 1 and 2.
△1	. . .	Indicates the level difference between X cursor 1 and 2.
L 1	. . .	Indicates the level of Y cursor 1.
△L	. . .	Indicates the level difference between Y cursor 1 and 2.

③ 2ND PEAK

Selects the "2ND PEAK" display mode. The data display format is as follows:
When this key is pressed, X cursor 1 automatically moves to the maximum peak, and X cursor 2 moves to the secondary peak.

λ_P	. . .	Indicates the peak wavelength.
ℓ_P	. . .	Indicates the peak level.
△Λ	. . .	Indicates the wavelength difference between the peak and second peak.
△1	. . .	Indicates the level difference between the peak and second peak.

④ POWER

Selects the "POWER" display mode. The data display format is as follows:

λ1	. . .	Indicates the wavelength of X cursor 1.
λ2	. . .	Indicates the wavelength of X cursor 2.
ΣL	. . .	Indicates the sum of the levels of X cursor 1 and 2.

⑤ LEFT PEAK

Moves X cursor 1 from the current position to the peak position on the left.
If X cursor 1 is OFF or no peak is found on the left, this key is ignored.
When Y cursor 2 is displayed, only the peaks exceeding the level of Y cursor 2 are counted.

⑥ RIGHT PEAK

Moves X cursor 1 from the current position to the peak position on the right.
If X cursor 1 is OFF or no peak is found on the right, this key is ignored.
When Y cursor 2 is displayed, only the peaks exceeding the level of Y cursor 2 are counted.

Explanation on the key functions

① ON/OFF key

This key is used to control the display of all cursors.
If this key is pressed while the cursors are ON, all cursors are switched OFF.
If this key is pressed while the cursors are OFF, one of the following operations is executed depending on the preceding state.

(a) If the cursor was ON and the CENTER, SPAN and REF LEVEL measurement conditions are not modified:
→ The previously displayed cursor is restored.

(b) Otherwise:
→ The λ1 LED lights and X cursor 1 is displayed at the peak wavelength position.

Note: If "2ND PEAK" has been selected for the cursor display mode, X cursor 1 is automatically displayed at the peak wavelength position and X cursor 2 at the second peak wavelength position, irrespective of the preceding state.

② λ1, λ2, L1, L2 keys

The λ1, λ2, L1 and L2 keys correspond to X cursor 1, X cursor 2, Y cursor 1 and Y cursor 2, respectively.
If this key is pressed when no cursor is displayed, the corresponding LED lights and the cursor is displayed. The cursor can be moved using the knob and arrow keys.
If these keys are pressed while a cursor is displayed and the LED is off, the LED lights, and the cursor can be moved using the knob and arrow keys.
If these keys are pressed when no LED is lit, the corresponding cursor disappears.
Note that the LED goes off when the FUNCTION or DISPLAY key is pressed.

4.3.3 Label setting

A measurement data comment can be entered on the label data line (up to 48 characters).
The label display area is fixed on the uppermost line of the CRT. The initial state of the label line is as follows:

** ADVANTEST Q8344A Optical Spectrum Analyzer **

When the LABEL key is pressed, a list of characters (character menu) appears at the lower right of the CRT and the current label data appears at the lower left.

Character menu

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 . , " ' ` : ; ( ) [ ] < > − + =
／ ¥ _ | ～ ! @ # $ % ^ & * ? {} α β γ δ λ μ Δ Λ Σ ∫

Modification of the label data can be performed using the Softkeys, knob, arrow keys and numeric keys.
To terminate the label setting mode, press the LABEL key again or update the label data by pressing the "ENTER" Softkey.
When the label setting mode is cleared, the Softkey menu returns to the previous one.

Softkey menu

[LABEL]

←	→	DEL CHR	INS SP	CLR LINE	ENTER	UNDO

Explanation on the Softkey menu

① ←
Moves the cursor in the label input buffer to the left one space.

② →
Moves the cursor in the label input buffer to the right one space.

③ DEL CHR
Deletes the character at the cursor position in the label input buffer.

④ INS SP
A space is inserted at the cursor position in the label input buffer. The data right of the cursor position is shifted to the right one character.

⑤ CLR LINE
Deletes all data in the label input buffer.

⑥ ENTER
This key is used to enter the character at the cursor position in the character menu at the cursor position in the label data.

⑦ UNDO
The label data specified before the LABEL key is pressed is restored.
This key is helpful when an in correct label is specified.

Key functions

① Knob
Select the characters to be entered by moving the cursor in the character menu.
The cursor moves to the right when the knob is turned clockwise (to the right) and to the left when turned counterclockwise (to the left).

② Arrow keys
These keys are used to move the cursor vertically in the character menu. The cursor moves right when the [↑] key is pressed and left when the [↓] key is pressed.

③ BACK SPACE key
This key is used to delete a character immediately before the cursor in the label data.

④ "0" to "9", "." and "−" Keys
These keys are used to specify the key data entered at the cursor position in the label data.

⑤ ENTER key
The data in the label input buffer is specified as label data.
When this key is pressed, the label input mode is released, and the character menu and label input buffer disappear.

4.4 DISPLAY Section

This section consists of six keys used to specify the display format, measurement data analysis, and data memory processing.

(1) CONTROL key : Specifies the measurement data display mode.

(2) SAVE key : Saves the measurement and panel setting data in the internal memory.

(3) RECALL key : Reads out the measurement data and panel settings been saved.

(4) NORMALIZE key (LOSS/TRANS) : Normalizes the measurement data and analyzes the loss and transparency characteristics.

(5) SPECTRAL WIDTH key : Calculates and displays the spectral width.

(6) ADVANCE key : Executes a higher level of wavelength analysis.

4.4.1 CONTROL key

This key is used to specify the measurement data display mode (dual-screen, superimpose or 3-dimensional).
When the CONTROL key is pressed, the following Softkey menu appears.

Softkey menu

[DISPLAY]

DUAL	S.IMPOSE	3D	GRID	act. U&L	xcng U/L	

Explanation on the Softkey menu

① DUAL

This key is used to display the data on the CRT, dividing into upper and lower screens.
When this key is pressed, the upper screen is updated upon completion of the next measurement, while the lower screen shows the current measurement. (If necessary, both screens can be updated using the "act. U&L" Softkey.) In the dual-screen mode, the measurement conditions and cursor movements are modified in the upper screen.
If this key is pressed in dual-screen mode, the upper screen is set to normal single screen display.
Softkeys ⑤ and ⑥ are enabled only in dual-screen mode.
Each time the DUAL key is pressed, the dual-screen mode is turned ON or OFF and the characters "DUAL" are switched between reversed and normal display.

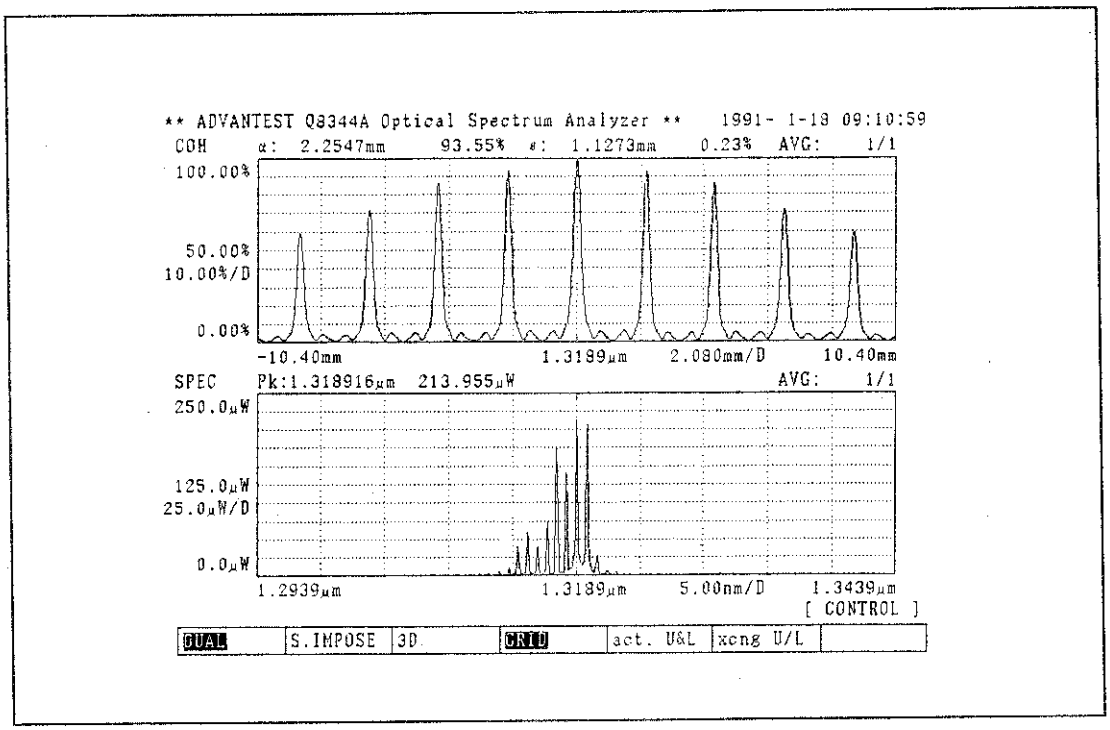


Fig. 4-1 A typical dual-screen display

② S.IMPOSE

This key controls the superimpose mode.
If this key is pressed in normal mode, the current measurement data is retained as background data on the CRT and displayed along with new measurement data.
If this key is pressed in dual-screen mode, the lower screen retains the background data, superimposing on the upper screen. (Excluding REF LEVEL the measurement conditions on the upper and lower screens should be identical).
This mode is automatically released when the measurement conditions (X-axis conditions such as center wavelength and span) are modified.

Each time this key is pressed, the superimpose mode is turned ON or OFF and the characters "S.IMPOSE" are switched between reversed and normal display.

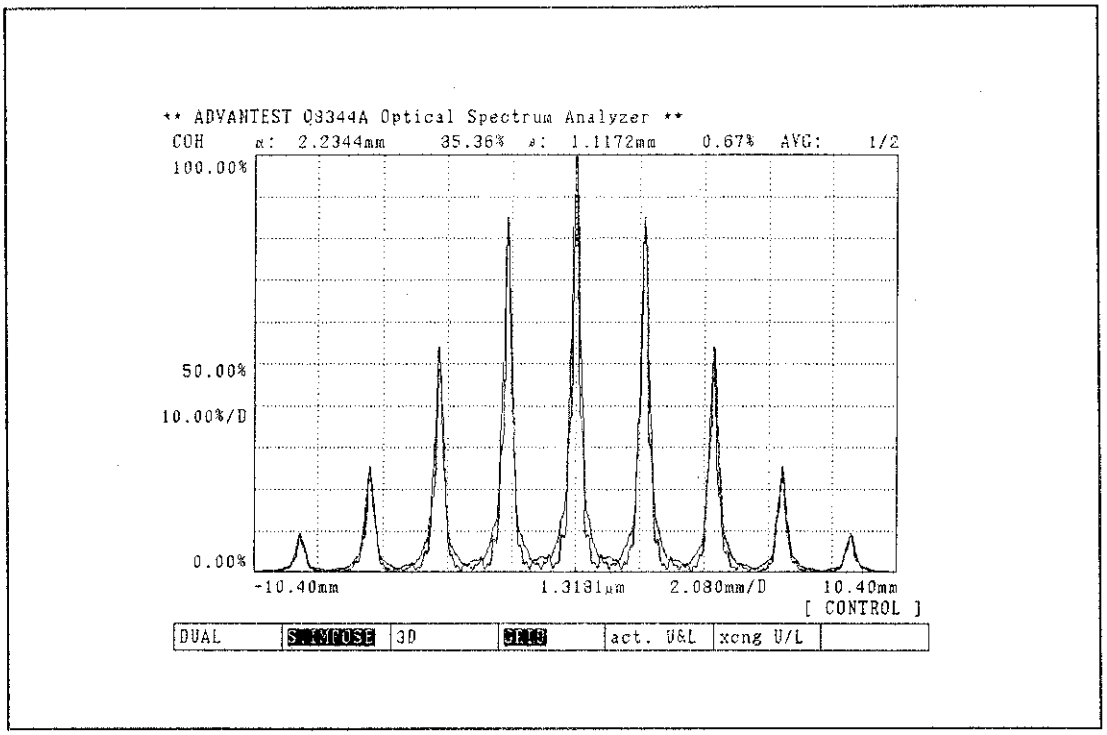


Fig. 4-2 A typical superimposed screen

③ 3D

This key is used for ON/OFF switching of the 3-dimensional mode and for specifying the display condition.

When this key is pressed, the following Softkey menu pears.

- Outline of the 3-dimensional display function

(a) The maximum number of data displayed : 16 (stored in the internal memory)
(b) Display angle : −75° to +75° (in 15° steps)
(c) Others : Cursor display and data recall functions

Softkey menu

[3D (1)]

3D ON/OFF	INC ANGLE	DEC ANGLE	CSR NEXT	DELETE	more	prev menu

Explanation on the Softkey menu

③-1 3D ON/OFF

Switches the 3-dimensional display mode ON/OFF. Each time this key is pressed, the mode is switched between 3-dimensional and normal display mode.

When the mode is set from ON to OFF, the 3-dimensional data displayed immediately before is stored in the internal memory and the latest measurement data is displayed in normal display mode.

When the 3-dimensional display mode is ON, the display conditions are displayed in the following format above the Softkey menu.

(θ:xx, C: c, D: i/n)

xx: Display angle; c: Cursor data number; i: The number of data displayed

n: Maximum number of data

Notes

1. No measurement condition can be modified while the 3-dimensional mode is ON ("condition cannot change at 3D ON!!" appears on the screen).

2. If previous 3-dimensional data is recalled, the measurement conditions such as wavelength and level are automatically modified to the previous values.

③-2 INC ANGLE

The display angle is increased one step (15°). (The display data is turned to the left.) The maximum display angle is +75° .

③-3 DEC ANGLE

The display angle is decreased one step (15°).(The display data is turned to the right.) The maximum display angle is −75° .

③-4 CSR NEXT

The cursor is shifted to the next measurement data. If the cursor is currently at the latest data, it is shifted to the oldest data.

The data number at which the cursor is positioned is indicated at the lower left of the CRT.

③-5 DELETE

The latest data is deleted.

However, if a different data number is specified with the ③-4 key, the data specified is deleted.

③-6 more

When this key is pressed, the following Softkey menu is displayed.

Softkey menu

[3D (2)]

CLEAR	INC N	DEC N	N LOCK	ROLL	RECALL	prev menu

Explanation on the Softkey menu

③-6-1 CLEAR

3-dimensional display data stored in memory is cleared.

③-6-2 INC N

The maximum number of display data is incremented by +1. (Up to 16 can be specified.)

The initial value of the maximum number of display data is 16 and the current number is indicated by i in the i/n format above the Softkey menu.

③-6-3 DEC N

The maximum number of display data is decremented by −1. (The minimum number of display data which can be set is 2.)

③-6-4 N LOCK

This key specifies whether to stop measurement when the data with the greatest number is completed.

When the characters "N LOCK" are reverse displayed, the lock mode is ON and measurement stops when the maximum number of data is complete.

(If "REPEAT" measurement is specified, the LED automatically goes off.)

When the characters "N LOCK" are displayed normally, the lock mode is OFF and measurement continues after the maximum number of data is completed. This means that the old data disappears.

③-6-5 ROLL

This key specifies the display method of the next data exceeding the maximum number of the display data.

When the characters "ROLL" are reversed, ROLL is ON. The oldest data is lost and the latest data is displayed at the end.

When the characters "ROLL" are displayed normally, ROLL is OFF. All the previous measurement data is cleared and the latest data is displayed as the first data.

Each time this key is pressed, ROLL mode is switched ON or OFF.

③-6-6 RECALL

The 3-dimensional data previously measured is recalled and displayed.

This function is only valid when no display data is present.

The 3-dimensional data previously measured means that which was displayed immediately before the 3-dimensional mode was turned off.

Note: A 16-data internal memory area is available for 3-dimensional display. This memory is entirely cleared when the first data is measured after the 3-dimensional display mode it turned on. Consequently, the "RECALL" key is valid from the moment the 3-dimensional display mode is turned on until the the first data is measured.

③-6-7 prev menu
The Softkey menu is reset to the preceding one.

③-7 prev menu
The Softkey menu is reset to the preceding one.

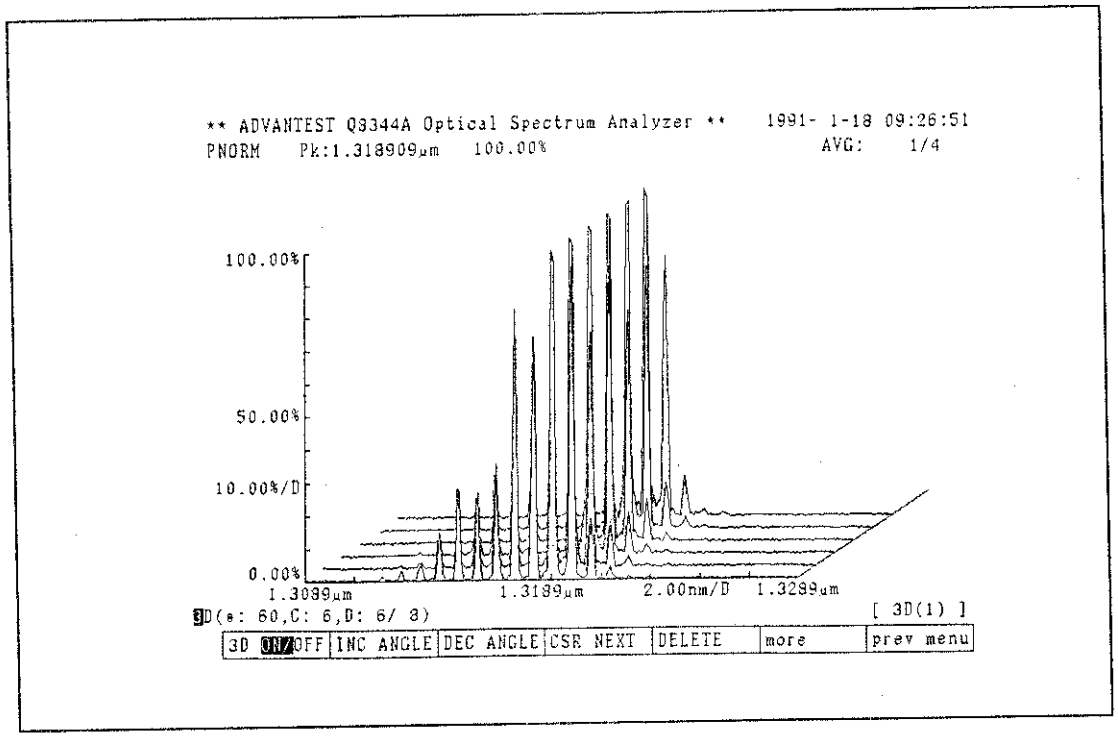


Fig. 4-3 A typical 3-dimensional display

④ GRID
This key specifies whether or not to display a grid within the data display area.
This function is helpful when measurement data cannot be seen because of the grid.
Each time this key is pressed, the grid display is turned ON or OFF.

⑤ act. U&L

This key is valid when the dual-screen mode is ON and is used to specify whether or not to update both upper and lower screens at each measurement.

When "act. U&L" are reversed, both upper and lower screens are active and updated by one measurement.

When "act. U&L" are displayed normally, only the upper screen is active and the data in the lower screen is not updated by a measurement.

Each time this key is pressed, active mode of both screens is turned ON or OFF.

⑥ xcng U/L

When dual-screen mode is ON, this key is used to exchange upper screen data with lower screen data.

Since the measurement conditions can only be specified in the upper screen, this key is helpful when modifying conditions on both screens by setting active mode ⑤.

4.4.2 SAVE and RECALL keys

These keys are used to save and recall measurement data and panel conditions stored in the internal memory.

The analyzer is equipped with a memory capable of storing 33 screens of measurement data and 10 types of panel conditions (the memory is backed up by a battery).

When the SAVE or RECALL key is pressed, the Softkey menu described below appears.

The Softkeys, knob, arrow keys and numeric keys can be used to execute SAVE/RECALL.

Note that the parameters given below are stored as panel conditions, which are also contained in measurement data.

< <Panel Condition Memory Parameters> >

① CENTER
② SPAN
③ REF LEVEL
④ LEVEL SCALE
⑤ SPECTRUM/COHERENCE
⑥ AVERAGE ON/OFF, the number of times
⑦ ZOOM mode
⑧ GRID
⑨ Cursor display mode
⑩ Type of spectral width calculation, parameter
⑪ Label
⑫ Plotter setting
⑬ Printer setting
⑭ Buzzer setting
⑮ CLOCK ON/OFF, CLOCK
⑯ CAL VALID

Note: The dual-screen, superimpose and 3-dimensional display modes are not stored in memory.

Softkey menu

- When the SAVE key is pressed:

[SAVE]

SAV REF	SAV MEAS1	SAV MEAS2	SAV MEAS3	sav meas	sav panel	

- When the RECALL key is pressed:

[RECALL]

RCL REF	RCL MEAS1	RCL MEAS2	RCL MEAS3	rcl meas	rcl panel	

Explanation on the Softkey menu

① SAV REF
This key is used to save the displayed data in the reference memory (normalizing LOSS/TRANS).

② SAV MEAS 1 to 3
This key is used to save the displayed data in the measurement data memory areas 1 to 3.

③ sav meas, sav panel
These keys are used to save the displayed data in one of the measurement data memory areas 1 to 32 (sav meas) or save the current panel setting conditions in one of the panel memory areas 1 to 10 (sav panel).
When these keys are pressed, the measurement data stored or a list of the panel memory areas is displayed and the following Softkey menu appears.

- When the sav meas key is pressed:

[sav meas]

SAVE	DELETE	RECOVER			name	EXIT

Note: When the sav panel key is pressed, the [sav meas] menu title is replaced with [sav panel].

< <How to read the directory> >

No. : Memory number. Measurement data is numbered from 01 to 32, while panel conditions are numbered from 01 to 10. If a number is preceded by an asterisk (*), the data has been deleted with the DELETE key.

name : Name stored in memory. Up to 10 characters can be specified.

date : The date when the data was saved in memory.

time : The time when the data was saved in memory.

Note : The datas displayed with No. only are unused memories.

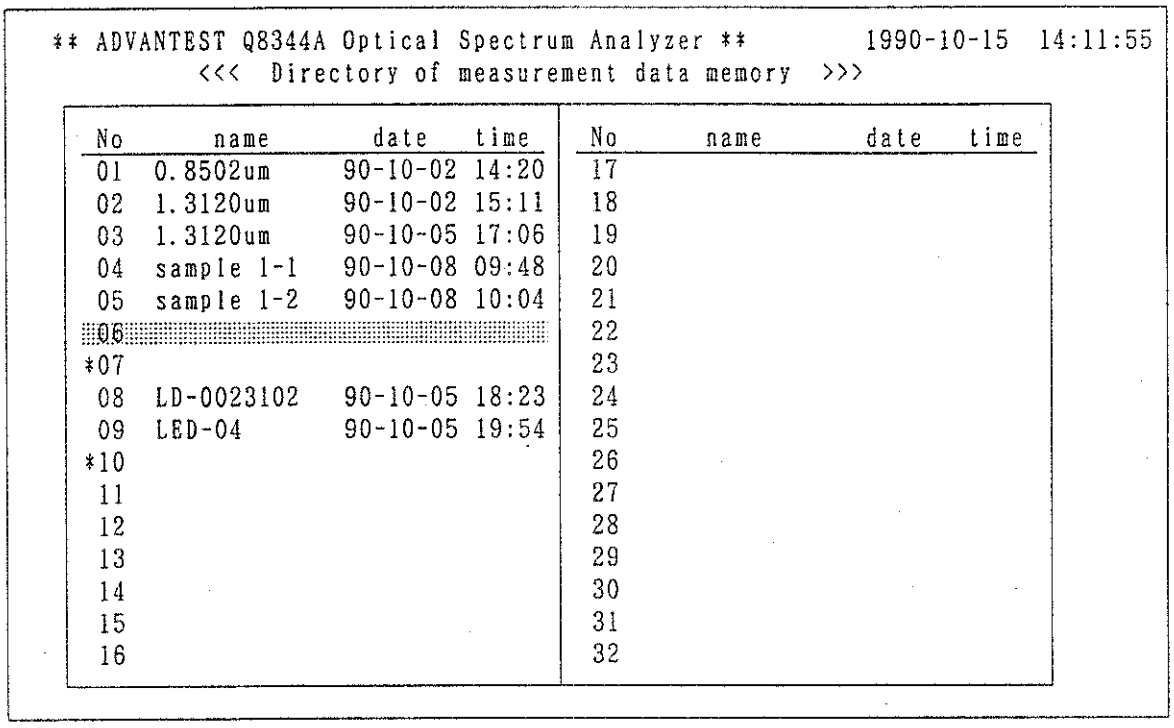


Fig. 4-4 Directory of measurement data memory

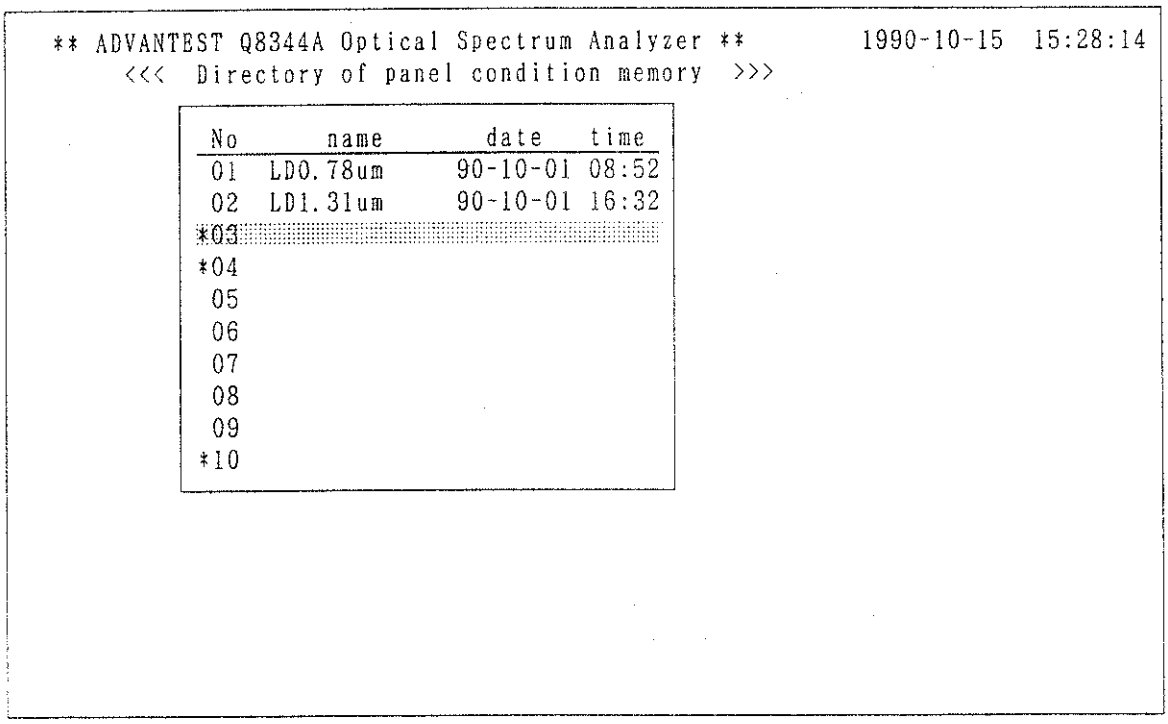


Fig. 4-5 Directory of panel condition memory

③-1 SAVE

Measurement data or panel conditions are saved under the memory number selected (reversed in the directory).

Select the memory number using the knob or arrow keys. The memory number and name selected are displayed at the upper left of the Softkey menu.

③-2 DELETE

The measurement data or panel conditions saved under the memory number selected (reversed in the directory) are deleted.

③-3 RECOVER

This key is used to recover data deleted using the DELETE key.

This key is valid only for numbers preceded by an asterisk (*). Data on names, dates and times are also recovered.

③-4 name

This key is used to specify a name in the memory.

When this key is pressed, the Softkey menu described below appears. Specify a name in the same way as for label setting in the name entry column, using the character menu displayed.

Select a character by moving the cursor in the character menu using the knob and arrow keys, then press ENTER to load the character. Numbers 0 to 9 as well as symbols " – " and "." can be directly loaded using the corresponding keys.

After entering a name, press the ENTER Softkey to load the data and return to the

Softkey menu to save the data.
If SAVE is executed without specifying a name, the value of the current center wavelength is set as the name.

[name]

←	→	↑ (No)	↓ (No)	CLR LINE	ENTER	prev menu

③-4-1 ←

Moves the cursor in the name entry column to the left.

③-4-2 →

Moves the cursor in the name entry column to the right

③-4-3 ↑ (No)

Selects the next memory number up (smaller number).

③-4-4 ↓ (No)

Selects the next memory number down (greater number).

③-4-5 CLR LINE
Clears the name data entered.

③-4-6 ENTER
The name data entered is loaded under the memory number selected.
Press this key, the preceding softkey menu is displayed.

③-4-7 prev menu
The preceding Softkey menu is displayed.

③-5 EXIT
The memory directory screen is replaced with the measurement screen.

④ RCL REF
Data from the reference memory is read out and displayed.

⑤ RCL MEAS 1 to 3
Data from measurement data memory areas 1 to 3 are read out and displayed.

⑥ rcl meas, rcl panel
These keys are used to read and display data from measurement data memory areas 1 32 and panel condition memory areas 1 to 10.
When these keys are pressed, directory information on the measurement data or panel condition memory is displayed as shown in Figs. 4-4 and 4-5, and the Softkey menu described below appears on the screen. Select the necessary memory number using the knob or arrow keys and read out the data from the memory by pressing the "RECALL" Softkey.

[rcl meas]

RECALL						EXIT

Note: When the rcl panel key is pressed, the [rcl meas] title is replaced with [rcl panel].

⑥-1 RECALL
The measurement data or panel condition of the memory number selected is read out and displayed.
When measurement data is read out, the clock is fixed to the value when saved and the characters "RCL" are displayed at the right of the CRT. The clock and "RCL" return to the normal state when measurement is executed.

⑥-2 EXIT
This key is used to set the memory directory screen back to the measurement screen.

4.4.3 NORMALIZE (LOSS/TRANS) key

The measurement data is normalized with the reference memory data or the maximum spectrum value stored, and is displayed.
This key is valid for measuring the transparency and loss wavelength characteristic s of an optical device such as a fiber or filter using a TQ8111 white light source connected to the Q8344A.
When this key is pressed, the following Softkey menu appears.

Softkey menu

[NORMALIZE]

Pk. NORM	MEM NORM	LOSS	TRANS	SAV REF	SAV MEAS1	FUNC MENU

Explanation of the Softkey menu

① Pk. NORM (Peak Normalize)
This key selects the function to normalize the measurement data at the peak level and display the results (peak normalize function). The displayed data is shifted so that the peak level is at 0dB on the screen (or 100% in case of linear display).
The vertical axis unit is dB in LOG mode and % in LINEAR mode. While the peak normalize function is being executed, the characters "Pk.NORM" are reversed. Each time this key is pressed, the peak normalize function is turned ON or OFF.

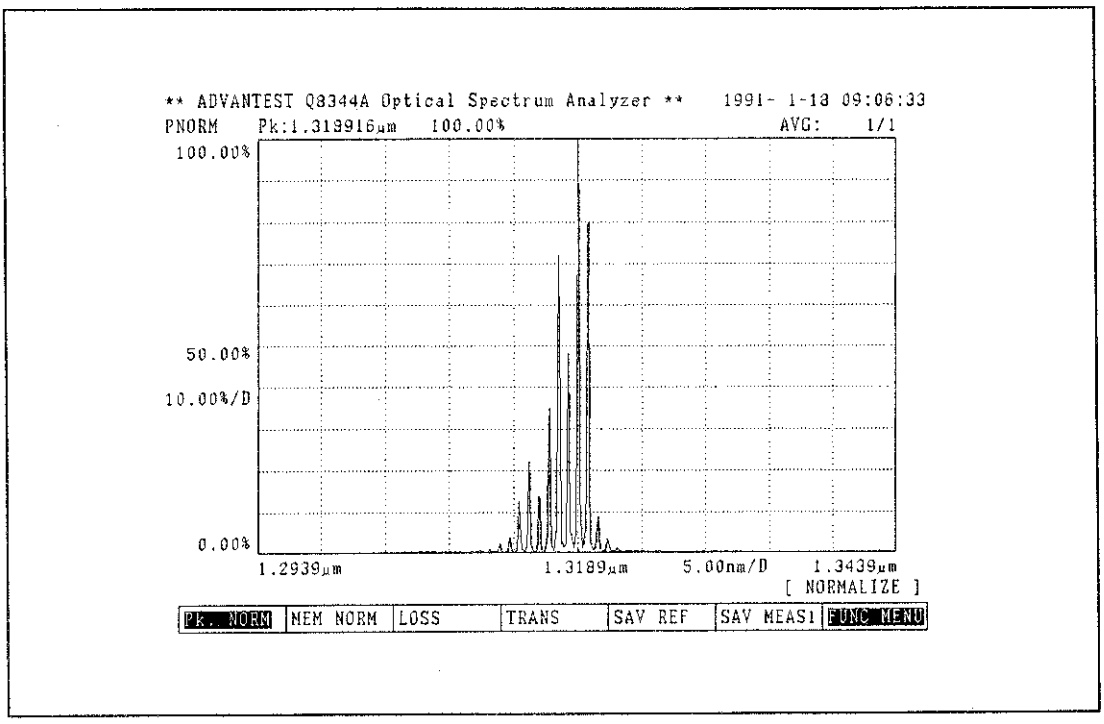


Fig. 4-6 Peak normalize function

② MEM NORM (Memory Normalize)

When executing an arithmetic operation between the measurement data and the reference memory, it is necessary to specify operation between data in multiple memories or between the current measurement data and the reference memory.

When memory normalize is ON (the characters "MEM NORM" are reversed), operation is executed between measurement data memory 1 and the reference memory.

When memory normalize is OFF (the characters "MEM NORM" are displayed normally), operation is executed between the current measurement data and the reference memory.

If this key is pressed when "MEM NORM", "LOSS" and "TRANS" are all OFF, "MEM NORM" and "TRANS" are switched ON. Otherwise, only the characters "MEM NORM" are reversed when the key is pressed.

The relationship between the "MEM NORM", "LOSS" and "TRANS" modes and to which operation the data is executed are described below.

(a) When "MEM NORM" is ON

- When "LOSS" is ON : Normalized = Reference / Measure-memory-1
  [Loss characteristics]
- When "TRANS" is ON : Normalized = Measure-memory-1 / Reference
  [Transparency characteristics]

(b) When "MEM NORM" is OFF

- When "LOSS" is ON : Normalized = Reference / Measure
  [Loss characteristics]
- When "TRANS" is ON : Normalized = Measure / Reference
  [Transparency characteristics]

Note: Normalized : Operation results
Reference : Reference memory
Measure-memory-1 : Measurement data memory 1
Measure : The current measurement data

<< Precautions when using the Normalize (LOSS/TRANS) function >>

1. The LOSS/TRANS function executes an arithmetic operation between data with identical CENTER, SPAN and REF LEVEL measurement conditions. Consequently, this function cannot be executed if the measurement conditions of the reference memory, measurement data memory 1 and the current measurement data differ.
   In they do, "different condition at REF< >MEAS!!" appears on the screen and a buzzer sounds when the "MEM NORM", "LOSS" or "TRANS" Softkey is pressed.
2. While the Normalize function is in progress, the REF LEVEL key can be used to move the display vertically (the input sensitivity cannot be modified).
3. While the Normalize function is in progress, the measurement conditions such as CENTER and SPAN cannot be modified. If modification is required, turn the Normalize function OFF.
4. When "MEM NORM" is ON, operation is executed between memories. Therefore, the display data is not modified on measurement completion.

③ LOSS

This key is used to measure the loss characteristics.
Either "LOSS" or "TRANS" are turned on (reversed) alternately.
If this key is pressed when "LOSS" is ON, the Normalize function is switched OFF (if pressed when "MEM NORM" is ON, "MEM NORM" is switched OFF.)

④ TRANS

This key is used when measuring transparency characteristics.
In the same way as "LOSS", the Normalize function is switched OFF if this key is pressed while "TRANS" is ON (if pressed when "MEM NORM" is ON, "MEM NORM" is switched OFF).

⑤ SAV REF

This key is used to save the latest measurement data in the reference memory.

⑥ SAV MEAS1

This key is used to save the latest measurement data in the measurement data memory 1.

⑦ FUNC MENU

This key specifies display of the Softkey menu corresponding to the FUNCTION key when a FUNCTION key is pressed. Each time this key is pressed, the Function menu display mode is switched ON or OFF.
When the characters "FUNC MENU" are reversed, the FUNCTION menu display mode is ON. When a FUNCTION key is pressed, the corresponding menu appears on the screen.
When the characters "FUNC MENU" are displayed normally, the FUNCTION menu display mode is OFF. No menu change occurs when a FUNCTION key is pressed.
This key is helpful when using the LOSS/TRANS function to execute measurement while changing the measurement conditions.

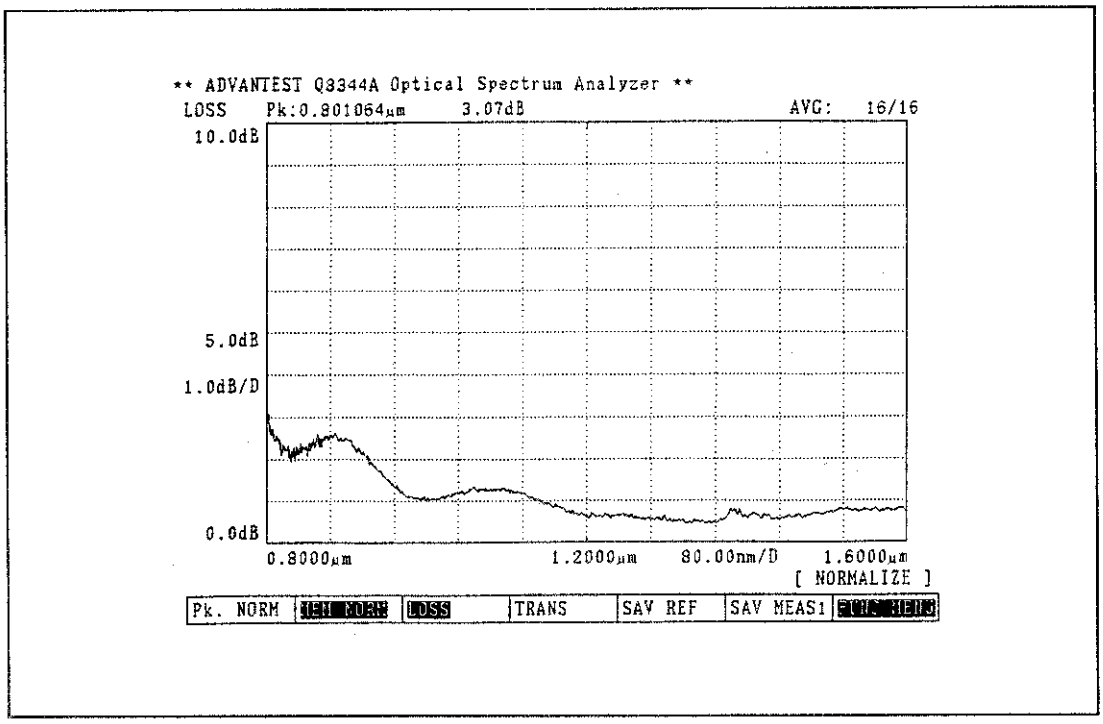


Fig. 4-7 An example of LOSS NORMALIZE data

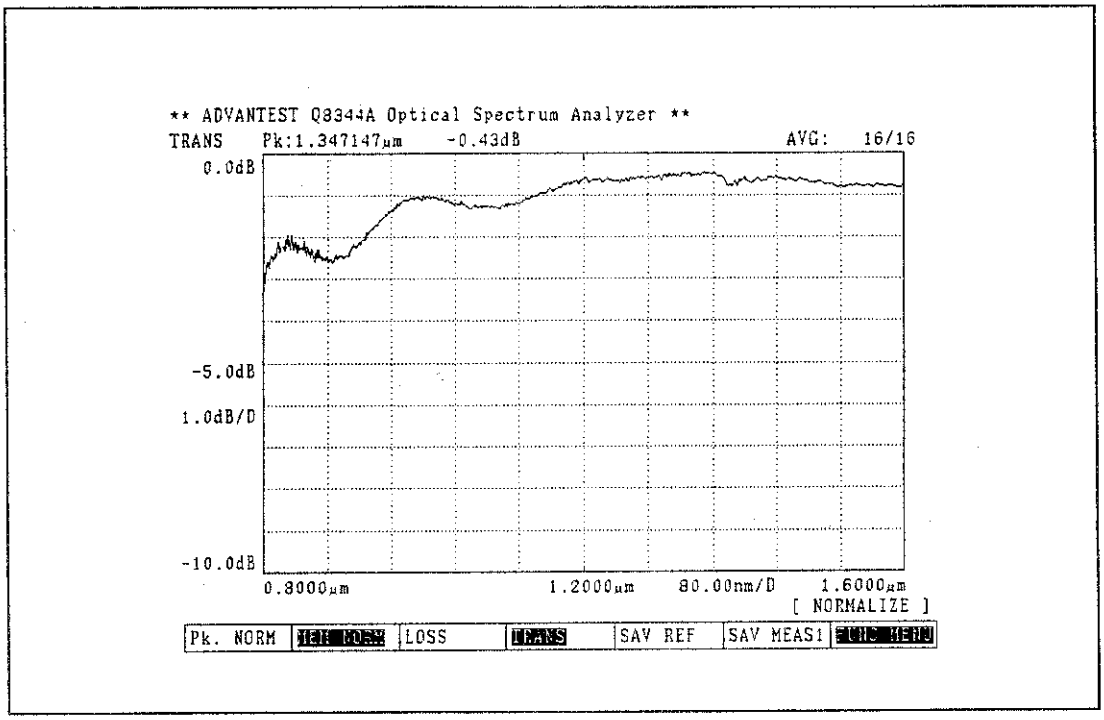


Fig. 4-8 An example of TRANS NORMALIZE data

4.4.4 SPECTRAL WIDTH key

This key is used to execute spectral width calculation and display the results.
Four types of spectral width calculations are available. The center wavelength, spectral width and the number of the peaks are calculated and the results displayed at the upper right of the CRT.
When this key is pressed, the spectral width is calculated by the method currently specified and the results displayed.
The following Softkey menu can be used to select the type of calculation and specify the necessary parameters.

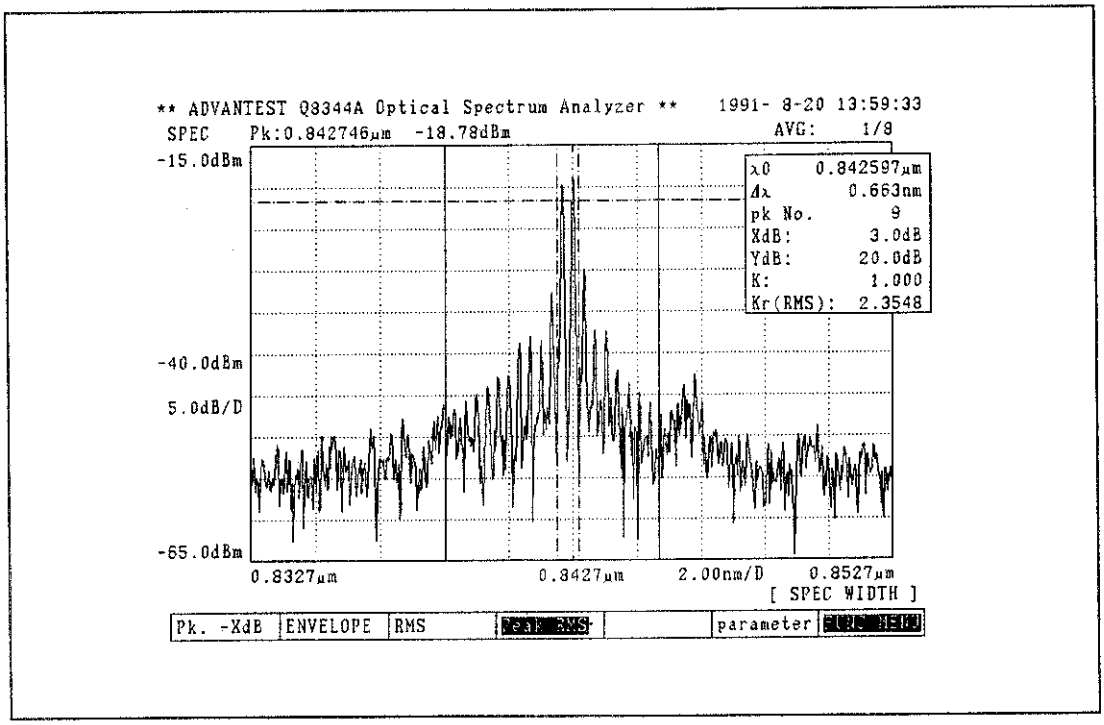


Fig. 4-9 An example of spectral width data

Softkey menu

[SPEC WIDTH]

pk -XdB	ENVELOPE	RMS	Peak RMS		parameter	FUNC MENU

Explanation on calculation data

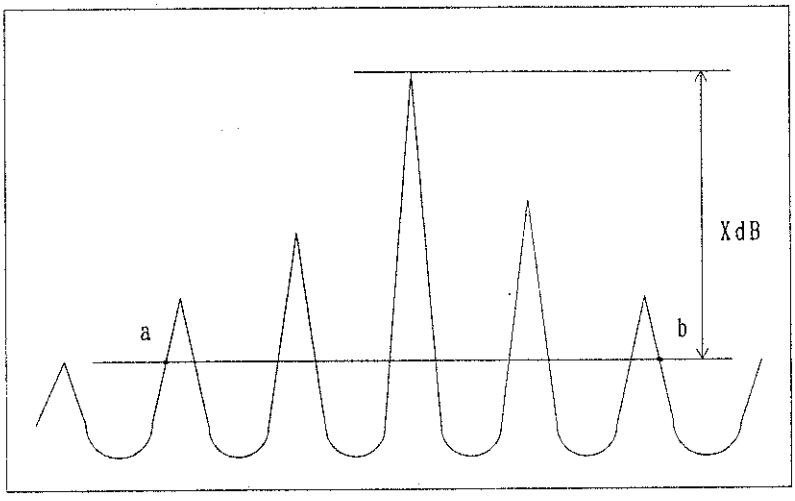
λ0	X.XXXXXX μm	. .	Center wavelength. 0 if a calculation error occurs.
△λ	XXXX.XXX nm	. .	Spectral width. 0 if a calculation error occurs.
pk No.	XXX	. .	The number of peaks (maximum value).
XdB:	XX.Xd B	. .	Parameter XdB.
YdB:	XX.Xd B	. .	Parameter YdB.
K:	XXX.XXX	. .	Parameter K.
kr (RMS):	XX.XXXX	. .	Parameter Kr (RMS)

Explanation on the Softkey menu

The center wavelength and spectral width can be calculated in the four ways as described in ① to ④ below.

If two cursors are displayed, only the data between the cursors are calculated.

① Pk.-XdB (XdB attenuation method)
The difference between points a and b where the level line attenuated by XdB from the maximum spectrum peak intersects the left and right of the spectrum is assumed to be the spectral width, and the intermediate position between points a and b is assumed to be the center wavelength. Points a and b where the level line intersects the left and right of the spectrum are determined by linear interpolation between the measurement points (linear interpolation is executed according to the current LOG/LINEAR display scale).



$\lambda_0 = (a + b) / 2$

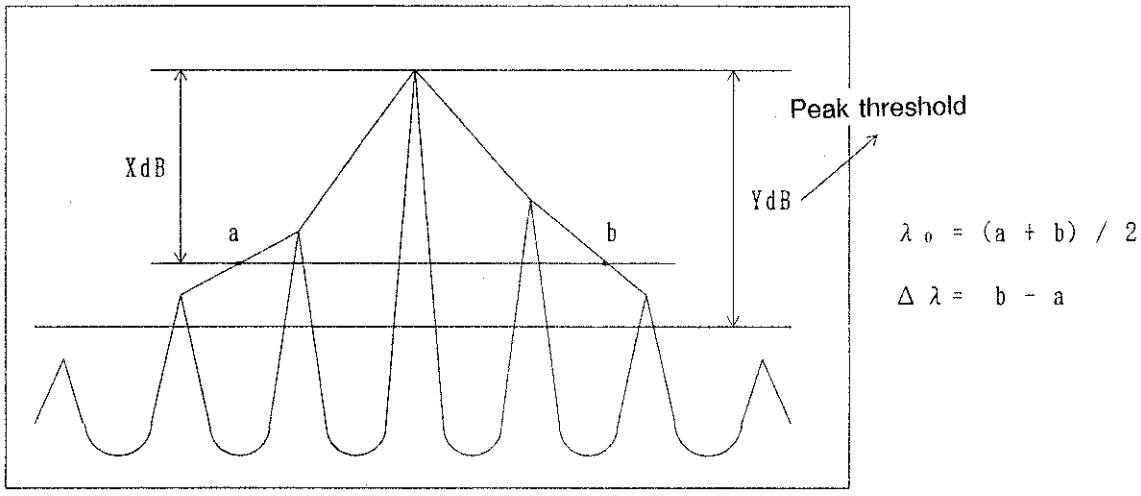
$\Delta\lambda = b - a$

XdB attenuation method

② ENVELOPE (Envelope method)

The peaks exceeding the specified peak threshold are connected with direct lines and the resultant envelope intersects the level line determined by the maximum peak value attenuated by XdB at points a and b. The difference between points a and b is assumed to be the spectral width and the intermediate position between points a and b, the center wavelength.

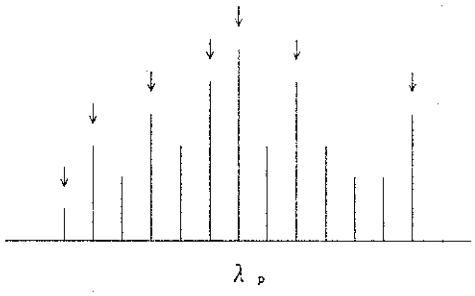
Peaks are connected so that direct lines can be obtained in the current LOG/LINEAR display scale. Consequently, the values differ slightly between the LINEAR and LOG displays.



Envelope method

Algorithm for calculating the envelope

(a) The spectrum is divided into left (short wavelength) and right (long wavelength) sides, centering at the peak wavelength. At each side, peaks which make monotone increase are selected (peaks indicated by downward arrow below).



(b) Peaks exceeding the peak threshold (YdB) are selected from those selected in step (a) and are connected with direct lines to form an envelope.

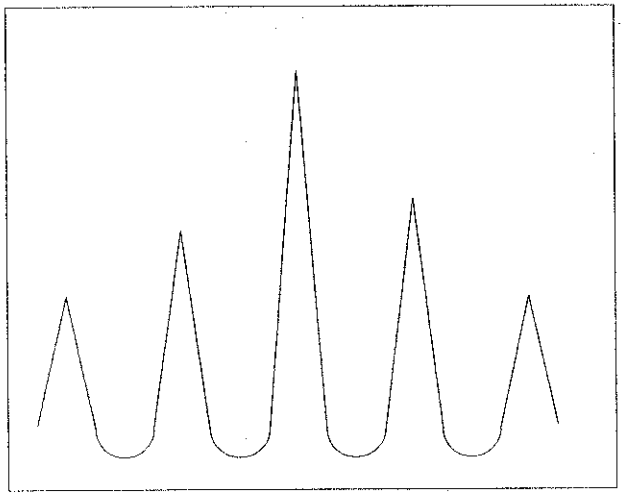
Caution

No envelope can be obtained under the following conditions, and the calculation results in 0.
1. When no peak exceeding the threshold can be found to the left of λ_p.
2. Then no peak exceeding the threshold can be found to the right of λ_p.

③ RMS (RMS method)

The weighted average wavelength of the spectrum is determined to be the center wavelength. The standard deviation from this center wavelength is multiplied by the coefficient Kr (RMS) to determine the spectral width.

This method is effective when obtaining center wavelength and half power width for LED, for example.



RMS method

If the spectrum value at λ_i is assumed to be X_i:

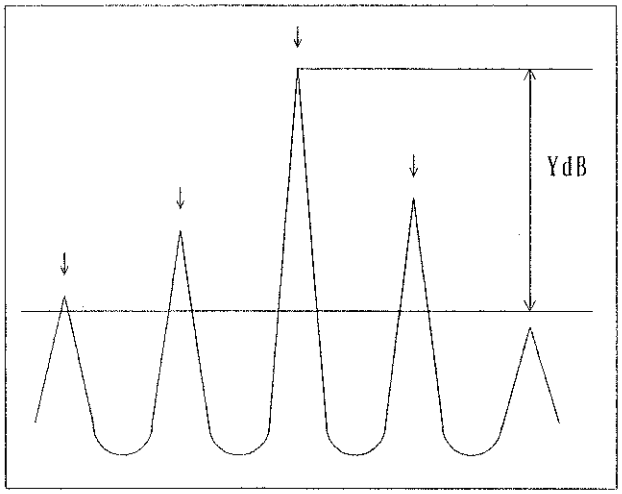
$$\lambda_0 = \frac{1}{\Sigma \chi_i} \Sigma \lambda_i \chi_i$$

$$\Delta\lambda = K_{RMS} \sqrt{\frac{1}{\Sigma \chi_i} \Sigma (\lambda_i - \lambda_0)^2 \chi_i}$$

$$\left(= K_{RMS} \sqrt{\frac{\Sigma \chi_i \lambda_i^2}{\Sigma \chi_i} - \lambda_0^2} \right)$$

④ Peak RMS (Peak RMS method)

In the Peak RMS method, the weighted average and standard deviation are calculated only for peaks exceeding the peak threshold (YdB), while in the RMS method, they are calculated for the entire spectrum.



Peak RMS method

If the spectrum value at peak λ_{ip} is assumed to be X_{ip}:

$$\lambda_0 = \frac{1}{\Sigma \chi_{ip}} \Sigma \lambda_{ip} \chi_{ip}$$

$$\Delta\lambda = K_{RMS} \sqrt{\frac{1}{\Sigma \chi_{ip}} \Sigma (\lambda_{ip} - \lambda_0)^2 \chi_{ip}}$$

$$\left(= K_{RMS} \sqrt{\frac{\Sigma \chi_i \lambda_i^2}{\Sigma \chi_i} - \lambda_0^2} \right)$$

⑤ parameter

This key is used to set the parameters required for spectral width calculation.
When this key is pressed, the Softkey menu which can be used appears on the screen.
Select the parameter, set a value with the numeric keys and press ENTER.

Softkey menu

[parameter]

XdB	YdB	K	Kr (RMS)			prev menu

Explanation on the Softkey menu

⑤-1 XdB

This key is used to specify the level difference X from the peak required in the XdB attenuation and Envelope methods. The initial value of X is 3dB and the value which can be set ranges from 0.1dB to 59.9dB (setting resolution 0.1dB).

⑤-2 YdB

This key is used to specify the peak threshold Y required in the Envelope and Peak RMS methods. (It is also required to determine the number of peaks when using other methods.)

The initial value of Y is 20dB and the value which can be set ranges from 0.1dB to 99.9dB (setting resolution 0.1dB).

⑤-3 K

This key is used to specify the coefficient for multiplying the spectral obtained by calculation.

The initial value of K is 1.0 and the value which can be specified ranges from 0.1 to 100 (setting resolution 0.001).

⑤-4 Kr (RMS)

This key is used to specify the coefficient required to determine the spectral width in the RMS and Peak RMS methods.

This coefficient is required to show the correspondence with the spectral width in the XdB attenuation and Envelope methods.

(On the normal distribution curve, the 3dB down spectral width is equal to the standard deviation value multiplied by 2.3548.)

The initial value of Kr (RMS) is 2.3548 and the value which can be set ranges from 1 to 10 (setting resolution 0.0001).

⑤-5 prev menu

The Softkey menu is replaced with the preceding one.

⑤-6 FUNC MENU

This key is used to specify whether or not to display the Softkey menu corresponding to the FUNCTION key pressed. For details, see paragraph 4.4.3 (Softkey menu ⑦).

4.4.5 ADVANCE key

This key is used to execute advanced wavelength analysis.
When this key is pressed, the following Softkey menu appears.

Softkey menu

[ADVANCE]

CURVE FIT						FUNC MENU

Explanation on the Softkey menu

① CURVE FIT
When this key is ON, the spectrum waveform measured is displayed, having been curve-fit to a particular function waveform (a curve of secondary degree).
This function helps to evaluate the natural emit mode (EL mode) of the laser diode.
Each time this key is pressed, the curve-fit waveform display is switched ON or OFF.

② FUNC MENU
This key is used to specify whether or not to display the Softkey menu corresponding the FUNCTION key pressed. For details, see paragraph 4.4.3 (Softkey menu ⑦).

4.5 DATA OUT Section

This section is used to specify display data output (to the plotter and printer) and clock setting. The three keys are:

(1) DEVICE : Specifies the output device and format or sets the clock and buzzer.

(2) COPY : Starts data output.

(3) FEED : Feeds paper to the printer (valid only when the analyzer is equipped with an optional printer).

4.5.1 DEVICE key

This key is used to specify the output device and format or sets the clock and buzzer.
When this key is pressed, the following Softkey menu appears.
The initial output device is a printer if the analyzer is equipped with an optional printer.

Softkey menu

[DEVICE]

PRINTER	PLOTTER				CLOCK	BUZZER

Explanation on the Softkey menu

① PRINTER
This key is used when selecting a built-in printer (optional) as the output device. When this key is pressed, the characters "PRINTER" are reversed and the following Softkey menu appears.
(Note that this menu will not appear unless the analyzer is equipped with an optional printer.)

[PRINTER]

MENU OUT						prev menu

①-1 MENU OUT
This key is used to specify whether or not to output all data on the CRT (MENU OUT is ON) or data excluding the Softkey menu (MENU OUT is OFF). The MENU OUT function is ON when the characters are reversed.

①-2 prev menu
When this key is pressed, the Softkey menu is replaced with the preceding one.

② PLOTTER

This key is used to select a plotter as the output device.
Plotters which can be used with the Q8344A include the R9833 produced by our company or those with "HP-GL" (graphics language of Hewlett Packard) or equivalent to the specifications. When this key is pressed, the characters "PLOTTER" are reversed and the following Softkey menu appears. The plotter type, output data type and output size can be specified from the Softkey menu.

Note: When using a plotter, set the GP-IB address of both the analyzer and the plotter to ONLY mode.

[PLOTTER]

		DATA:ALL	DATA:SIG	PAPER ADV	plot size	prev menu

②-1 DATA: ALL

The initial state of this key specifies construction of all data displayed on the CRT (excluding the Softkey menu).

②-2 DATA: SIG

This key specifies construction of only the waveform data displayed on the CRT.

②-3 PAPER ADV

This key specifies whether or not to feed paper automatically after construction is complete if the plotter is equipped with the paper feed device. Each time this key is pressed, the automatic paper feed function is switched ON or OFF. When the automatic paper feed function is ON, the characters "PAPER ADV" are reversed.

②-4 plot size

This key specifies the plot size (the number of plottings on a single paper, vertically or horizontally).
When this key is pressed, the following Softkey menu appears.
This menu is used to specify the size.

②-5 prev menu

When this key is pressed, the Softkey menu is replaced with the preceding one.

[plot size]

A4 (H1)	H2	H4	V1	V2	V4	prev menu

②-6-1 A4 (H1)
A single plotting is executed horizontally on A4 paper (initial state).

②-6-2 H2
Two plottings are executed horizontally on A4 paper.

②-6-3 H4
Four plottings are executed horizontally on A4 paper.

②-6-4 V1
A single plotting is executed vertically on A4 paper.

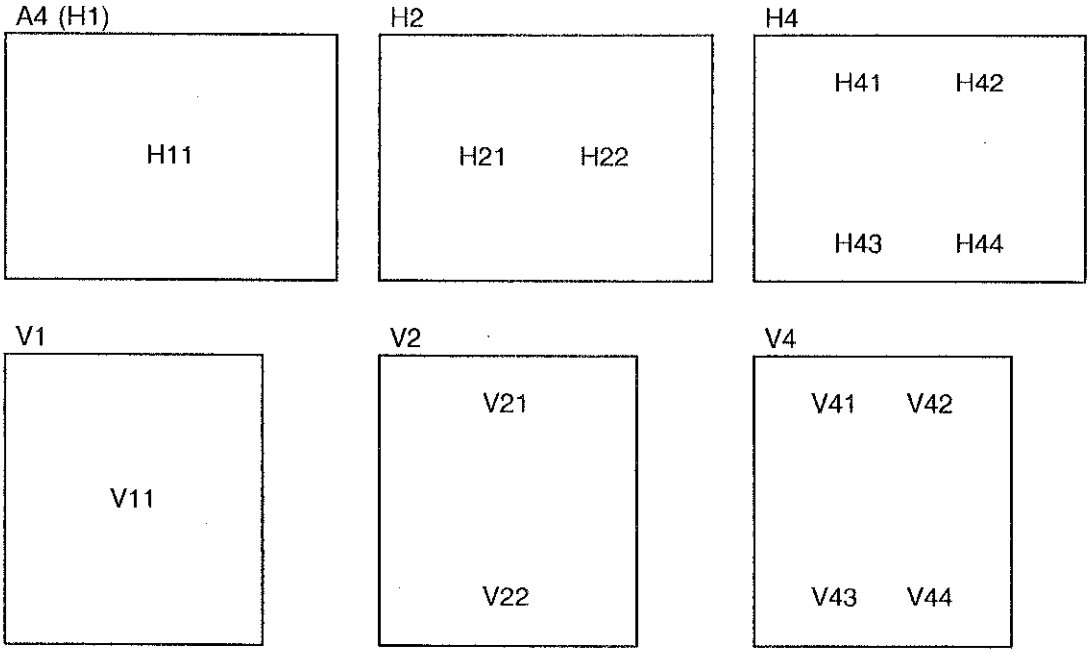
②-6-5 V2
Two plottings are executed vertically on A4 paper.

②-6-6 V4
Four plottings are executed vertically on A4 paper.

②-6-7 prev menu
The Softkey menu is replaced with the preceding one.

Note: When this mode is specified to execute multiple plottings on a single sheet, the plotting position can be adjusted using the ↑ and ↓ arrow keys. (Normally, plottings are executed at pre-specified position in pre-specified order.)
Data at the next plotting position is displayed on the Softkey menu.
Note that the plotting position is automatically set at the initial position when the plot size is modified.

Plotting position and plot size order



③ CLOCK

This analyzer is equipped with a clock function with a backup battery.

The date and time are displayed at the upper right of the CRT. This key is used to modify the date and time and switch the clock display ON or OFF.

When this key is pressed, the following Softkey menu appears. Select the item to be modified and set the necessary value with the ↑ and ↓ arrow keys or knob. The value is increased when the ↑ key is pressed or the knob is turned clockwise (to the right) and decreased when the ↓ key is pressed or the knob is turned counterclockwise (to the left).

[CLOCK]

ON/OFF	YEAR	MONTH	DAY	HOUR	MINUTE	prev menu

③-1 ON/OFF

Specifies whether to display the clock (ON) or not (OFF).

Each time this key is pressed, ON or OFF is reversed.

③-2 YEAR

This key is used to modify the year.

③-3 MONTH

This key is used to modify the month.

③-4 DAY

This key is used to modify the day.

③-5 HOUR

This key is used to modify the hour.

③-6 MINUTE

This key is used to modify the minute.

③-7 prev menu

When this key is pressed, the Softkey menu is replaced with the preceding one.

④ BUZZER

Controls the buzzer.

When this key is pressed, the following Softkey menu appears.

[BUZZER]

BEEP	WARNING				QUIET	prev menu

④-1 BEEP

This key specifies whether or not to activate the buzzer each time a panel key is pressed.
If the characters "BEEP" are reversed, a beep is heard each time a panel key is pressed.

④-2 WARNING

This key specifies whether or not to sound the buzzer when an illegal value is specified for the measurement conditions or others.
If the characters "WARNING" are reversed, a low beep is heard when an operation error occurs.

④-3 QUIET

This key is used to lower the sound of the buzzer.
If the characters "QUIET" are reversed, a softer beep than normal is heard when a panel key is pressed or an operation error occurs.

④-4 prev menu

When this key is pressed, the Softkey menu is replaced with the preceding one.

4.5.2 COPY key

This key is used to start data output. When this key is pressed, data output is started to the printer or plotter under the conditions specified with the DEVICE key. The LED lights while data output is being executed and goes off when output is completed. In the case of plotter output, operation stops if this key is pressed while the LED is ON (if the plotter has an internal buffer, plotting may not stop promptly).

4.5.3 FEED key

This key is used to feed paper.
If a printer is selected as the output device, about 5mm of the paper is fed each time this key is pressed.

4.6 GP-IB Section

This section is used to specify the GP-IB address, switch to local operation to display the GP-IB status.
The GP-IB section consists of a LOCAL (ADDRESS) key and four status LEDs.

4.6.1 LOCAL (ADDRESS) key

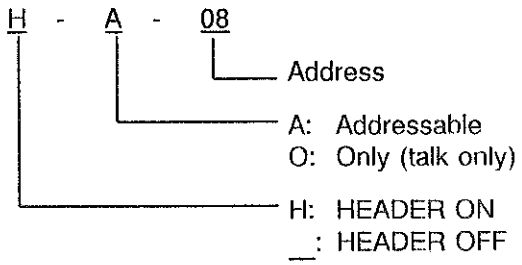
When the "REMOTE" LED is ON, the mode is switched from remote to local when this key is pressed (in local mode, the other panel keys are enabled).
When the "REMOTE" LED is OFF, this key is used to specify the GP-IB address. When this key is pressed, the following Softkey menu appears.

Softkey menu

[GPIB]

HEADER	ONLY	ADR UP	ADR DOWN			

How to read the value displayed



Explanation on the Softkey menu

① HEADER
This key specifies whether or not to add a header to the data transmitted via the GP-IB interface. Each time this key is pressed, ON or OFF is reversed (the initial state is OFF).
When the HEADER function is ON, the characters "HEADER" are reversed.

② ONLY
This key switches between the Talk only mode (during plotter output) and Addressable mode (mode for accepting an address specification from an external controller).
Each time this key is pressed, ONLY< >Addressable is enabled.
When the ONLY mode is selected, the characters "ONLY" are reversed.

③ ADR UP, ADR DOWN
From 0 to 30 can be set for the GP-IB address in this analyzer. "ADR UP" increments the address and "ADR DOWN" decrements the address.
The [↑] and [↓] arrow keys function in the same way as "ADR UP" and "ADR DOWN", respectively.

4.6.2 Status lamps

The following four LED lamps indicate the GP-IB status.

① SRQ : Lit while a service request signal is being transmitted to the GP-IB bus from the analyzer.

② TALK : Lit in talker status when data transmit is enabled.

③ LISTEN : Lit in listener status when data receive is enabled.

④ REMOTE : Lit when controlled from an external device. While this lamp is ON, panel keys other than LOCAL are disabled.
This LED goes off when the LOCAL key is pressed (unless the universal command LLO "Local Lockout" is set).

4.7 Other Keys

In addition to the keys described above, two other keys, the INSTR PRESET key for initializing the analyzer and the CAL key, can also be used.

4.7.1 INSTR PRESET key

This key is used to initialize panel settings or execute the self-diagnosis function. When this key is pressed, the following Softkey menu appears.

Softkey menu

[INSTR PRESET]

PRESET					SELF TEST	

Explanation on the Softkey menu

① PRESET
The analyzer is initialized. The initial state is that described in the table below.

Table 4-2 Initialization using INSTR PRESET

Item		Description
①	CENTER	0.725μm, APC: OFF
②	SPAN	650nm (0.4μm to 1.05μm)
③	REF LEVEL	0dBm, HI-SENS: OFF, LASER mode, AUTO: OFF
④	LEVEL SCALE	LOG, 5dB/DIV
⑤	Analysis data type	Spectrum analysis
⑥	AVERAGE	OFF
⑦	ZOOM	All OFF
⑧	Measurement	STOP state
⑨	Cursor	All OFF, NORMAL mode
⑩	Display	Single-screen, grid ON
⑪	Normalize	All OFF
⑫	Spectral width calculation	"Pk.-XdB" XdB: 3dB; YdB: 20dB K: 1.0, Kr (RMS): 2.3548
⑬	CURVE FIT	OFF
⑭	Output device	Plotter (DATA: ALL, PAPER ADV: OFF, SIZE: A4(H1)) Note: Printer (MENU OUT: OFF) if one is connected.
⑮	CLOCK display	ON
⑯	Buzzer	BEEP, WARNING: ON, QUIET: OFF
⑰	Label	** ADVANTEST Q8344A Optical Spectrum Analyzer **

Note: Other items are not modified on initialization.

When modifying the initial state, press the keys in the following sequence:

SAVE | sav panel | 9 | 9 | ENTER

With this operation, the current panel condition setting is stored as the initial setting.
After the initial state has been modified with the above operation, it can be reset by pressing the following keys in the sequence shown.

SAVE | sav panel | 0 | 0 | ENTER

② SELF TEST

This key is used to execute self-diagnosis.
When this key is pressed, the CRT display shown below appears and the results of self-diagnosis are displayed one by one. If no error is found, the screen is reset to the preceding screen, i.e., measurement data screen.
If an error is found, the corresponding error code is displayed and the self-diagnosis stops. (If an error is found in the backup RAM, diagnosis continues without stopping operation and a buzzer sounds three times when diagnosis is completed.)
If "backup memory destroyed!! > press any key for continue." is displayed, press any panel key to reset the system to the measurement screen.

```
**************************************************
*      Q8344A Optical Spectrum Analyzer          *
*                          rev. A00              *
*                    MFD by ADVANTEST CORP.      *
**************************************************

        SELF-TEST in progress .......

   item                      judge      code
(1) ROM                      PASS
(2) RAM                      PASS
(3) backup RAM               PASS
(4) peripheral               PASS
(5) measurement block        PASS
```

Fig. 4-10 Self-diagnosis Screen

Note: If "FAIL" occurs as the result of self-diagnosis, write down the item and the error code and contact the sales dealer and support offices.
The addresses and phone numbers of the support offices are listed at the end of this manual.

4.7.2 CAL key

This key is used to calibrate the analyzer level.
Before pressing this key, enter a light source having a single spectrum and accurately determined level into the analyzer and execute measurement.
When this key is pressed, the following Softkey menu appears.

Softkey menu

[CALR]

LEVEL					EXECUTE	CAL VALID

Explanation on the Softkey menu

① LEVEL
Next, enter the known level data of the input signal by pressing the numeric keys.
When this key is pressed, the characters "LEVEL" are reversed to indicate that level calibration is enabled. When this key is pressed again, the level calibration mode is released.

② EXECUTE
This key is used to execute level calibration. The level calibration data is determined by the difference between the level data entered in step ① and the peak level measured.
If the value of the level calibration data exceeds ±9.9dB, a WARNING sound is heard when this key is pressed and "illegal level data input!!" appears.

③ CAL VALID
This key is used to make the level calibration data valid. The calibration data is valid when the characters "CAL VALID" are reversed. When measurement is executed, this calibration data is added to the level displayed.
When this key is pressed again, the calibration data is made invalid and only the data stored when the analyzer was shipped is used for measurement.
Once calibration is executed the level calibration data determined during calibration is stored in the internal backup memory.

<A typical level calibration operation>

- Enter a light source having a known level and single spectrum into the analyzer and execute spectrum measurement (at this time, execute measurement in "LASER" mode with "CAL VALID" OFF).
- If the known level is -5.8dBm, press the following keys in the sequence shown.

CAL [ ] LEVEL [ ] [–] [5] [.] [8] [ ] dBm

- Execute calibration using the "EXECUTE" Softkey, then press "CAL VALID" to validate the calibration data.

5. EXPLANATION ON FUNCTIONS

Section 5.1 lists the Softkey menus and section 5.2 describes the key functions and corresponding Softkey operations.

5.1 List of Softkey Menus

The Softkey menus are listed below according to the corresponding hardkeys.

(1) FUNCTION section

CENTER [CENTER]

PEAK	CURSOR				AUTO PKC	

SPAN

<Spectrum mode> [SPAN (SPEC)]

SPAN	START	STOP	△λ→SPAN	0.4 to 1.05	0.8 to 1.75	FULL

<Coherence mode> [SPAN (COH)]

AUTO	0.32 mm	0.65 mm	1.3 mm	2.6 mm	5.2 mm	10.4 mm

REF LEVEL [REF LEVEL]

TOTAL PWR		HI-SENS A	HI-SENS B		LASER/LED	AUTO

LEVEL SCALE [LEVEL SCALE]

LIN/LOG	10dB/D	5dB/D	2dB/D	1dB/D	0.5dB/D	0.2dB/D

AUTO [AUTO]

FULL	0.4 to 1.05	0.8 to 1.75				

AVERAGE [AVERAGE]

ON/OFF	2	4	8	16	32	64

ZOOM [ZOOM]

START	STOP			CTR AUTO	SPAN AUTO	

COHERENCE [COHERENCE]

SPECTRUM	COHERENCE					

(2) CURSOR section

When Cursor is ON →

[CURSOR]

NORMAL	△MODE	2ND PEAK	POWER		LEFT PEAK	RIGHT PEAK

(3) DATA section

LABEL →

[LABEL]

←	→	DEL CHR	INS SP	CLR LINE	ENTER	UNDO

(4) DISPLAY section

CONTROL →

[CONTROL]

DUAL	S.IMPOSE	3D	GRID	act. U&L	xcng U/L	
3D ON/OFF	INC ANGLE	DEC ANGLE	CSR NEXT	DELETE	more	prev menu
CLEAR	INC N	DEC N	N LOCK	ROLL	RECALL	prev menu

SAVE →

[SAVE]

SAV REF	SAV MEAS1	SAV MEAS2	SAV MEAS3	sav meas	sav panel	
SAVE	DELETE	RECOVER			name	EXIT
←	→	↑ (No)	↓ (No)	CLR LINE	ENTER	prev menu

RECALL →

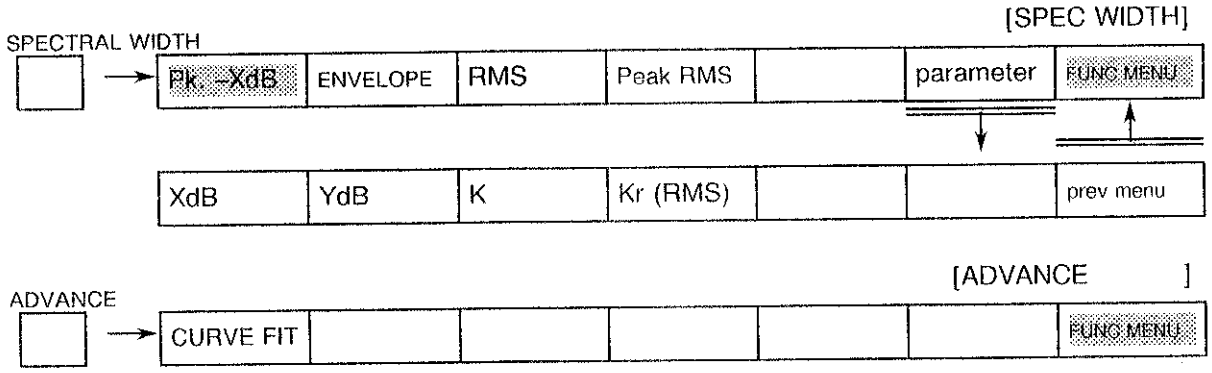
[RECALL]

RCL REF	RCL MEAS1	RCL MEAS2	RCL MEAS3	rcl meas	rcl panel	
RECALL						EXIT

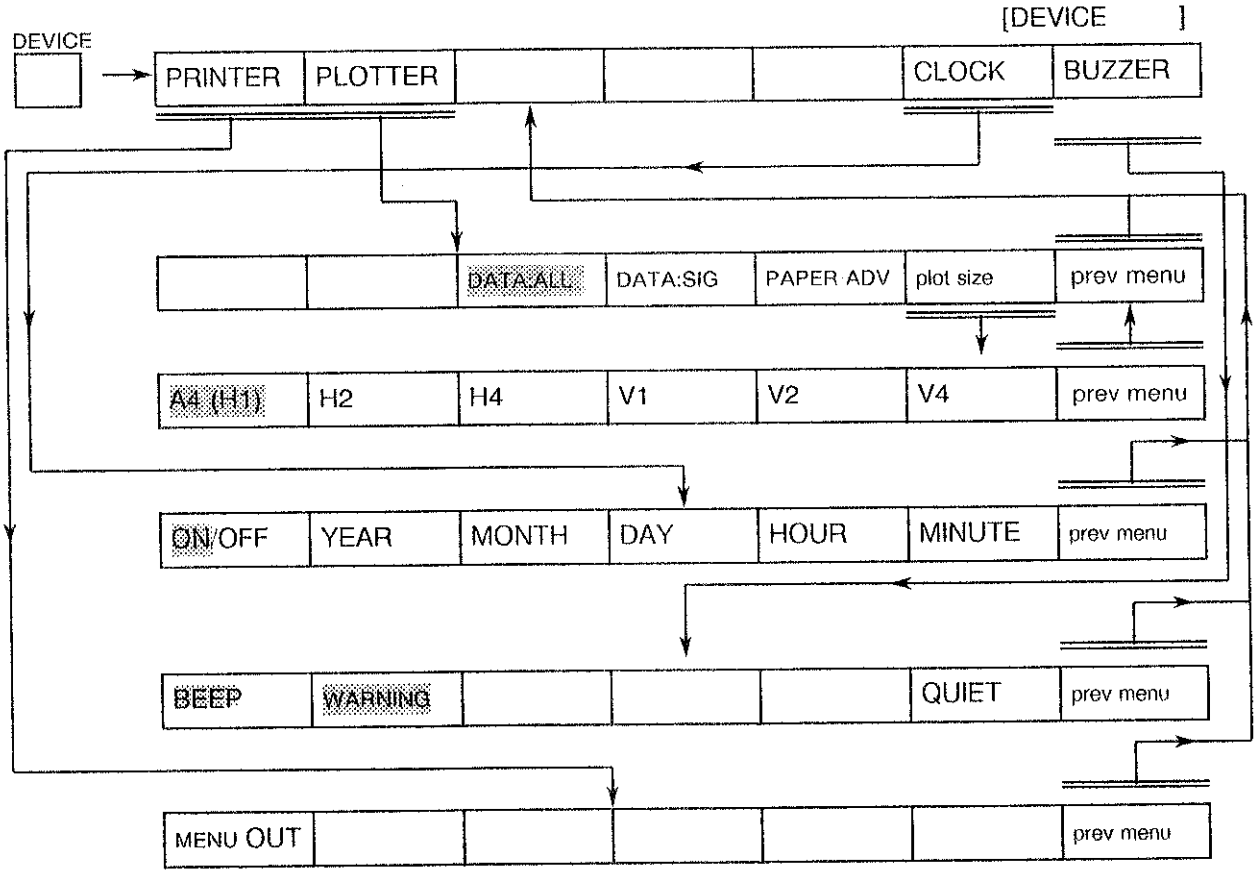
NORMALIZE →

[NORMALIZE]

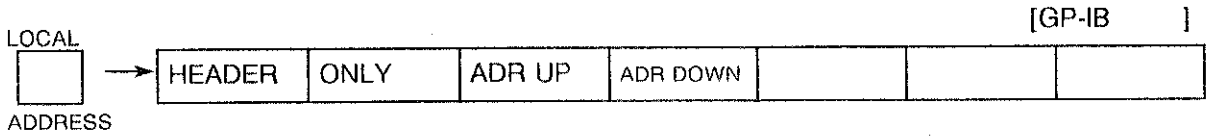
Pk.NORM	MEM NORM	LOSS	TRANS	SAV REF	SAV MEAS1	FUNC MENU



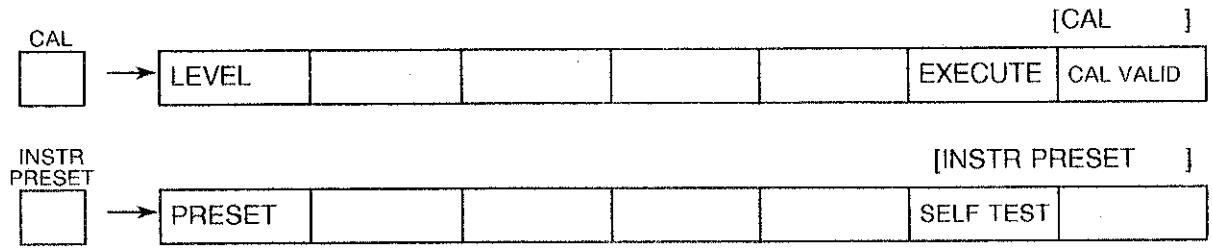
(5) DATA OUT section



(6) GP-IB section



(7) Others



5.2 Key Function and Corresponding Softkey Menus

The hardkey functions can be divided into the following three types: functions executed immediately after the keys are pressed; functions to display corresponding Softkey menus when the keys are pressed; and functions to load setting data.
The Softkeys also function as: keys for executing corresponding functions immediately after the keys are pressed, keys for selecting particular functions, keys for displaying Softkey menus of lower nodes and others. (Normally, keys represented by lower case alphabets are used to display Softkey menus or lower or upper nodes.)
The knob is used to specify a particular function such as CENTER, SPAN and REF LEVEL or to move cursors. If the LED of the key corresponding to the cursor is ON, cursor movement has priority.

5.2.1 FUNCTION section

This section consists of keys which are used to specify the basic measurement conditions of the optical spectrum analyzer.

CENTER

Specifies the center wavelength for analysis.
Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>

PEAK	Specifies the peak level wavelength as the center wavelength.
CURSOR	CURSOR Specifies the wavelength at the cursor positions as the center wavelength. If two cursors are displayed on the screen, the wavelength at the intermediate position is specified as the center wavelength.
AUTO PKC	Switches ON/OFF the APC function which automatically sets the peak wavelength as the center wavelength at the end of measurement.

SPAN

Specifies the wavelength span, and start/stop wavelengths analysis.
Numeric keys, knob, arrow keys and Softkeys can be used.
The Softkey menu in Spectrum mode is different from that in Coherence mode.

<Softkey menu> Spectrum mode

SPAN	Specifies the wavelength span for analysis.
START	Specifies the start wavelength.
STOP	Specifies the stop wavelength.
△λ→SPAN	SPAN Specifies the area between the two wavelength (X) cursors as the span.
0.4 to 1.05	0.4 to 1.05 Specifies the short wavelength (0.65 μm from 0.4 to 1.05) as the span.
0.8 to 1.75	0.8 to 1.75 Specifies the long wavelength (0.95 μm from 0.8 to 1.75) as the span.
FULL	Specifies the maximum span (1.4 μm from 0.35 to 1.75).

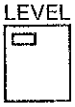
<Softkey menu>	Coherence mode
AUTO	The span determined by the spectrum analysis is automatically set.
0.32 mm	± 0.32mm is set for the coherent length analysis span.
0.65 mm	± 0.64mm is set for the coherent length analysis span.
1.3 mm	± 1.28mm is set for the coherent length analysis span.
2.6 mm	± 2.56mm is set for the coherent length analysis span.
5.2 mm	± 5.25mm is set for the coherent length analysis span.
10.4 mm	± 10.4mm is set for the coherent length analysis span.

REF LEVEL

Specifies the input sensitivity.
Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>	
TOTAL PWR	The total (power) spectra measured is set as the REF LEVEL.
HI-SENS A	Switches ON/OFF the mode which decelerates the internal movable mirror to the half speed, decreases the frequency range to half and lowers the noise level.
HI-SENS B	Switches ON/OFF the mode which sets the resolution to half as compared with ordinary measurement and sets the A/D sampling interval to half for increasing the signal-to-noise ratio (enlarging signal).
LASER/LED	Selects the light to be measured. The level unit is /nm when LED is selected.
AUTO	Selects the mode in which the optimum REF LEVEL is set in accordance with the input signal. ON/OFF operation (Reversed/Normal display)

LEVEL SCALE



Switches between linear and logarithm and sets the scale for logarithm. Numeric keys, knob arrow keys and Softkeys can be used.

<Softkey menu>

LIN/LOG	Switches between Linear/Log display.
10dB/D	Specifies 10dB/DIV for the log scale.
5dB/D	Specifies 5dB/DIV for the log scale.
2dB/D	Specifies 2dB/DIV for the log scale.
1dB/D	Specifies 1dB/DIV for the log scale.
0.5dB/D	Specifies 0.5dB/DIV for the log scale.
0.2dB/D	Specifies 0.2dB/DIV for the log scale.

AUTO

The optimum conditions including the wavelength span and level are automatically specified in accordance with the input signal. Softkeys can be used.

<Softkey menu>

FULL	The entire measurement wavelength is searched and the optimum condition specified.
0.4 to 1.05	The range from 0.4 μm to 1.05 μm is searched and the optimum condition specified.
0.8 to 1.75	The range from 0.8 μm to 1.75 μm is searched and the optimum condition specified.

AVERAGE

Specifies the number of averaging times and controls ON/OFF switching of averaging. Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>

ON/OFF	Starts averaging. Processing stops if the key is pressed during averaging.
2	Specifies 2 for the number of averaging times.
4	Specifies 4 for the number of averaging times.
8	Specifies 8 for the number of averaging times.
16	Specifies 16 for the number of averaging times.
32	Specifies 32 for the number of averaging times.
64	Specifies 64 for the number of averaging times.

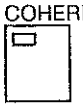
ZOOM

This key is used to re-analyze previous measurement data under different wavelength conditions (HOLD-ZOOM processing). Analysis can be executed without re-measuring at various spans. Softkeys can be used. (This key cannot be used in "REPEAT" mode.)

<Softkey menu>

START	Starts ZOOMing under the specified wavelength conditions.
STOP	Interrupts current ZOOMing.
CTR AUTO	Selects the mode in which ZOOMing is automatically started when the CENTER wavelength is modified.
SPAN AUTO	Selects the mode in which ZOOMing is automatically started when the span is modified.

COHERENCE



Selects the Spectrum/Coherence analysis mode. Softkeys can be used.

<Softkey menu>

SPECTRUM	Selects spectrum analysis mode.
COHERENCE	Selects coherence analysis mode.

5.2.2 CURSOR section

ON/OFF

This switch controls cursor display ON/OFF. When ON, the following Softkey menu appears.
The cursor data display format can be selected using the Softkeys.

<Softkey menu>

NORMAL	Mode for displaying wavelength and level at the cursor position as they are.
△MODE	Mode for displaying wavelength and level differences at the cursor position.
2ND PEAK	Mode for displaying wavelength and level differences between the 1st and 2nd peaks.
POWER	Mode for displaying the total levels (Power) between wavelength cursors.
LEFT PEAK	The current wavelength cursor 1 is shifted to the nearest peak on the left.
RIGHT PEAK	The current wavelength cursor 1 is shifted to the nearest peak on the right.

λ1

Controls ON/OFF switching of wavelength cursor 1.

λ2

Controls ON/OFF switching of wavelength cursor 2.

L1

Controls ON/OFF switching of level cursor 1.

L2

Controls ON/OFF switching of level cursor 2.

Note: The cursors can be shifted when the corresponding LEDs (λ1, λ2, L1 and L2) are lit.

5.2.3 DATA section

This section consists of numeric keys, unit keys and arrow keys used to modify the setting data and a LABEL key for entering comments.

LABEL [ ] — Modifies label (comment).
Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>

←	Moves the cursor in the label input buffer to the left.
→	Moves the cursor in the label input buffer to the right.
DEL CHR	Deletes the character at the cursor position in the label input buffer.
INS SP	Inserts a space at the cursor position in the label input buffer. Data to the right of the cursor is shifted right one character.
CLR LINE	The label input buffer is cleared of all data.
ENTER	Loads the data in the label input buffer as the label data. The label setting mode is released when this key is pressed.
UNDO	The label data is reset to the previous state before the LABEL key was pressed.

Keys which can be used for label modification

- Knob : Moves the cursor in the character menu to the right and left.
- [↑] [↓] : Moves the cursor in the character menu up and down.
- BACK SPACE [ ] : Deletes a character immediately before the cursor in the label input buffer.
- [ ] ENTER : Loads the character at the cursor position in the character menu to the cursor position in the label data.

5.2.4 DISPLAY section

This section consists of keys for specifying the display format, analyzing measurement data and controlling data memory.

CONTROL
[ ] Specifies the display mode.
Softkeys can be used.

<Softkey menu>

- DUAL — Controls ON/OFF switching of the dual-screen mode.
- S.IMPOSE — Controls ON/OFF switching of the superimpose mode.
- 3D — Specifies ON/OFF switching of the 3-dimensional mode and display condition.
  - 3D ON/OFF — Controls ON/OFF switching of the 3-dimensional mode.
  - INC ANGLE — Increases the display angle one step (15°) (maximum +75°).
  - DEC ANGLE — Decreases the display angle one step (15°) (minimum –75°).
  - CSR NEXT — Moves the cursor to the next measurement data.
  - DELETE — Deletes the latest measurement data.
  - more — Displays the next Softkey menu.
    - CLEAR — Clears all 3-dimensional display data.
    - INC N — Increases the maximum number of display data by +1 (maximum: 16).
    - DEC N — Decreases the maximum number of display data by –1 (minimum: 2).
    - N LOCK — Specifies whether or not to stop measurement when the maximum number of data has been measured.
    - ROLL — Controls ON/OFF switching of the ROLL display mode (older data is deleted when the maximum number of display data is exceeded).
    - RECALL — Recalls and displays the previous 3-dimensional display data.
    - prev menu — Displays the preceding Softkey menu.
  - prev menu — Displays the preceding Softkey menu.
- GRID — Controls ON/OFF switching of the grid in the data display area.
- act U&L — Controls ON/OFF (Reversed/Normal display) switching of the mode used to modify the data in both the upper and lower screens in dual-screen mode.
- xcng U/L — Replaces upper screen data with lower screen data in dual-screen mode.

SAVE

Saves measurement data and panel condition settings in the internal memory.
SAVE Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>

SAV REF	Saves the current measurement data in the reference memory.
SAV MEAS1	Saves the current measurement data in measurement data memory 1.
SAV MEAS2	Saves the current measurement data in measurement data memory 2.
SAV MEAS3	Saves the current measurement data in measurement data memory 3.
sav meas	Saves the current data in one of measurement data memories 1 to 32. When this key is pressed, the measurement data memory directory is displayed.

SAVE	Saves the current measurement data in the memory number selected.
DELETE	Deletes data from the memory number selected.
RECOVER	Recovers the memory deleted with the DELETE key.
name	This key is used to specify a particular memory name separate from the memory number. When this key is pressed, the character menu is displayed (the memory name can contain up to 10 characters).

←	Moves the memory name input cursor to the left one character.
→	Moves the memory name input cursor to the right one character.
↑ (No)	(No) Selects the preceding memory number.
↓ (No)	(No) Selects the next memory number.
CLR LINE	Clears the memory name entered.
ENTER	Specifies the data in the input buffer as the memory name.
prev menu	Displays the preceding Softkey menu.

EXIT	Returns to normal mode from measurement data save mode. The measurement data memory directory is replaced with the normal measurement data on the screen.

sav panel	Saves the current panel condition in one of the condition setting memories 1 to 10. When this key is pressed, the condition setting memory directory is displayed.

SAVE	Saves the current measurement data in the memory number selected.
DELETE	Deletes data from the memory number selected.
RECOVER	Recovers the memory deleted with the DELETE key.
name	Specifies a particular memory name separate from the memory number. When this key is pressed, the character menu for memory name input is displayed (the memory name can contain up to 10 characters.)

←	Moves the memory name input cursor to the left one character.
→	Moves the memory name input cursor to the right one character.
↑ (No)	(No) Selects the preceding memory number.
↓ (No)	(No) Selects the next memory number.
CLR LINE	Clears the memory name entered.
ENTER	Specifies the data in the input buffer as the memory name.
prev menu	The preceding Softkey menu is displayed.

EXIT	The system returns to normal mode from panel condition save mode. The panel condition memory directory is replaced with the normal measurement data on the screen.

Keys which can be used in 'sav meas' and 'sav panel' functions:

- Knob : ① Selects a memory number in the directory window.
  ② Moves the cursor in the character menu to the left and right.
- [↑] [↓] : ① Selects a memory number in the directory window.
  ② Moves the cursor in the character menu up and down.
- BACK SPACE : Deletes the character immediately before the cursor in the memory name data.
- [ ] : Moves the character at the cursor position in the character menu to the cursor position in the memory name data.
  ENTER

RECALL

Recalls the measurement data and panel condition from the internal memory. Numeric keys, knob, arrow keys and Softkeys can be used.

<Softkey menu>

- RCL REF — Recalls data from the reference memory.
- RCL MEAS1 — Recalls data from measurement data memory 1.
- RCL MEAS2 — Recalls data from measurement data memory 2.
- RCL MEAS3 — Recalls data from measurement data memory 3.
- rcl meas — Recalls data from one of the measurement data memories 1 to 32. When this key is pressed, the current measurement data memory directory is displayed.
  - RECALL — Recalls data from the memory number selected. After the data is recalled, the directory information is replaced with the normal measurement data on the screen.
  - EXIT — The system is reset to normal mode from measurement data recall mode. The measurement data memory directory is replaced by the normal measurement data on the screen.
- rcl panel — Recalls the panel condition setting from one of memories 1 to 10. When this key is pressed, the directory information from the memory containing the current panel condition data is displayed.
  - RECALL — Recalls the panel condition setting from the memory number selected. After recall is executed, the directory information is replaced by the normal measurement data on the screen.
  - EXIT — The system is reset to normal mode from the panel condition setting recall mode. The panel condition setting directory is replaced by the normal measurement data on the screen.

Keys which can be used in 'rcl meas' and 'rcl panel' modes

- Knob : Selects a memory number in the directory window.
- ↑ ↓ : Selects a memory number in the directory window.

NORMALIZE
LOSS/TRANS

Normalizes the measurement data with the saved reference memory or the maximum measurement data value and displays the results.

<Softkey menu>

Pk.NORM	Specifies the mode for normalizing the measurement data with the maximum level value and displays the results.
MEM NORM	Selects data to be calculated from the reference memory. Measurement data memory 1 (Reversed display) or measurement data (Normal display). This function is not enabled (reversed) unless both reference memory and measurement data memory 1 are stored. When the function is ON (reversed), "LOSS" is automatically selected.
LOSS	Specifies the calculation/display mode of loss characteristics (REF/MEAS or REF/MEAS-MEM1). When 'MEM NORM' is OFF (normal display), the loss characteristics mode and normal modes are reversed each time this key is pressed. The LOSS mode is switched off when 'TRANS' is pressed. If no data is found in the reference memory (REF) or the wavelength condition of the reference memory differs from the current one, key operation is ignored.
TRANS	Specifies the calculation/display mode of transparency characteristics (MEAS/REF or MEAS-MEM1/REF). When 'MEM NORM'is OFF (normal display), the transparency characteristics and normal modes are reversed each time this key is pressed. The 'TRANS' mode is switched off when 'LOSS' is pressed. If no data is found in the reference memory (REF) or the wavelength condition of the reference memory differs from the current one, key operation is ignored.
SAV REF	Saves the current measurement data in the reference memory.
SAV MEAS1	Saves the current measurement data in measurement data memory 1.
FUNC MENU	Controls whether or not to modify the Softkey menu when a FUNCTION key section is pressed. The Softkey menu is modified when this key is ON (reversed).

SPECTRAL WIDTH — Executes spectral width calculation and displays the results. The following four types of calculation are available.

<Softkey menu>

Pk.–XdB	Calculates the spectral width using the XdB method and displays the results.
ENVELOPE	Calculates the spectral width using the Envelope method and displays the results.
RMS	Calculates the spectral width using the RMS method and displays the results.
Peak RMS	Calculates the spectral width using the Peak RMS method and displays the results.
parameter	Specifies the parameters required for spectral width calculation.

XdB	Specifies the downward level difference X from the peak (the initial value is 3dB).
YdB	Specifies the peak threshold level Y (the initial value is 20dB).
K	Specifies the value of factor K for multiplying the spectral width calculated (the initial value is 1.0).
Kr(RMS)	Specifies the value of multiplication factor Kr when RMS and Peak RMS methods are used (the initial value is 2.3548).
prev menu	The preceding Softkey menu is displayed.

FUNC MENU	Controls whether or not to modify the Softkey menu when a FUNCTION key is pressed.

ADVANCE — This key is used when executing advanced wavelength analysis.

<Softkey menu>

CURVE FIT	Curve fits a particular function waveform over the spectrum waveform measured and displays the results. Curve fits display shows ON/OFF by press the key.
FUNC MENU	Controls whether or not to modify the Softkey menu when a FUNCTION key is pressed.

5.2.5 DATA OUT section

This section consists of keys used for measurement data output, and clock (calendar) and buzzer setting.

DEVICE

Specifies the output device, format and buzzer. Softkeys can be used.

<Softkey menu>

- PRINTER — Selects the built-in printer as the output device. (Only displayed when a built-in printer is present.)
- MENU OUT — Controls whether or not to output the Softkey menu to the printer.
- prev menu — Displays the preceding Softkey menu.
- PLOTTER — Selects a GP-IB plotter as the output device.
- DATA: ALL — Uses all the information displayed on the CRT for plotting.
- DATA: SIG — Specifies only the waveform data displayed on the CRT for plotting.
- PAPER ADV — Specifies ON/OFF switching of the automatic paper feeder.
- plot size — Specifies plot size (the number of plottings on a single sheet; horizontally or vertically).
  - A4(H1) — Executes one horizontal plotting on A4 paper.
  - H2 — Executes two horizontal plottings on A4 paper.
  - H4 — Executes four horizontal plottings on A4 paper.
  - V1 — Executes one vertical plotting on A4 paper.
  - V2 — Executes two vertical plottings on A4 paper.
  - V4 — Executes four vertical plottings on A4 paper.
  - prev menu — Displays the preceding Softkey menu.
- prev menu — Displays the preceding Softkey menu.

CLOCK	Sets the clock (calendar).
ON/OFF	Specifies ON/OFF switching of the clock (calendar).
YEAR	Used to modify the year.
MONTH	Used to modify the month.
DAY	Used to modify the day.
HOUR	Used to modify the hour.
MINUTE	Used to modify the minute (when modifying the minute, the second is set to 0).
prev menu	Displays the preceding Softkey menu.
BUZZER	Specifies the buzzer.
BEEP	Specifies whether or not the buzzer sounds when a panel key is pressed.
WARNING	Specifies ON/OFF switching of the warning buzzer when an illegal value is set.
QUIET	Specifies loudness of the buzzer. The volume is lowered when the QUIET mode is ON.
prev menu	Displays the preceding Softkey menu.

COPY


Used to start data output.

FEED

Used to feed paper to the printer (only valid if the analyzer is equipped with an optional printer.)

5.2.6 GP-IB section

This section is used for specifying the GP-IB address and switching to local operation.

LOCAL
ADDRESS

Specifies the GP-IB address and switching to local operation. LOCAL Switches the system to local operation when the REMOTE lamp is ON, or specifies the GP-IB address when the REMOTE lamp is OFF.

<Softkey menu>

HEADER	Specifies whether or not to add a header during data output.
ONLY	Switches between Talk only (valid during plotter output) and addressable mode (to accept address specified from an external controller).
ADR UP	The GP-IB address is increased by one.
ADR DOWN	The GP-IB address is decreased by one.

5.2.7 Others

CAL

Executes level calibration.

<Softkey menu>

LEVEL	Used to enter the level calibration data.
EXECUTE	Used to execute calibration.
CAL VALID	Used to validate the calibrated data.

INSTR PRESET

Initializes the panel conditions or executes the self-diagnosis function.

<Softkey menu>

PRESET	Initializes the panel condition.
SELF TEST	Executes the self-diagnosis function. If an error is found during self-diagnosis, the error type is displayed. When self-diagnosis processing is complete, the system enters the initial state (the state at power on).

6. GP-IB INTERFACE

This chapter describes the command names (programming names corresponding to the keys), data arrangement and programs for reference.

6.1 General

The Q8344A is equipped with a GP-IB interface (GP-IB: General Purpose Interface Bus) and can be remotely controlled via the 488-1978 measurement bus which meets IEEE specifications.
The GP-IB interface contains the following functions.

(1) Setting

① Panel setting : Same as the manual panel setting functions (including label setting).

② Data transmit mode setting : The data transmit mode setting, delimiter selection, header ON/OFF, and read command setting can be executed.

(2) Read

① The panel setting condition can be read.

② Data read: Cursor, wavelength and level data can be read.

(3) Service request

The service request function can be used whenever an error occurs and upon completion of processing. Particular service request factors can be masked.

The GP-IB interface can be used for connecting the analyzer to a controller and other peripheral devices using a simple cable (bus line).
The GP-IB is a superior interface designed to ensure extendibility as well as electrical, mechanical and functional compatibility with products of other companies. Using a single bus cable, it is possible to construct a simple system as well as an automatic measurement system with advanced functions.
With the GP-IB system it is first of all necessary to specify the "address" of devices connected to the bus line. These devices can be assigned to one or more of three roles: controller, talker and listener.
During system operation, although only one "Talker" can transmit data to the bus line, multiple "Listeners" can receive the data.
The controller specifies the address of the "Talker" and "Listener" and transfers data from the "Talker" to the "Listener". The controller can also specify setting conditions from the "Talker" to the "Listener".
Eight bit-parallel and byte-serial type data lines are used for data transfer between devices and transfer is executed in synchronous two-way mode. Thanks to synchronous transfer, both high and low speed devices can be connected.
The ASCII code is used for data (messages) transmitted and received between devices, including measurement data, measurement conditions (programs) and commands.
The GP-IB interface is equipped with eight data lines, three handshake lines for controlling synchronous data transfer between devices and five control lines for controlling information flow on the bus.

- The handshake lines are used for the following signals:

  DAV (Data Valid) : Signal indicating data valid state.

  NRFD (Not Ready for Data): Signal indicating ready state for transmitting or receiving data.

  NDAC (Not Data Accepted): Signal indicating completion of data reception.

- The control lines are used for the following signals:

  ATN (Attention) : Signal for determining whether the data line signal is an address, command or other information.

  IFC (Interface Clear) : Signal which clears the interface.

  EOI (End of Identify) : Signal used upon completion of data transfer.

  SRQ (Service Request) : Signal used to request the controller for service from a device.

  REN (Remote Enable) : Signal used to control a device enabled for remote program processing.

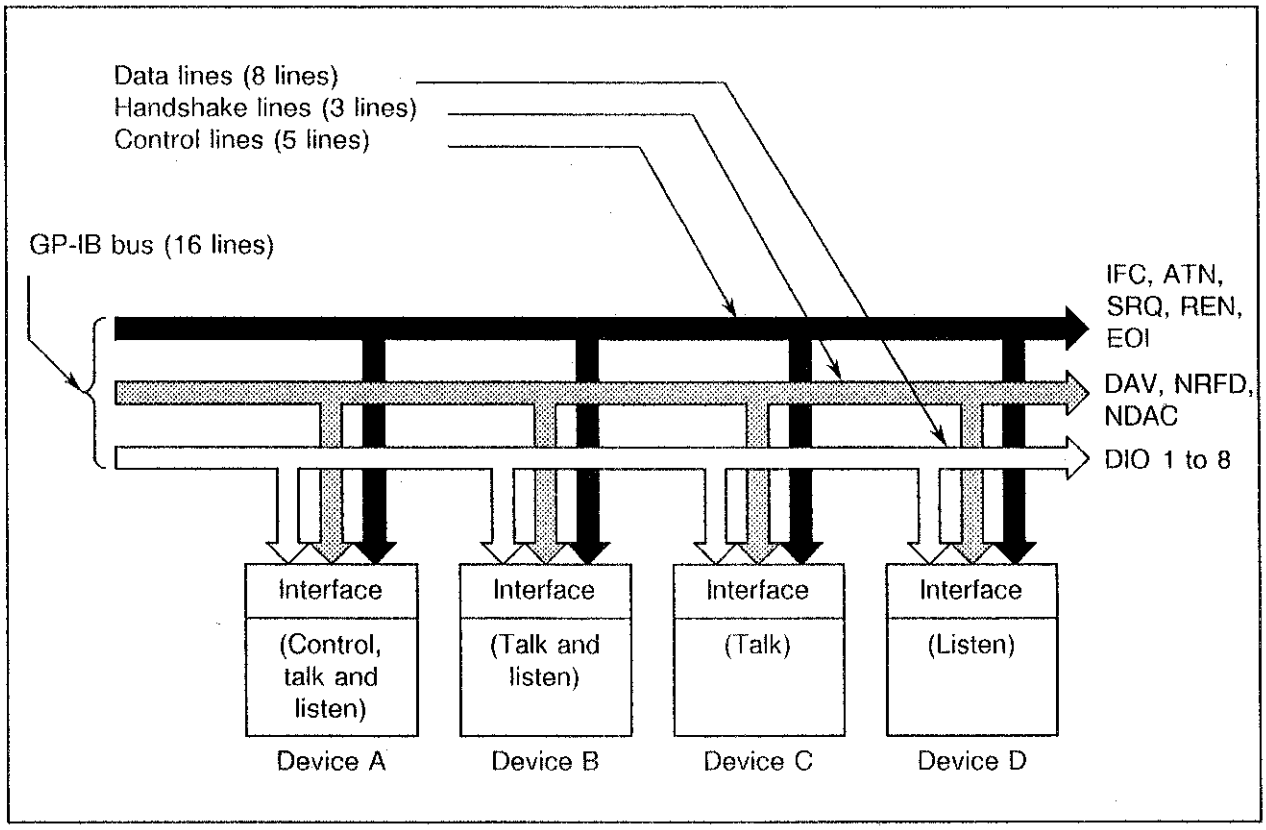


Fig. 6-1 Outline of GP-IB interface

6.2 Specifications

6.2.1 GP-IB specifications

Specification	:	IEEE488-1978
Code used	:	ASCII code However, binary code is used in packed format.
Logic level	:	Logic "0" (High) +2.4V or above Logic "1" (Low) +0.4V or below
Signal line terminal	:	The 16 bus lines are terminated as shown in Fig. 6-2.

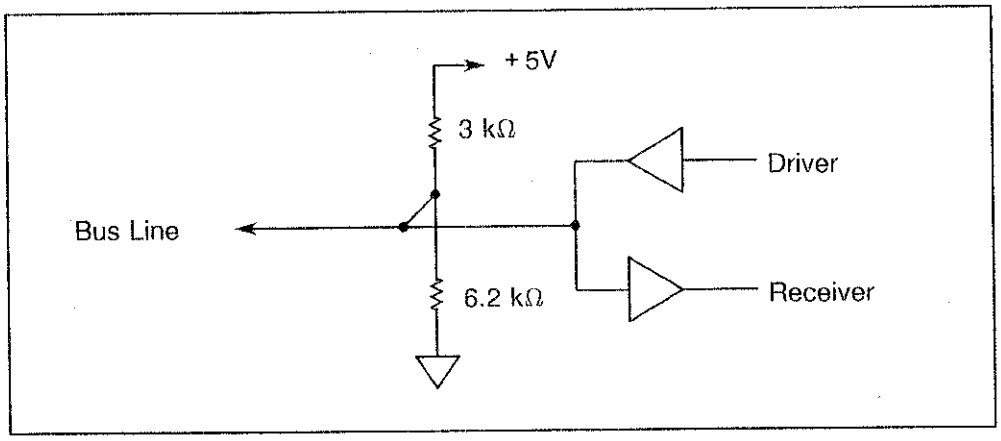
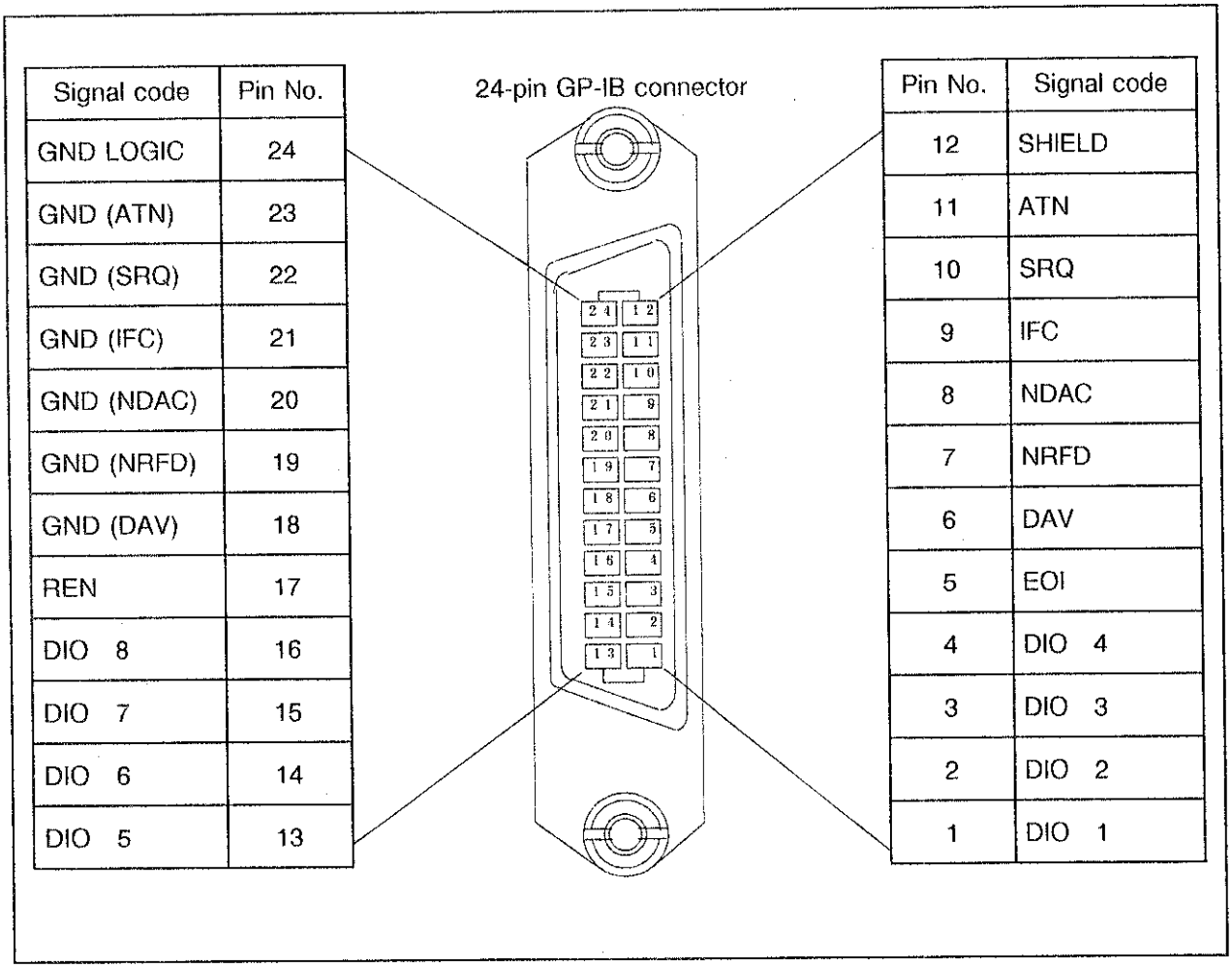


Fig. 6-2 Signal line terminals

Driver	:	Three-state type Output voltage in "Low" state: +0.4V or below, 48mA Output voltage in "High" state: +2.4V or above, –5.2mA
Receiver	:	"Low" state when +0.6V or below "High" state when +2.0V or above
Overall length of bus cable	:	(Number of devices connected to the bus) × 2m or less, and not exceeding 20m
Address	:	Up to 31 Talk and Listen addresses can be specified using the LOCAL / ADDRESS local address switch on the front panel (8 addresses specified when shipped).
Connector	:	24-pin GP-IB connector 57-20240-D35A (Amphenol equivalent)



Signal code	Pin No.
GND LOGIC	24
GND (ATN)	23
GND (SRQ)	22
GND (IFC)	21
GND (NDAC)	20
GND (NRFD)	19
GND (DAV)	18
REN	17
DIO 8	16
DIO 7	15
DIO 6	14
DIO 5	13

Pin No.	Signal code
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1

Fig. 6-3 GP-IB connector pin arrangement

6.2.2 Interface functions

The GP-IB interface functions are listed in Table 6-1.

Table 6-1 Interface functions

Code	Description
SH1	Source handshake function
AH1	Acceptor handshake function
T5	Basic talker, serial poll and talk only* functions as well as talker release function specified by the listener
L4	Basic listener function, and listener release function specified by the talker
SR1	Service request function
RL1	Remote function
PR0	No parallel poll function
DC1	Device clear function enabled
DT1	Device trigger function enabled
C0	No controller function
E2	Three-state bus driver is used.

* The talk only function operates on the plotter.
When the analyzer is used in Only mode, press the "ONLY" Softkey at the address specified from the panel and set "0" for address mode. The remote device to be connected by bus cable should also be set to Only mode.
Note that during Only mode, the controller should not be operated simultaneously since operation in Only mode is not guaranteed.

Note: If the "ATN" signal is switched to True during message transfer, the previous transfer states are released.

6.3 GP-IB Handling

6.3.1 Connecting other devices

Since the GP-IB system consists of multiple devices, pay attention to the following when preparing the system.

(1) Check the condition (preparation) and operation of the analyzer, controller and peripheral devices, and read the respective instruction manuals before starting connection.

(2) The bus cable for connecting the devices should be no longer than required. The total length of the bus cable should not exceed that specified.
The total length of the bus cable should be (number of devices connected to the bus) × 2m, not exceeding 20m.
The following standard bus cables are provided.

Table 6-2 GP-IB standard bus cables (sold separately)

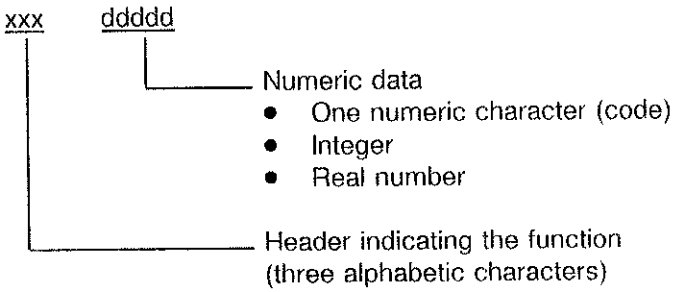
Length	Specification
0.5 m	408JE-1P5
1 m	408JE-101
2 m	408JE-102
4 m	408JE-104

(3) When connecting the bus cable, do not use three or more connectors together.
Connectors should be fixed firmly with screws.
The bus cable connector is a piggy-back type and one connector has a pair of male and female threads which can be used simultaneously.

(4) Before turning the power switches of the devices on, check their power conditions, grounding state and setting conditions (if required).
The power switches of all devices connected to the bus line should be turned ON. If any device is not turned ON, the operation of the entire system cannot be guaranteed.

6.3.2 Program code (Listener format)

This paragraph describes the program codes used by an external controller to set the conditions of the analyzer.
Each program code basically consists of three alphabetic characters to indicate the function and numeric data to specify the value.



The condition state is read when "?" is added to the end of the function header.
(After "xxx?" is transmitted, the analyzer is set to Talker to read the data.)
This is valid for those codes with a circle in READ column.

Notes:

1. Characters of both upper and lower cases can be used for describing the function header and the unit. Any space code (20H) can be used in the program code.

2. The analyzer processes the program codes by one line up to the terminator. Up to 255 characters can be set in one line.
   When describing multiple program codes in a line, they should be separated from one another by a comma (,) or semicolon (;). The codes with function header attached by ## should be specified solely.

Program codes used to set various conditions are listed below.

[ ] : Can be omitted.
( ) : Header with identical function

- FUNCTION (1/3)

Item		Program code		Contents	Read
		Function header	Setting		
CENTER	CENTER	CEN	Numeric + unit	Unit UM: μm (Default) NM: nm Example CEN1.55UM CEN780nm CEN1.31	○
	PEAK	PKC	———	peak to center	×
	CURSOR	CUC	———	cursor to center	×
	AUTO PKC	APC	0,1	0: OFF, 1: ON	○
SPAN	SPAN	SPA	Numeric + unit	Unit UM: μm NM: nm (Default) NMD:nm/DIV MM: mm (Coherence)* Example SPA50NM, SPA10.4 mm	○
	START	STA	Numeric + unit	Unit UM: μm (Default) NM: nm Example STA0.5UM, STA755nm	○
	STOP	STO	Numeric + unit	Unit UM: μm (Default) NM: nm Example STO1.6um, STO805NM	○
	△λ→SPAN	LSP	———	λ1⇌λ2 set to span	×
	0.4 to 1.05 0.8 to 1.75	HSP	0, 1	0: 0.4 to 1.05 1: 0.8 to 1.75	×
	FULL	FSP	———	FULL SPAN (0.35 to 1.75)	×
	AUTO (COH span)	CAU	0, 1	0: OFF, 1: ON	○

* Six types of coherence distances can be set. If another value is specified, the nearest higher value is loaded.

- FUNCTION (2/3)

Item		Program code		Contents	Read
		Function header	Setting		
REF LEVEL	REF LEVEL	REF	Numeric + unit **	Unit DBM: dbm (Default) MW: mW, UM: μm NW: nW DB: dB, RU: Example REF-10DBM REF0.1UW	○
	TOTAL PWR	TPL	———	total power to ref level	×
	HI-SENS A	HSA	0, 1	0: OFF 1: ON	○
	HI-SENS B	HSB	0, 1	0: OFF 1: ON	○
	LASER/LED	LED	0, 1	0: LASER 1: LED	○
	AUTO	RAU	0, 1	0: OFF 1: ON	○
LEVEL SCALE	LIN/LOG	LIN	0, 1	0: OFF (LOG) 1: ON (LINEAR)	○
	LEVEL SACLE	LEV	0 to 5	0: 10dB/D 1: 5dB/D 2: 2dB/D 3: 1dB/D 4: 0.5dB/D 5: 0.2dB/D	○
AUTO		AUT	0 to 3	0: OFF (STOP) 1: FULL SPAN 2: 0.4 to 1.05μm 3: 0.8 to 1.75μm	×
AVERAGE	ON/OFF	EAV	0, 1	0: OFF (STOP) 1: ON (START)	○
	AVERAGE	AVG	1 to 1024	Integers Example AVG 16 AVG128	○

** No unit can be specified in LOSS/TRANS mode (the unit is determined by the current display scale).

- FUNCTION (3/3)

Item		Program code		Contents	Read
		Function header	Setting		
ZOOM	START STOP	ZOO	0, 1	0: STOP 1: START	×
	CENTER AUTO	CZO	0, 1	0: OFF 1: ON	○
	SPAN AUTO	SZO	0, 1	0: OFF 1: ON	○
COHER-ENCE	COHERENCE	COH	0, 1	0: OFF (SPECTRUM) 1: ON (COHERENCE)	○
	α search range lower	ASC	0.0 to 10.4	Specifies the range (lower limit value) for obtaining secondary peak α in coherence analysis. The initial value is 1 mm.	○
	α search range upper	ASV	0.0 to 10.4	Specifies the range (upper limit value) for obtaining secondary peak α in coherence analysis. The initial value is 3 mm.	○

- CURSOR

Item		Program code		Contents	Read
		Function header	Setting		
CURSOR ON/OFF		CUR	0, 1	0: CURSOR OFF 1: CURSOR ON	○
λ1	ON/OFF	XAC	0, 1	0: λ1 OFF 1: λ1 ON	○
	SET λ1	XAS	Numeric + unit *	Unit UM: μm NM: nm, MM mm Example XAS0.78UM	○
λ2	ON/OFF	XBC	0, 1	0: λ2 OFF 1: λ2 ON	○
	SET λ2	XBS	Numeric + unit *	Unit UM: μm NM: nm, MM mm Example XBS630.5nm	○
L1	ON/OFF	YAC	0, 1	0: L1 OFF 1: L1 ON	○
	SET L1	YAS	Numeric + unit **	Unit DBM: dBm, DB: dB MW: mW, UM: μW NW: nW PC: %	○
L2	ON/OFF	YBC	0, 1	0: L2 OFF 1: L2 ON	○
	SET L2	YBS	Numeric + unit **	Unit DBM: dBm, DB: dB MW: mW, UM: μW NW: nW PC: %	○
CURSOR DATA		CUD	0 to 3	0: NORMAL 1: △MODE 2: 2ND PEAK 3: POWER	○
LEFT PEAK		LPK	———	λ1 set next left peak	×
RIGHT PEAK		RPK	———	λ1 set ext right peak	×

* The default is μm in spectrum mode and mm in coherence mode.

** The default is the current display scale unit.

- LABEL

Item	Program code		Contents	Read
	Function header	Setting		
LABEL	LAB**	Alphabet, Numeric, Symbol (up to 48 characters)	LAB__#_____# Up to 48 characters Terminator (# or !)	○

- MEASURE

Item	Program code		Contents	Read
	Function header	Setting		
MEASURE	MEA	0, 1, 2	0: STOP 1: SINGLE 2: REPEAT	○

- DISPLAY (1/3)

Item		Program code		Contents	Read
		Function header	Setting		
CON-TROL	DUAL	DUA	0, 1	0: OFF 1: ON (Dual-screen)	○
	SUPER IMPOSE	SIM	0, 1	0: OFF 1: ON (Super-impose)	○
	GRID	GRI	0, 1	0: OFF 1: ON	○
	act. U&L	AUL	0, 1	0: Upper screen active 1: Both upper and lower screens active	○
	xcng U/L	XUL	——	Upper screen replaced with lower screen	×

- DISPLAY (2/3)

Item		Program code		Contents	Read
		Function header	Setting		
CON-TROL	3D	TDM	0, 1	0: OFF 1: ON (3-dimensional mode)	○
	3D ANGLE	TAN	–75 to +75	–75 to +75: Display angle (in by 15° steps)	○
	3D CURSOR NO	TCN	1 to 16	1 to 16: Data number	○
	3D DELETE	TDL	———	The latest data deleted.	×
	3D CLEAR	TCL	———	All data cleared.	×
	3D MAX NO	TMX	2 to 16	2 to 16: Maximum number of data displayed	○
	3D N LOCK	TNL	0, 1	0: N-lock mode OFF 1: N-lock mode ON	○
	3D ROLL	TRO	0, 1	0: Roll mode OFF 1: Roll mode ON	○
	3D RECALL	TRC	———	Previous 3-dimensional data recalled.	×
SAVE	SAVE MEAS DATA	SAV**	0 to 32 + [; data name*]	0: REF (no data name) 1 to 32: MEAS 1 to 32 Example: SAV15;LD-No.15	×
	SAVE PANEL	SVP**	1 to 10,00,99 + [; data name]	1 to 10: PANEL 1 to 10 00: Initialized from the INSTR PRESET condition 99: The INSTR PRESET condition is replaced with the current setting. Example: SVP9;CON-LED1,3 Specified data name identical to MEAS (No data name for data Nos. 00 and 99.)	×
	DELETE MEAS	DMD	1 to 32	1 to 32: MEAS 1 to 32	×
	DELETE PANEL	DPC	1 to 32	1 to 10: PANEL 1 to 10	×

* When specifying a data name, insert ";" between the data No. and the data name. The data name can consist of up to 10 characters, using alphabets, numerics or symbol.

- DISPLAY (3/3)

Item		Program code		Contents	Read
		Function header	Setting		
RECALL	RECALL MEAS	RCL	0 to 32	0: REF 1 to 32: MEAS 1 to 32	×
	RECALL PANEL	RCP	1 to 10	1 to 10 : PANEL 1 to 10	×
NOR-MALIZE	PEAK NORM.	PNR	0, 1	0: OFF 1: ON (Peak normalize)	○
	MEM NORM.	MNR (RNR)	0, 1	0: OFF 1: ON (REF < > MEAS1)	○
	LOSS	LOS	0, 1	0: OFF 1: ON	○
	TRANS	TRA	0, 1	0: OFF 1: ON	○
SPECTRAL WIDTH	SPEC. WIDTH	SPW	0, 1	0: OFF 1: ON	○
	WIDTH TYPE	WTY	0 to 3	0: Pk-XdB 1: ENVELOPE 2: RMS 3: Peak RMS	○
	XdB parameter	WPX	Numeric	Setting range: 0.1 to 59.9 Example WPX3.0, WPX12.0	○
	YdB parameter	WPY	Numeric	Setting range: 0.1 to 99.9 Example WPY20, WPY35.0	○
	K parameter	WPK	Numeric	Setting range: 0.1 to 100	○
	Kr (RMS) parameter	WPR	Numeric	Setting range: 1 to 10	○
ADVANCE	CURVE FIT	CFT	0, 1	0: OFF 1: ON	○

- DATA OUT

Item		Program code		Contents	Read
		Function header	Setting		
DEVICE	DEVICE TYPE	DEV	0, 1	0: PRINTER 1: PLOTTER	○
	PLOT DATA	PDT	0, 1	0: ALL 1: SIGNAL only	○
	PAPER ADV.	PPA	0, 1	0: OFF 1: ON	○
	PLOT SIZE	PSZ	0 to 5	0: A4 (H1), 3: V1 1: H2 , 4: V2 2: H4 , 5: V4 Hn: Horizontal, Vn: Vertical	○
	BUZZER (BEEP)	BUZ	0, 1	0: OFF 1: ON	○
	WARNING	WAR	0, 1	0: OFF 1: ON	○
	QUIET BEEP	QUI	0, 1	0: NORMAL 1: QUIET	○
	CLOCK	CLO##	See below.	Setting the date and time	○
	CLOCK ON/OFF	CKD	0, 1	0: Clock not displayed 1: Clock displayed	○
	MENU OUT (PRINTER)	MEN	0, 1	0: OFF 1: ON	○
COPY& FEED	COPY	COP	——	Output to printer	×
	FEED	FEE	——	Paper fed about 5mm to printer.	×

CLO _# YY-MM-DD, hh:mm:ss _#

Terminator (# or !)

YY: Year (00 to 99)
MM: Month (01 to 12)
DD: Day (01 to 31)
hh: Hour (00 to 23)
mm: Minute (01 to 59)
ss: second (01 to 59)

- Codes corresponding to other keys

Item		Program code		Contents	Read
		Function header	Setting		
INSTR PRESET		IPR	———	Measurement conditions initialized.	×
CAL	LEVEL	CLV	Numeric + unit	Unit DBM: dBm, MW: mW UW: μW Level calibration data set.	×
	EXECUTE	CEX	———	Level calibration executed.	×
	VALID	CVA	0, 1	0: Mode not using CAL data 1: Mode using CAL data	○

- Controlling data output and others (1/3)

Item	Program code		Contents	Read
	Function header	Setting		
SRQ signal control-1	SRQ	0, 1	0: Mode not transmitting SRQ 1: Mode transmitting SRQ	○
Status byte mask	MSK	0 to 255 (Bit 6 can not be masked)	Status byte bit "1" to be masked switched on. (Initial value: 0) Example: b1 and b2 are to be masked: MSK6	○
Status byte clear	CSB	———		×
Header data output control	HED (HD)	0, 1	0: HEADER OFF 1: HEADER ON	○
Terminator	DEL (DL)	0 to 3	0: NL <EOI> 1: NL 2: <EOI> 3: CR NL <EOI>	○

- Controlling data output and others (2/3)

Item	Program code		Contents	Read
	Function header	Setting		
Data separator (ASCII waveform data)	SDL (DS)	0, 1, 2	0: , (Comma) 1: SP (Space) 2: CR NL	○
Message separator	MSP (MS)	0, 1	0: ; (Semicolon) 1: CR NL	○
Data output format (valid for waveform data)	FMT	0, 1, 2	0: ASCII 1: BINARY (16 bit) 2: BINARY (64 bit float)	○
Data output screen	OVS	0, 1	0: upper (upper screen) 1: lower (lower screen) (Valid in dual screen mode)	○
Request for waveform data output	OSD	0, 1	0: Y-axis data output 1: X-axis data output	×
Request for output of the number of waveform data	ODN (ODN?)	——	Output of the number of data contained on the screen specified by 0VSn	×
Request for peak search data output	OPK (OPK?)	——	Output data differs between Spectrum and Coherent modes	×
Request for cursor data output	OCD (OCD?)	——	Output data differs depending on cursor display mode	×
Request for spectral width data output	OSW (OSW?)	——	Output of the spectral width calculated.	×
Request for curve fit data output	OCF (OCF?)	——		×
Request for measurement data status output	OST (OST?)	——	Output data is 0 or 1. 0: Normal 1: Overload No header is output.	×

- Controlling data output and others (3/3)

Item	Program code		Contents	Read
	Function header	Setting		
Measurement data display ON/OFF	DSP	0, 1	Specifies if display should be updated at the end of measurement. 0: Display OFF 1: Display ON (initial value)	○
Request for 3-dimensional display data output	OTD	1 to 16	1 to 16: Data number	×
SRQ signal control-2	S	0, 1	0: Mode to output SRQ 1: Mode not to output SRQ	○
Single measurement	E (*TRG)	——	Code identical to "MEA1" Single measurement executed	×
Initialization	C (*RST)	——	Analyzer initialized (to mode at power on)	×
Device identification	*IDN?	——	Request to output company name, device name, serial number and software revision.	○
Execution of self-diagnosis and output of results.	*TST?	——	Request to execute self-diagnosis and output results. (See Table 6-3.)	○

Table 6-3 Error codes used in self-diagnosis

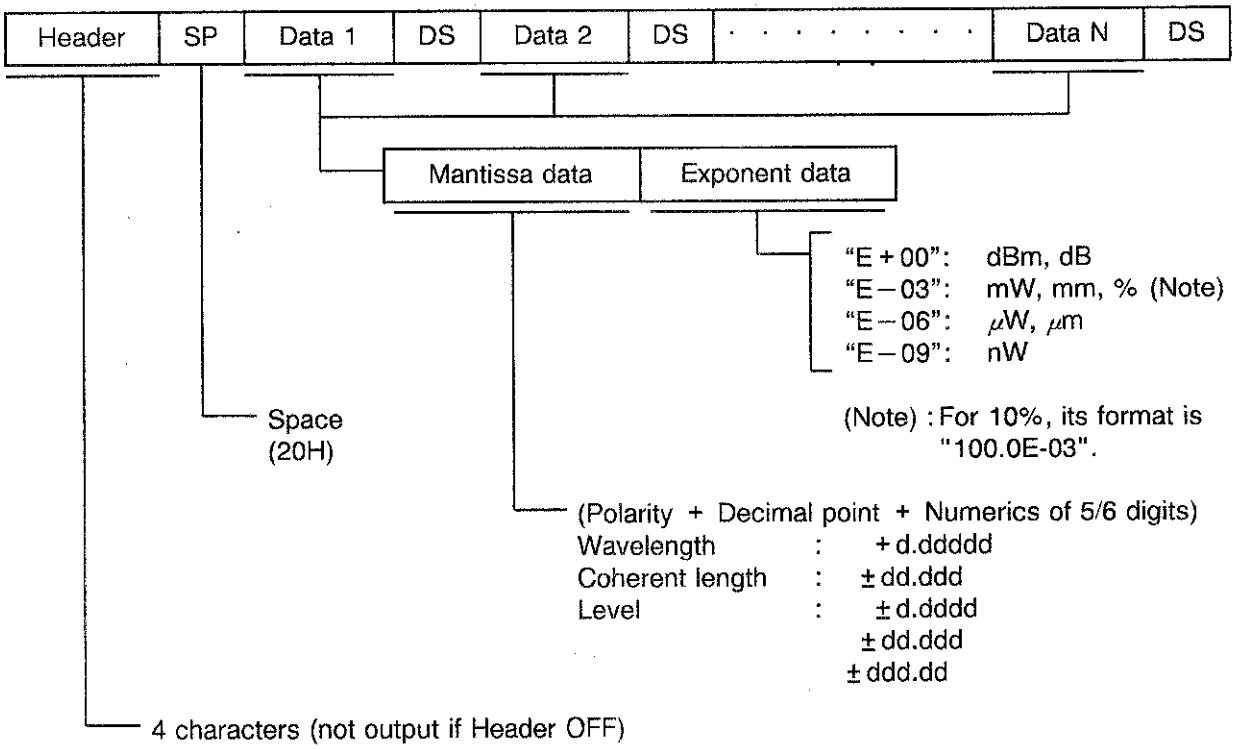
Code	Description
0000	Normal
010X	ROM error
02XX	RAM error
030X	Backup-RAM error
040X ∫ 070X	Peripheral circuit error (Internal clock, timer, printer interface and others)
110X ∫ 30XX	Measurement error (Measurement memory, interferometer, A/D converter and others)

6.3.3 Talker format (Data output format)

This paragraph describes the talker format required to transmit data from the analyzer to an external controller.
Six formats are used for data transmission depending on the data contents: waveform, peak search, cursor, spectral width and setting condition data.

(1) Waveform data (Program code "OSD0", "OSD1", "OCF", "OTDn")

① ASCII format (code for specifying "FMT0" format)

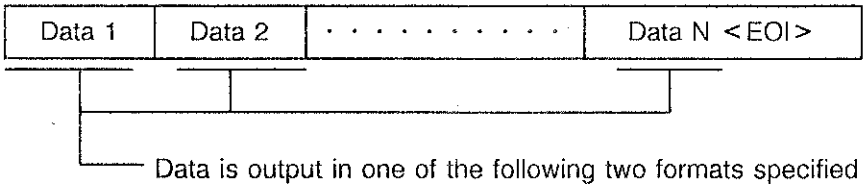


Header	Data type
LMUM	Wavelength [μm]
CLMM	Coherent length [mm]
LVLG	Log scale level data [dBm, dB]
LVLI	Linear scale level data
LVPC	% unit level data

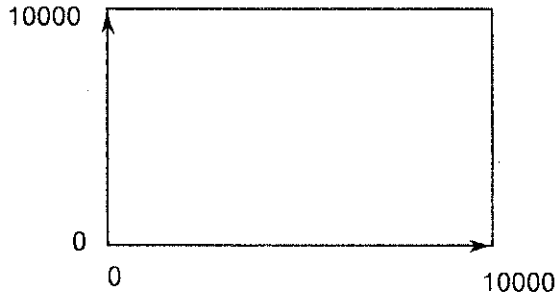
DS: Data separate (",", ";", CR or NL)
Can be specified with program code "SDLn" ("DSn")

T: Terminator (NL<EOI> NL <EOI> or CR,NL<EOI>)
Can be specified with program code "DELn" ("DLn")

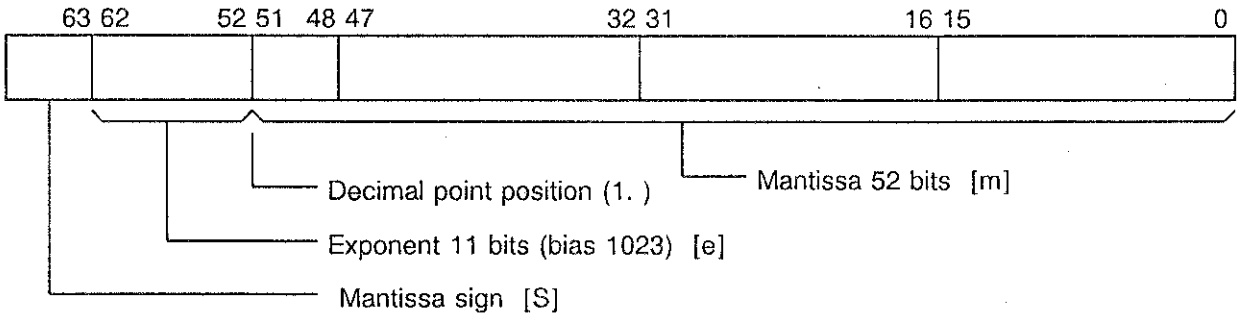
② BINARY format (Format specification code "FMT1", "FMT2")



(a) "FMT1"……16-bit (Integer type)
All data on the screen assumed to be linear scale. Both X- and Y-axis data output ranging from 0 to 10000.



(B) "FMT2"……64-bit (Floating point type)
Data is output in floating point format (IEEE Std. 754-1985 format) as shown below.

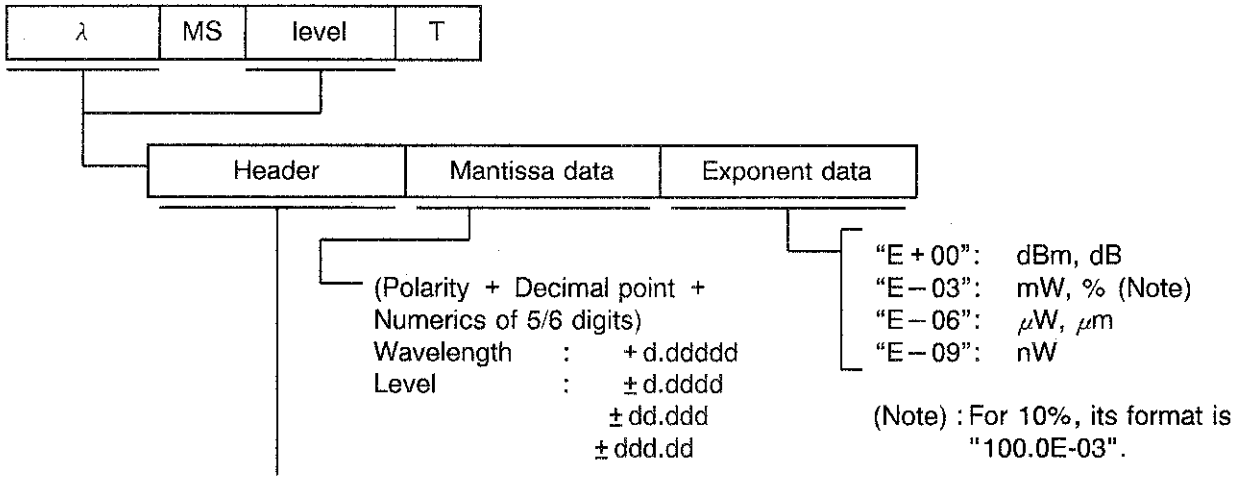


The value is expressed as follows:

$(-1)^S \times 2^{(e-1023)} \times 1.m$

(2) Peak search data (Program code "OPK")

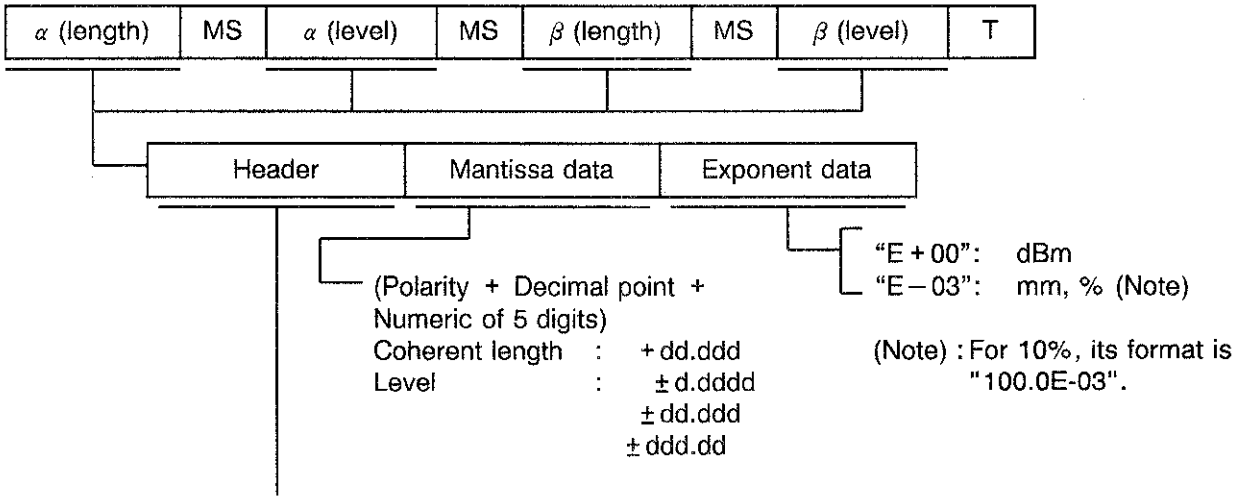
① Spectrum mode



4 characters (not output if Header OFF)

Header	Data type
LMPK	Peak wavelength (λ)
LVPK	Peak level (level)

② Coherent mode



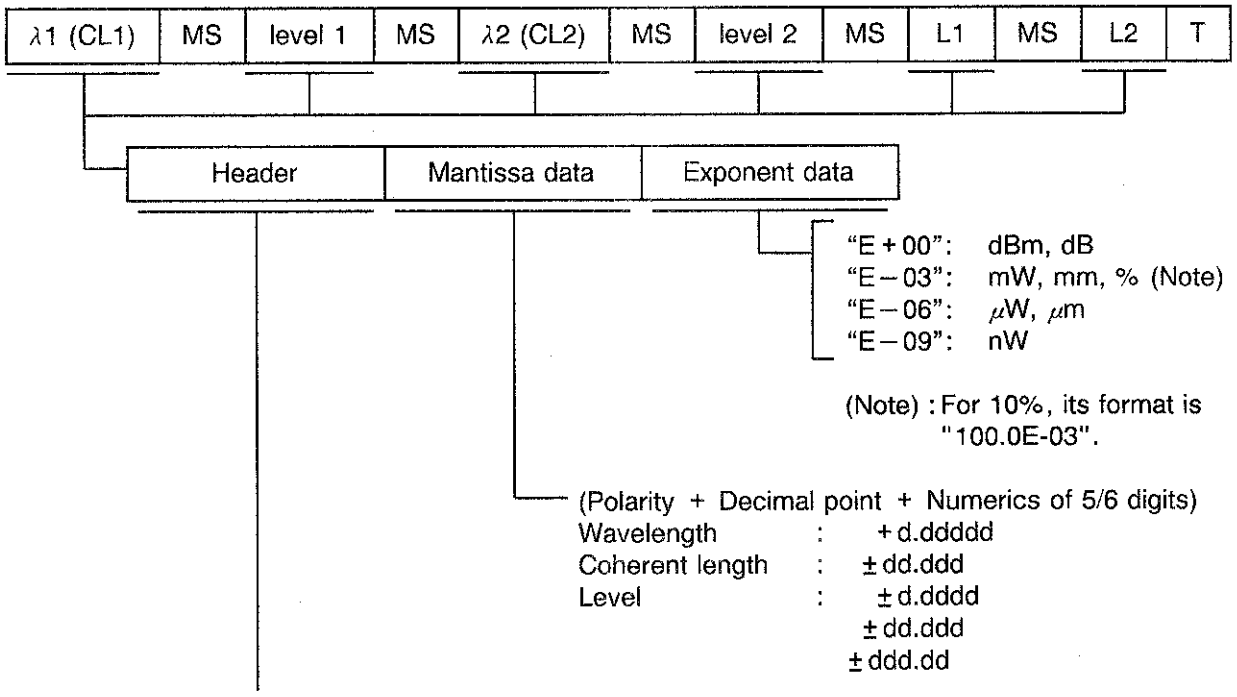
4 characters (not output if Header OFF)

Header	Data type
CLAL	α (length)
LVAL	α (level)
CLBE	β (length)
LVBE	β (level)

(3) Cursor data (Program code "OCD)

One of the following four formats is used according to the "CUDn" code for specifying the cursor display mode.

① "CUD0"·····Normal



Header	Data type
LMXA	Wavelength of X cursor 1 (λ1)
CLXA	Coherent length of X cursor 1 (CL1)
LVXA	Level of X cursor 1 (level1)
LMXB	Wavelength of X cursor 2 (λ2)
CLXB	Coherent length of X cursor 2 (CL2)
LVXB	Level of X cursor 2 (level2)
LVYA	Level of Y cursor 1 (L1)
LVYB	Level of Y cursor 2 (L2)

MS: Message separator (';', CR or NL)
Can be specified using program code "MSPn" ("MSn")

T: Terminator (NL<EOI>, NL, <EOI>, or CR,NL<EOI>)
Can be specified using program code "DELn" ("DLn").

Note 1: Data is "0" if the corresponding cursor is OFF.
Note 2: The mantissa and exponent formats are common to all "CUDn" codes.

② "CUD1"…… △MODE

λ1 (CL1)	MS	level 1	MS	△λ (△CL)	MS	△level	MS	L1	MS	△L	T

Header: 4 characters (not output if Header OFF)

Header	Data type
LMXA	Wavelength of X cursor 1 (λ1)
CLXA	Coherent length of X cursor 1 (CL1)
LVXA	Level of X cursor 1 (level1)
LMDX	Wavelength difference between X cursors 1 and 2 (△λ)
CLDX	Coherent length difference between X cursors 1 and 2 (△CL)
LVDX	Level difference between X cursors 1 and 2 (△ level)
LVYA	Level of X cursor 1 (L1)
LVDY	Level difference between Y cursors 1 and 2 (△L)

③ "CUD2" …… 2ND PEAK (not in coherence mode)

λ1	MS	level 1	MS	△λ	MS	△level	T

Header: 4 characters (not output if Header OFF)

Header	Data type
LMPK	Peak wavelength (λ1)
LVPK	Peak level (level1)
LMDP	Wavelength difference between 1st and 2nd peaks (△λ)
LVDP	Level difference between 1st and 2nd peaks (△level)

④ "CUD3"…… POWER (not in coherence mode)

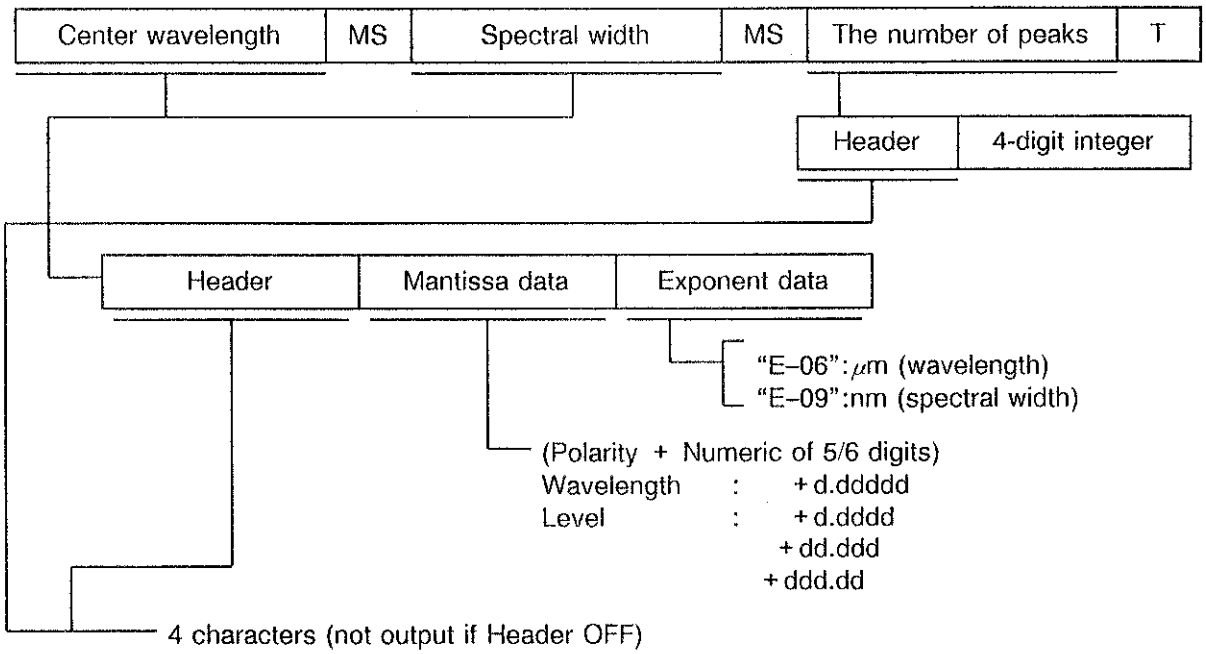
λ1	MS	λ2	MS	ΣL	T

Header: 4 characters (not output if Header OFF)

Header	Data type
LMXA	Wavelength of X cursor 1 (λ1)
LMXB	Wavelength of X cursor 2 (λ2)
LVPW	Sum of levels between X cursors 1 and 2 (△L)

(4) Spectral width data (Program code "OSW")

The results of four types of calculations are all output in the following format:



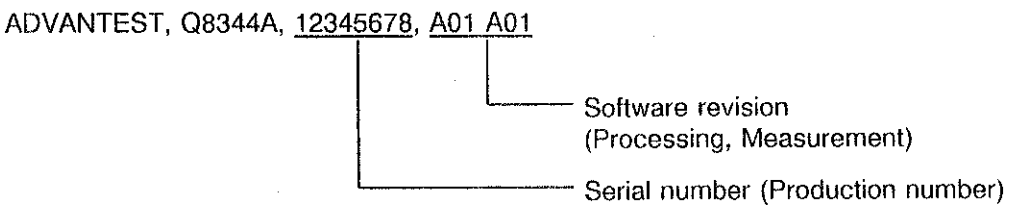
Header	Data type
LMCN	Center wavelength
LMHW	Spectral width
NOSP	Number of peaks

MS: Message separator (';', CR or NL)
Can be specified using program code "MSPn" ("MSn").

T: Terminator (NL<EOI>, NL, <EOI> or CR,NL<EOI>)
Can be specified using program code "DELn" ("DLn").

(5) Device identification

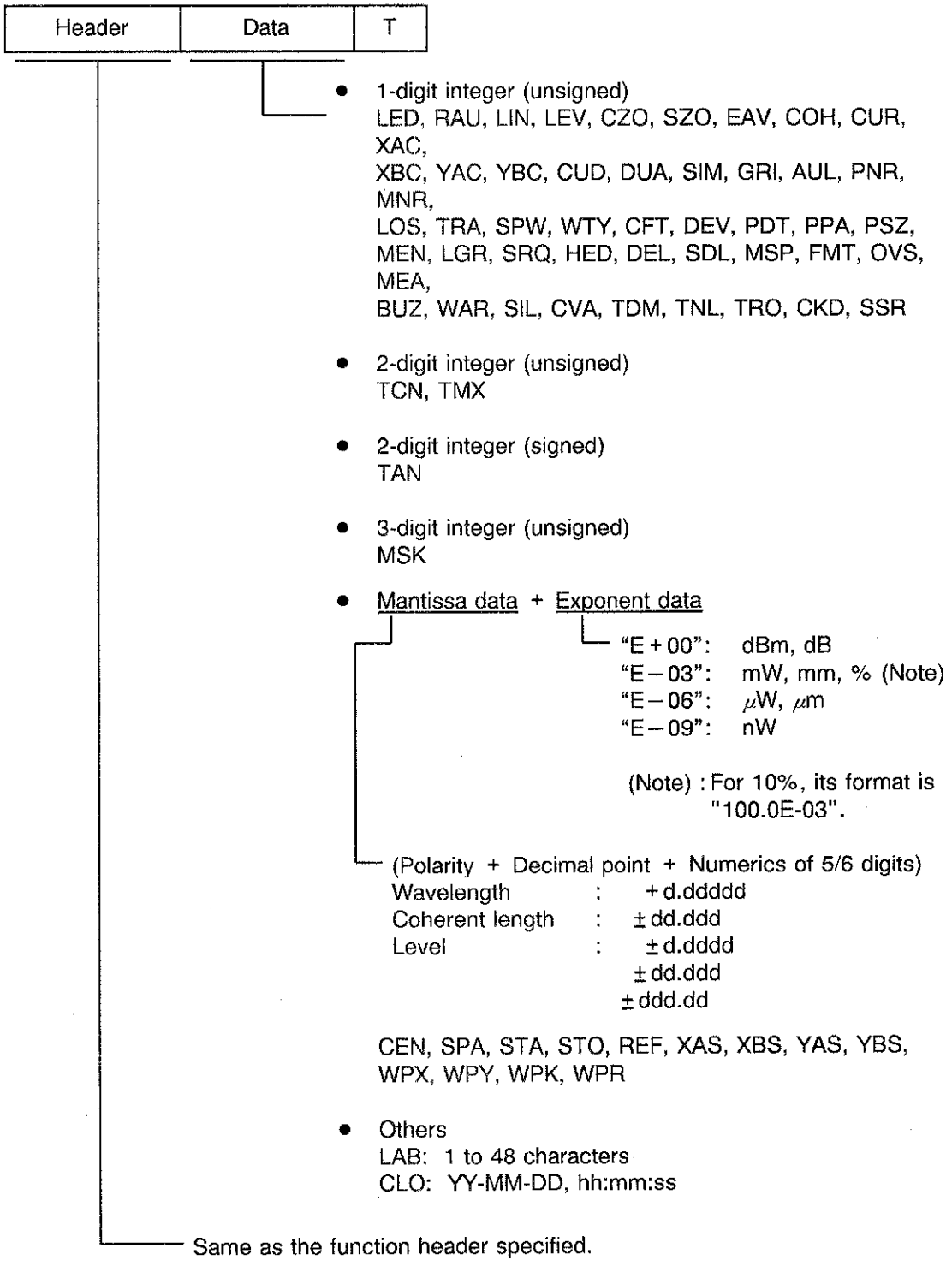
When program code "*IDN?" is received, the following data is output:



(6) Setting condition data

The current setting state can be read by using "?" instead of setting data if the code is readable.

The setting state is output in the following format:



6.3.4 Service request

The analyzer transmits a service request to the controller according to the operation state. When a service request is transmitted, the status byte is transmitted in response to serial polling from the controller.

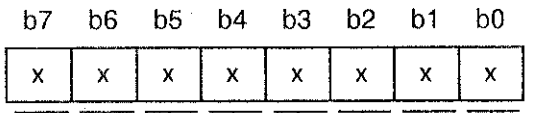
<Status byte>
Bits contained in the status byte are set and cleared according to the conditions described below. The status byte relates to three program codes: "SRQn", "MSKnnn" and "CSB".
The "SRQn" is used to control SRQ signal transmission: "SRQ1" is the mode for transmitting the SRQ signal and "SRQ0" does not transmit the SRQ signal.
The "MSKnnn" is used to mask specification of the status byte and 1 is set to the bit to be masked.

Example: Bits 1 and 3 are to be masked >> "MSK10" [10 = 00001010 binary]
Bits 2, 3 and 5 are to be masked >> "MSK44" [44 = 00101100 binary]

Note: Bit 6 cannot be masked although it can be specified.

All the bits are cleared with code "CSB", "C" or when a device clear message is received.

- Meanings and set/reset conditions of status byte bits



b0: measure end
Set to 1 when measurement is complete.
Set to 0 when next measurement is started.

b1: syntax error
Set to 1 when a syntax or setting error is found in the program code received.
Set to 0 when the next program code is received.

b2: calculation end
Set to 1 when spectral width or curve fit calculation is complete.
Set to 0 when measurement or ZOOMing is started or output of calculation data is complete.

b3: copy end
Set to 1 when output to the printer (optional) is complete.
Set to 0 at measurement start or when "COP" code is received.

b4: zoom end
Set to 1 when ZOOMing to re-analyze the previous measurement data with different wavelength condition is complete.
Set to 0 when measurement or ZOOMing is started.

b5: average end
Set to 1 when the specified number of measurements is complete for averaging.
Set to 0 at measurement start or when averaging is switched OFF.

b6: RQS
Set to 1 when one of the bits b0 to b5 or b7 is switched ON to indicate that a service request has been transmitted.
Set to 0 when all bits are 0.

b7: self-test error
Set to 1 when an error is found during self-diagnosis.

6.3.5 Device trigger function

The analyzer executes SINGLE measurement when the address-specified command "GET" (Group Execute Trigger) is received in the same way as when program codes "MEA1", "E" and "*TRG" are received.

6.3.6 Device clear function

The analyzer is initialized by the address-specified command "SDC" (Selected Device Clear) and universal command "DCL" (Device Clear) at power on in the same way as when program codes "C" and "*RST" are received.
The initial state at power on is shown in Table 6-4.

Table 6-4 Initial state at power on

Item	Initial state
① Measurement condition (FUNCTION section)	Preceding state
② Data display	Normal display (dual-screen, superimpose, and 3-dimensional display modes are all OFF)
③ Cursor display	All OFF
④ Spectral width calculation	OFF
⑤ Normalize	OFF
⑥ Curve fit	OFF
⑦ GP-IB • Status byte • Status byte mask • SRG signal transmit • Waveform data output format • Terminator • Data separator • Message separator	 0 (cleared) "MSK0" (unmasked) "SRQ0" (mode not to transmit SRQ signal) "FMT0" (ASCII) "DEL0" ("DL0")→(NL<EOI>) "SDL0" ("DS0")→(,) "MSP0" ("MS0")→(;)

6.3.7 Status modification by command

The analyzer states are modified as shown in Table 6-5 at power on and when commands are received.

Table 6-5 Status modification by command

Command, Code	Talker (with lamp)	Listener (with lamp)	Remote (with lamp)	SRQ (with lamp)	Status byte	Transmit data	Parameter and operation status
POWER ON	Cleared	Cleared	Local	Cleared	Cleared	Cleared	Partially initialized
IFC	Cleared	Cleared	——	——	——	——	——
"DCL" command	——	——	——	Cleared	Cleared	Cleared	Partially initialized
"SDC" command	Cleared	Set	——	Cleared	Cleared	Cleared	Partially initialized
"C", "*RST" codes	Cleared	Set	Remote	Cleared	Cleared	Cleared	Partially initialized
"IPR" code	Cleared	Set	Remote	Cleared	Cleared	Cleared	Initalization
"GET" command	Cleared	Set	——	═══	b0, 2, 3, 4 cleared	Cleared	——
"E", "*TRG" codes	Cleared	Set	Remote	═══	b0, 2, 3, 4 cleared	Cleared	——
Talker specified to the analyzer	Set	Cleared	——	——	——	——	——
Talker release instruction	Cleared	——	——	——	——	——	——
Listener specified to the analyzer	Cleared	Set	——	——	——	——	——
Listener release instruction	——	Cleared	——	——	——	——	——
Serial poling	Set	Cleared	——	Cleared	——	——	——

—— : The previous state remains unchanged.
═══ : Indefinite state
"DCL" : Device Clear
"SDC" : Selected Device Clear
"GET" : Group Excute Trigger

6.3.8 Sample programs

The sample programs given in this paragraph are for controlling the analyzer using HP 300 of 9000 series and NEC PC-9800 series.
(In the examples below, "8" is used to identify the GP-IB address of the analyzer.)

(1) Example 1
Center wavelength and span are set for spectrum analysis and peak wavelength and level are read.

① Program 1 for HP 9000 series 300

```
10    !*****************************************
20    !     Q8344A Optical Spectrum Analyzer
30    !     == sample program 1 ==
40    !     ( set center,span etc and read
50    !       peak lambda,level )
60    !*****************************************
70    !
80   INTEGER Spa
90   REAL Peak_lambda,Peak_level
100   !
110  Spa=708                        ! define Q8344A GP-IB address (8)
120  ON INTR 7 GOSUB Srq            ! define SRQ interrupt routine
130  CLEAR Spa                      ! initialize Q8344A
140  OUTPUT Spa;"COH 0"             ! select 'SPECTRUM' mode
150  OUTPUT Spa;"CEN 0.78um"        ! 'CENTER' set to 0.78um
160  OUTPUT Spa;"SPA 20nm"          ! 'SPAN' set to 20nm
170  OUTPUT Spa;"REF 0dBm"          ! 'REF LEVEL' set to 0dBm
180  OUTPUT Spa;"LIN 0,LEV 1"       ! select LOG display and set 5dB/DIV
190  OUTPUT Spa;"EAV 0"             ! 'AVERAGE' OFF
200  OUTPUT Spa;"MSK 254"           ! enable only 'measurement end' bit
210  OUTPUT Spa;"SRQ 1"             ! enable SRQ signal
220  OUTPUT Spa;"MEA 1"             ! start single measurement
230  Meas_end=0                     ! clear measure end flag
240  ENABLE INTR 7;2                ! enable SRQ interrupt
250  IF Meas_end=0 THEN 250         ! wait measurement end
260  OUTPUT Spa;"OPK"               ! request peak data output
270  ENTER Spa;Peak_lambda,Peak_level     ! read peak lambda,level
280  DISP Peak_lambda,Peak_level    ! display peak lambda and level
290  STOP
300   !
310 Srq:S=SPOLL(Spa)                ! read status byte of Q8344A
320  Meas_end=1                     ! set measure end flag
330  RETURN
340   !
350  END
```

- Explanation on program 1 for HP9000 series 300

Line No.	Description
10 to 70	Comment
80 to 90	Definition of variables
110	The Q8344A's GP-IB address (8) is set as a variable.
120	Definition of the processing routine used when an interrupt by SRQ signal occurs.
130	The analyzer is initialized at power on.
140	Spectrum analysis mode is selected.
150	Center wavelength is set to 0.78 μm.
160	Span is set to 20nm.
170	Reference level is set to 0dBm.
180	In LOG display, Y-axis scale is set to 5dB/DIV.
190	Averaging is set to OFF.
200	Only b0 (measurement-end) in the status byte is made valid.
210	Mode to transmit SRQ signal is set.
220	Measurement is started.
230	Flag (variable) to indicate end of measurement is cleared.
240	Interrupt by SRQ signal is allowed.
250	Waiting for end of measurement.
260	Output of peak research data is requested.
270	Peak wavelength and level are read into variables.
280	Peak wavelength and level which have been read are displayed.
310	<Interrupt processing routine Srq> Serial poling is executed and status byte read into the variable.
320	Flag to indicate measurement end is set.
330	Return to main routine.

② Program 1 for PC9800 series

```
10  '**************************************
20  '    Q8344A Optical Spectrum Analyzer
30  '    == sample program 1 ==
40  '    (set center,span etc and read
50  '     peak lambda,level)
60  '**************************************
70  '
80  ISET IFC                    ' send 'IFC' signal
90  ISET REN                    ' 'REN' signal set to true
100 CMD DELIM = 0               ' delimitter CR/LF(LF=NL)
110 CMD TIMEOUT = 10            ' timeout set to 10sec
120 DEF SEG = &H60              ' --
130 A% = PEEK(&H9F3)            '   |
140 A% = A% AND &HBF            '    -- clear SRQ bit of PC9801
150 POKE &H9F3,A%               ' --
160 SPA = 8                     ' define Q8344A GP-IB address (8)
170 PRINT @SPA;"C"              ' initialize Q8344A
180 ON SRQ GOSUB *SSRQ          ' define SRQ interrupt routine
190 PRINT @SPA;"COH 0"          ' select 'SPECTRUM' mode
200 PRINT @SPA;"CEN 0.78um"     ' 'CENTER' set to 0.78um
210 PRINT @SPA;"SPA 20nm"       ' 'SPAN' set to 20nm
220 PRINT @SPA;"REF 0dBm"       ' 'REF LEVEL' set to 0dBm
230 PRINT @SPA;"LIN 0,LEV 1"    ' select LOG scale and set to 5dB/DIV
240 PRINT @SPA;"EAV 0"          ' 'AVERAGE' OFF
250 PRINT @SPA;"MSK 254"        ' enable only 'measurement end' bit
260 PRINT @SPA;"SRQ 1"          ' enable SRQ signal
270 PRINT @SPA;"MEA 1"          ' start single measurement
280 M.END = 0                   ' clear measure end flag
290 SRQ ON                      ' enable SRQ interrupt
300 IF M.END=0 THEN 300         ' wait measurement end
310 PRINT @SPA;"DEL 0,MSP 0"    ' terminator NL(EOI)
320                             ' message separator ';'
330 PRINT @SPA;"HED 0,OPK"      ' header OFF,request peak data output
340 INPUT @SPA;PEAK.LM,PEAK.LV  ' read peak lambda,level
350 PRINT PEAK.LM,PEAK.LV       ' print peak lambda,level
360 STOP
370 '
380 *SSRQ: POLL SPA,S           ' execute serial-poll and read status
390 M.END = 1                   ' set measure end flag
400 RETURN
410 '
420 END
```

- Explanation on program 1 for PC9800

Line No.	Description
10 to 70	Comment
80	"IFC" signal is transmitted.
90	"REN" signal is set to TRUE.
100	Delimiter used when loading a command is set to CR/LF (= CR/NL).
110	Time out duration at handshake is set at 10 seconds.
120 to150	The SRQ bit of the PC9800's GP-IB interface is cleared.
160	The Q8344A's GP-IB address (8) is set as a variable.
170	The analyzer is initialized at power on.
180	Definition of the processing routine used when an interrupt by SRQ signal occurs.
190	Spectrum analysis mode is selected.
200	Center wavelength is set to 0.78 μm.
210	Span is set to 20nm.
220	Reference level is set to 0dbm.
230	In LOG display, Y-axis scale is set to 5db/DIV.
240	Averaging is set to OFF.
250	Only b0 (measurement-end) in the status byte is made valid.
260	Mode to transmit SRQ signal is set.
270	Measurement is started.
280	Flag (variable) to indicate end of measurement is cleared.
290	Interrupt by SRQ signal is allowed.
300	Waiting for end of measurement.
310	Terminator is set to CR/NL(EOI) and data separator to ','.
330	Header OFF and output of peak search data is requested.
340	Peak wavelength and level are read into the variables.
350	Peak wavelength and level which have been read are displayed.
380	<Interrupt processing routine *SSRQ> Serial poling is executed and the status byte is read into the variable.
390	Flag to indicate end of measurement is set.
400	Return to main routine.

(2) Example 2

For coherence analysis, averaging is executed and α (2nd peak distance and level) and β (intermediate distance between the maximum peak and 2nd peak and level) are read into memory.

① Program 2 for HP9000 series 300

```
10    !*****************************************
20    !     Q8344A Optical Spectrum Analyzer
30    !     == sample program 2 ==
40    !     ( set coherence mode and read alpha,
50    !       beta parameters)
60    !*****************************************
70    !
80   INTEGER Spa
90   REAL A_len,A_lvl,B_len,B_lvl
100   !
110  Spa=708                          ! define Q8344A GP-IB address (8)
120  ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
130  CLEAR Spa                        ! initialize Q8344A
140  OUTPUT Spa;"COH 1"               ! select 'COHERENCE' mode
150  OUTPUT Spa;"CEN 850nm"           ! 'CENTER' set to 850nm
160  OUTPUT Spa;"SPA 5.2mm"           ! 'SPAN'(distance range) set to 5.2mm
170  OUTPUT Spa;"REF 0.1mW"           ! 'REF LEVEL' set to 0.1mW(linear scale)
180  OUTPUT Spa;"AVG 8,EAV 1"         ! average number set to 8,'AVERAGE' ON
190  OUTPUT Spa;"MSK 223"             ! enable only 'average end' bit
200  OUTPUT Spa;"SRQ 1"               ! enable SRQ signal
210  OUTPUT Spa;"MEA 1"               ! start single measurement(average of 8)
220  Meas_end=0                       ! clear measure end flag
230  ENABLE INTR 7;2                  ! enable SRQ interrupt
240  IF Meas_end=0 THEN 240           ! wait measurement end
250  OUTPUT Spa;"OPK"                 ! request alpha,beta data output
260  ENTER Spa;A_len,A_lvl,B_len,B_lvl    ! read alpha,beta(length,level)
270  DISP A_len,A_lvl,B_len,B_lvl     ! display alpha,beta(length,level)
280  STOP
290   !
300 Srq:S=SPOLL(Spa)                  ! read status byte of Q8344A
310  Meas_end=1                       ! set measure end flag
320  RETURN
330   !
340  END
```

- Explanation on program 2 for HP9000 series 300

Line No.	Description
10 to 70	Comment
80 to 90	Definition of variables
110	The Q8344A's GP-IB address (8) is set as a variable.
120	Definition of the processing routine used when an interrupt by SRQ signal occurs.
130	The analyzer is initialized at power on.
140	Coherence analysis mode is selected.
150	Center wavelength is set to 850nm.
160	Distance range is set to 5.2mm.
170	Reference level is set to 0.1mW (when using mW, linear scale is automatically set).
180	Number of averaging times is set to 8 with averaging set to ON.
190	Only b5 (average-end) in the status byte is made valid.
200	Mode to transmit SRQ signal is set.
210	Measurement starts (for the number of averaging times).
220	Flag (variable) to indicate the end of measurement is cleared.
230	Interrupt by SRQ signal is allowed.
240	Waiting for end of measurement (completion of averaging)
250	Output of peak search data (α , β) is requested.
260	Distance and level of α and $\beta$are read into variables.
270	The distance and level of α and β which have been read are displayed.
300	<Interrupt processing routine Srq> Serial poling is executed and the status byte read into the variable.
310	Flag to indicate end of measurement is set.
320	Return to main routine.

② Program 2 for PC9800

```
10  '**************************************
20  '    Q8344A Optical Spectrum Analyzer
30  '    == sample program 2 ==
40  '    (set coherence mode and read alpha,
50  '     beta parameters)
60  '**************************************
70  '
80  ISET IFC                        ' send 'IFC' signal
90  ISET REN                        ' 'REN' signal set to true
100 CMD DELIM = 0                   ' delimitter CR/LF(LF=NL)
110 CMD TIMEOUT = 10                ' timeout set to 10sec
120 DEF SEG = &H60                  ' --
130 A% = PEEK(&H9F3)                '   |
140 A% = A% AND &HBF                '    -- clear SRQ bit of PC9801
150 POKE &H9F3,A%                   ' --
160 SPA = 8                         ' define Q8344A GP-IB address (8)
170 PRINT @SPA;"C"                  ' initialize Q8344A
180 ON SRQ GOSUB *SSRQ              ' define SRQ interrupt routine
190 PRINT @SPA;"COH 1"              ' select 'COHERENCE" mode
200 PRINT @SPA;"CEN 850nm"          ' 'CENTER' set to 850nm
210 PRINT @SPA;"SPA 5.2mm"          ' 'SPAN'(distance range) set to 5.2mm
220 PRINT @SPA;"REF 0.1mW"          ' 'REF LEVEL' set to 0.1mW(LINEAR SCALE)
230 PRINT @SPA;"AVG 8,EAV 1"        ' average number set to 8,'AVERAGE' ON
240 PRINT @SPA;"MSK 223"            ' enable only 'average end' bit
250 PRINT @SPA;"SRQ 1"              ' enable SRQ signal
260 PRINT @SPA;"MEA 1"              ' start single measurement(average of 8)
270 M.END = 0                       ' clear measure end flag
280 SRQ ON                          ' enable SRQ interrupt
290 IF M.END=0 THEN 290             ' wait measurement end
300 PRINT @SPA;"DEL 0,MSP 0"        ' terminator NL(EOI)
310                                 ' message separator ';'
320 PRINT @SPA;"HED 0,OPK"          ' header OFF,request alpha,beta data output
330 INPUT @SPA;A.LEN.A.LVL,B.LEN,B.LVL     ' read alpha,beta(length,level)
340 PRINT A.LEN.A.LVL,B.LEN,B.LVL          ' print alpha,beta(length,level)
350 STOP
360 '
370 *SSRQ: POLL SPA,S               ' execute serial-poll and read status
380 M.END = 1                       ' set measure end flag
390 RETURN
400 '
410 END
```

- Explanation on program 2 for PC9800

Line No.	Description
10 to 70	Comment
80	"IFC" signal is transmitted.
90	"REN" signal is set to TRUE.
100	Delimiter for command setting is set to CR/LF (=CR/NL).
110	Time out duration at handshake is set at 10 seconds.
120 to 150	The SRQ bit of the PC9800's GP-IB interface series is cleared.
160	The Q8344A's GP-IB address (8) is set has a variable.
170	The analyzer is initialized at power is on.
180	Definition of the processing routine used when an interrupt by SRQ signal occurs.
190	Coherence analysis mode is selected.
200	Center wavelength is set to 850nm.
210	Distance range is set to 5.2mm.
220	Reference level is set to 0.1mW (when using mW, Linear scale is set automatically).
230	Number of average times is set to 8 with averaging set to ON.
240	Only b5 (average-end) in the status byte is made valid.
250	Mode to transmit SRQ signal is set.
260	Measurement starts (for the number of averaging times).
270	Flag (variable) to indicate the end of measurement is cleared.
280	Interrupt by SRQ signal is allowed.
290	Waiting for end of measurement (completion of averaging).
300	Terminator is set to CR/NL(EOI) and data separator to ','.
320	Header OFF and output of peak search data (α, β) is requested.
330	Distance and level of α and β are read into variables.
340	Distance and level of α and β which have been read are displayed.
370	<Interrupt processing routine *SSRQ> Serial poling is executed and the status byte is read into the variable.
380	Flag to indicate end of measurement (completion of averaging) is set.
390	Return to main routine.

(3) Example 3

After setting measurement conditions for spectrum analysis the spectrum data obtained is read in the ASCII format (wavelength and level data are read together).

① Program 3 for HP9000 series 300

```
10    !*****************************************
20    !     Q8344A Optical Spectrum Analyzer
30    !     == sample program 3 ==
40    !     ( set-up measurement condition
50    !       and read spectrum data )
60    !*****************************************
70    !
80    INTEGER Spa
90    REAL Lambda(1:801),Level(1:801)
100    !
110   Spa=708                          ! define Q8344A GP-IB address (8)
120   ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
130   CLEAR Spa                        ! initialize Q8344A
140   OUTPUT Spa;"COH 0"               ! select 'SPECTRUM' mode
150   OUTPUT Spa;"STA 1275nm"          ! 'START lambda' set to 1275nm
160   OUTPUT Spa;"STO 1325nm"          ! 'STOP lambda' set to 1325nm
170   OUTPUT Spa;"REF 0.1mW"           ! 'REF LEVEL' set to 0.1mW(select LINEAR)
180   OUTPUT Spa;"AVG 2,EAV 1"         ! average number set to 2,'AVERAGE' ON
190   OUTPUT Spa;"MSK 223"             ! enable only 'average end' bit
200   OUTPUT Spa;"SRQ 1"               ! enable SRQ signal
210   OUTPUT Spa;"MEA 1"               ! start single measurement(average of 2)
220   Meas_end=0                       ! clear measure end flag
230   ENABLE INTR 7;2                  ! enable SRQ interrupt
240   IF Meas_end=0 THEN 240           ! wait measurement end
250   OUTPUT Spa;"FMT 0,HED 0"         ! select ASCII format and header OFF
260   OUTPUT Spa;"ODN"                 ! request no-of-measured data output
270   ENTER Spa;N_meas                 ! read no-of-measured data
280   REDIM Lambda(1:N_meas),Level(1:N_meas)   ! re-sizing of variables
290   OUTPUT Spa;"OSD1"                ! request X-axis data output(lambda)
300   ENTER Spa;Lambda(*)              ! read lambda data
310   OUTPUT Spa;"OSD0"                ! request Y-axis data output(level)
320   ENTER Spa;Level(*)               ! read level data
330   !***  spectrum data transaction write here  ***
340   STOP
350    !
360 Srq:S=SPOLL(Spa)                   ! read status byte of Q8344A
370   Meas_end=1                       ! set measure end flag
380   RETURN
390    !
400   END
```

- Explanation on program 3 for HP9000 series 300

Line No.	Description
10 to 70	Comment
80 to 90	Definition of variables (to assure arrangement of the maximum number of data items).
110	The Q8344A's GP-IB address (8) is set as a variable.
120	Definition of the processing routine used when an interrupt by SRQ signal occurs.
130	The analyzer is initialized at power on.
140	Spectrum analysis mode is selected.
150	Start wavelength is set to 1275nm.
160	Stop wavelength is set to 1325nm.
170	Reference level is set to 0.1mW (when using mW, linear scale is automatically set).
180	Number of averaging times is set to 2 with averaging set to ON
190	Only b5 (average-end) in the status byte is made valid.
200	Mode to transmit SRQ signal is set.
210	Measurement starts (for the number of averaging times).
220	Flag (variable) to indicate the end of measurement is cleared.
230	Interrupt by SRQ signal is allowed.
240	Waiting for end of measurement (completion of averaging).
250	The data output format is set to ASCII and Header set to OFF.
260	Request is made to output the number of measurement points in spectrum.
270	Number of measurement points is read into the data variable.
280	Re-definition of the size of the arrangement variable for reading wavelength and level data (to be read into the arrangement variable en masse).
290	Output of X-axis data (wavelength) is requested.
300	Wavelength data is read into the arrangement variable en masse.
310	Output of Y-axis data (level) is requested.
320	Level data is read into the arrangement variable en masse).
330	(Normally, this line is used to describe the processing program for data read after this line number. To display data in graph form, use the wavelength and level data in pairs, is because wavelength axis data is not arranged at identical intervals).
360	<Interrupt processing routine Srq> Serial poling is executed and status byte read into the variable.
370	Flag to indicate end of measurement (completion of averaging) is set.
380	Return to main routine.

② Program 3 for PC9800

```
10  '****************************************
20  '     Q8344A Optical Spectrum Analyzer
30  '     == sample program 3 ==
40  '     (set-up measurement condition
50  '      and read spectrum data)
60  '****************************************
70  '
80  DIM LAMBDA(801),LEVEL(801)
90  ISET IFC                        ' send 'IFC' signal
100 ISET REN                        ' 'REN' signal set to true
110 CMD DELIM = 0                   ' delimitter CR/LF
120 CMD TIMEOUT = 10                ' timeout set to 10sec
130 DEF SEG = &H60                  ' --
140 A% = PEEK(&H9F3)                '   !
150 A% = A% AND &HBF                '    -- clear SRQ bit of PC9801
160 POKE &H9F3,A%                   ' --
170 SPA = 8                         ' define Q8344A GP-IB address (8)
180 PRINT @SPA;"C"                  ' initialize Q8344A
190 ON SRQ GOSUB *SSRQ              ' define SRQ interrupt routine
200 PRINT @SPA;"COH 0"              ' select 'SPECTRUM' mode
210 PRINT @SPA;"STA 1275nm"         ' 'START lambda' set to 1275nm
220 PRINT @SPA;"STO 1325nm"         ' 'STOP lambda' set to 1325nm
230 PRINT @SPA;"REF 0.1mW"          ' 'REF LEVEL' set to 0.1mW(select LINEAR)
240 PRINT @SPA;"AVG 2,EAV 1"        ' average number set to 2,'AVERAGE' ON
250 PRINT @SPA;"MSK 223"            ' enable only 'average end' bit
260 PRINT @SPA;"SRQ 1"              ' enable SRQ signal
270 PRINT @SPA;"MEA 1"              ' start single measurement(average of 2)
280 M.END = 0                       ' clear measure end flag
290 SRQ ON                          ' enable SRQ interrupt
300 IF M.END=0 THEN 300             ' wait measurement end
310 PRINT @SPA;"DEL 0,SDL 2"        ' teminator LF(EOI)
320                                 ' data separator CR/NL
330 PRINT @SPA;"FMT 0,HED 0"        ' select ASCII format and header OFF
340 PRINT @SPA;"ODN"                ' request no-of-measured data output
350 INPUT @SPA;N.DATA               ' read no-of-measured data
360 PRINT @SPA;"OSD1"               ' request X-axis data output(lambda)
370 FOR N=1 TO N.DATA               ' --
380   INPUT @SPA;LAMBDA(N)          '   --  read lambda data
390 NEXT N                          ' --
400 PRINT @SPA;"OSD0"               ' request Y-axis data output(level)
410 FOR N=1 TO N.DATA               ' --
420   INPUT @SPA;LEVEL(N)           '   --  read level data
430 NEXT N                          ' --
440 '*** spectrum data transaction write here ***
450 STOP
460 '
470 *SSRQ: POLL SPA,S               ' execute serial-poll and read status
480 M.END = 1                       ' set measure end flag
490 RETURN
500 '
510 END
```

- Explanation on program 3 for PC9800

Line No.	Description
10 to 70	Comment
80	Definition of variables (to assure arrangement of the maximum number of data items).
90	"IFC" signal is transmitted.
100	"REN" signal is set to TRUE.
110	Delimiter for command setting is set to CR/LF (=CR/NL).
120	Time out duration at handshake is set at 10 seconds.
130 to 160	The SRQ bit of the PC9800's GP-IB interface is cleared.
170	The Q8344A's GP-IB address (8) is set as a variable.
180	The analyzer is initialized at power on.
190	Definition of the processing routine used when an interrupt by SRQ signal occurs.
200	Spectrum analysis mode is selected.
210	Start wavelength is set to 1275nm.
220	Stop wavelength is set to 1325nm.
230	Reference level is set to 0.1mW (when using mW, linear scale is automatically set).
240	Number of averaging times is set to 2 with averaging set to ON.
250	Only b5 (average-end) in the status byte is made valid.
260	Mode to transmit SRQ signal is set.
270	Measurement starts (for the number of averaging times).
280	Flag (variable) to indicate the end of measurement is cleared.
290	Interrupt caused by SRQ signal is allowed.
300	Waiting for end of measurement (completion of averaging).
310	Terminator is set to CR/NL (EOI) and data separator to CR/LF.
330	Data output format is set to ASCII and Header to OFF.
340	Request is made to output the number of measurement points in spectrum.
350	Number of measurement points is read into the data variable.
360	Output of X-axis data (wavelength) is requested.
370 to 390	Wavelength data for the number of points read in line 350 is read into the arrangement variables.
400	Output of Y-axis data is requested.
410 to 430	Level data for the number of points read in line 350 is read into the arrangement variables.
440	(Normally, this line is used to describe the processing program for data read after this line number. To display data in graph form, use the wavelength and level data in pairs, because wavelength axis data is not arranged at identical intervals.)
470	<Interrupt processing routine *SSRQ> Serial poling is executed and the status byte read into the variable.
480	Flag to indicate end of measurement (completion of averaging) is set.
490	Return to main routine.

(4) Example 4

After measurement conditions are set for spectrum analysis, the spectrum data obtained is read in binary format (wavelength and level data are read together).

This way, the data transfer time is minimized (not supported by the PC9800 series).

① Program 4 for HP9000 series 300

```
10    !*****************************************
20    !     Q8344A Optical Spectrum Analyzer
30    !     == sample program 4 ==
40    !     ( set-up measurement condition
50    !       and read spectrum data with
60    !       64bit floating format )
70    !*****************************************
80    !
90   INTEGER Spa
100  REAL Lambda(1:801) BUFFER,Level(1:801) BUFFER
110   !
120  Spa=708                          ! define Q8344A GP-IB address (8)
130  ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
140  CLEAR Spa                        ! initialize Q8344A
150  OUTPUT Spa;"COH0"                ! select 'SPECTRUM' mode
160  OUTPUT Spa;"CEN1.55um"           ! 'CENTER' set to 1.55um
170  OUTPUT Spa;"SPA50nm"             ! 'SPAN' set to 50nm
180  OUTPUT Spa;"REF -10dBm"          ! 'REF LEVEL' set to -10dBm
190  OUTPUT Spa;"EAV0"                ! 'AVERAGE' OFF
200  OUTPUT Spa;"MSK254"              ! enable only 'measurement end' bit
210  OUTPUT Spa;"SRQ1"                ! enable SRQ signal
220  TRIGGER Spa                      ! start single measurement
230  Meas_end=0                       ! clear measure end flag
240  ENABLE INTR 7;2                  ! enable SRQ interrupt
250  IF Meas_end=0 THEN 250           ! wait measurement end
260  OUTPUT Spa;"ODN"                 ! request no-of-measured data output
270  ENTER Spa;N_meas                 ! read no-of-measured data
280   !
290  OUTPUT Spa;"FMT 2"               ! select 64bit floating format
300                                   ! terminator (EOI)
310  OUTPUT Spa;"OSD1"                ! request X-axis data output(lambda)
320  ASSIGN @Buf TO BUFFER Lambda(*)      ! assign path-name for variable
330  ASSIGN @Spa TO Spa               ! assign path-name for Q8344A
340  TRANSFER @Spa TO @Buf;END,WAIT     ! Q8344A lambda data xfer to Lambda(*)
350  OUTPUT Spa;"OSD0"                ! request Y-axis data output(level)
360  ASSIGN @Buf TO BUFFER Level(*)       ! assign path-name for variable
370  TRANSFER @Spa TO @Buf;END,WAIT     ! Q8344A level data xfer to Level(*)
380   !***  spectrum data transaction write here  ***
390  STOP
400   !
410 Srq:S=SPOLL(Spa)                  ! read status byte of Q8344A
420  Meas_end=1                       ! set measure end flag
430  RETURN
440   !
450  END
```

- Explanation on program 4 for HP9000 series 300

Line No.	Description
10 to 80	Comment
90 to 100	Definition of variables (to assure arrangement of the maximum number of data items).
120	The Q8344A's GP-IB address (8) is set as a variable.
130	Definition of the processing routine used when an interrupt by SRQ signal occurs.
140	The analyzer is initialized at power on.
150	Spectrum analysis mode is selected.
160	Center wavelength is set to 1.55 μm.
170	Span is set to 50nm.
180	Reference level is set to –10dBm.
190	Averaging is set to OFF.
200	Only b0 (measure-end) in the status byte is made valid.
210	Mode to transmit SRQ signal is set.
220	Measurement starts.
230	Flag (variable) to indicate the end of measurement is cleared.
240	Interrupt by SRQ signal is allowed.
250	Waiting for end of measurement.
260	Request is made to output the number of measurement points in the spectrum.
270	Number of measurement points is read into the data variable.
290	The data output format is set to binary (64-bit floating point type). (When binary format is selected, (EOI) is automatically specified as the terminator.)
310	Output of X-axis data (wavelength) is requested.
320 to 330	The I/O route name is defined in the arrangement variable for the wavelength data read and in the Q8344A to enable the buffer transfer mode.
340	Buffer transfer starts and wavelength data is read in.
350	Output of Y-axis data is requested.
360	The I/O route name is defined in the arrangement variable for level data read to enable the buffer transfer mode.
370	Buffer transfer starts and level data is read.
380	(Normally, this line is used to describe the processing program for data read after this line number. To display data in graph form, use the wavelength and level data in pairs, because the wavelength axis data is not arranged at identical intervals.)
410	< Interrupt processing routine Srq > Serial poling is executed and the status byte read into the variable.
420	Flag to indicate end of measurement is set.
430	Return to the routine.

(5) Example 5

Spectrum measurement is executed and the 2nd peak (cursor data) and spectral width calculation data read.

① Program 5 for HP9000 series 300

```
10    !*****************************************
20    !     Q8344A Optical Spectrum Analyzer
30    !     == sample program 5 ==
40    !     ( set-up measurement condition
50    !       and read 2nd-peak<cursor data>,
60    !       spectral width data )
70    !*****************************************
80    !
90   INTEGER Spa
100  REAL Lm1,Lv1,D_lm,D_lv
110  REAL Lambda_0,S_width,N_peak
120   !
130  Spa=708                          ! define Q8344A GP-IB address (8)
140  ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
150  CLEAR Spa                        ! initialize Q8344A
160  OUTPUT Spa;"COH 0"               ! select 'SPECTRUM' mode
170  OUTPUT Spa;"CEN 830nm"           ! 'CENTER' set to 830nm
180  OUTPUT Spa;"SPA 20nm"            ! 'SPAN' set to 20nm
190  OUTPUT Spa;"REF 0dBm,LEV 0"      ! 'REF LEVEL':0dBm,'LEVEL SCALE':10dB/DIV
200  OUTPUT Spa;"EAV 0"               ! 'AVERAGE' OFF
210  OUTPUT Spa;"MSK 254"             ! enable only 'measurement end' bit
220  OUTPUT Spa;"SRQ 1"               ! enable SRQ signal
230  OUTPUT Spa;"MEA 1"               ! start single measurement
240  Meas_end=0                       ! clear measure end flag
250  ENABLE INTR 7;2                  ! enable SRQ interrupt
260  IF Meas_end=0 THEN 260           ! wait measurement end
270  OUTPUT Spa;"CUD 2,CUR 1"         ! select '2nd peak' and cursor ON
280  OUTPUT Spa;"OCD"                 ! request cursor data output
290  ENTER Spa;Lm1,Lv1,D_lm,D_lv      ! read lambda1,L1,delta-lambda,delta-L
300  OUTPUT Spa;"WTY 0,WPX 3"         ! select 'Pk-XdB' and X set to 3dB
310  OUTPUT Spa;"SPW 1"               ! spectral width ON(execute calculation)
320  OUTPUT Spa;"OSW"                 ! request spectral width data output
330  ENTER Spa;Lambda_0,S_width,N_peak ! read lambda-0,width,no-of-peak
340  STOP
350   !
360 Srq:S=SPOLL(Spa)                  ! read status byte of Q8344A
370  Meas_end=1                       ! set measure end flag
380  RETURN
390   !
400  END
```

- Explanation on program 5 for HP9000 series 300

Line No.	Description
10 to 80	Comment
90 to 110	Definition of variables (to assure arrangement of the maximum number of data items).
130	The Q8344A's GP-IB address (8) is set as a variable.
140	Definition of the processing routine used when an interrupt by SRQ signal occurs.
150	The analyzer is initialized at power on.
160	Spectrum analysis mode is selected.
170	Center wavelength is set to 830nm.
180	Span is set to 20nm.
190	Reference level is set to 0dBm and level scale to 10dB/DIV.
200	Averaging is set to OFF.
210	Only b0 (measure-end) in the status byte is made valid.
220	Mode to transmit SRQ signal is set.
230	Measurement starts.
240	Flag (variable) to indicate the end of measurement is cleared.
250	Interrupt by SRQ signal is allowed.
260	Waiting for end of measurement.
270	Cursor data display mode is set to "2ND PEAK" with cursor set to ON. (When Cursor is ON, the 2ND PEAK calculation is executed.)
280	Output of cursor data is requested.
290	Cursor data is read (λ1, level, $\triangle\lambda$, $\triangle$ level).
300	Spectral width calculation -0(Pk-XdB) is selected and parameter XdB to 3dB.
310	Spectral width is set to ON (calculation is executed).
320	Output of spectral width data is requested.
330	Center wavelength, spectral width and number of peaks data read.
360	<Interrupt processing routine Srq> Serial poling is executed and the status byte read into the variable.
370	Flag to indicate end of measurement is set.
380	Return to main routine.

② Program 5 for PC9800

```
10  '****************************************
20  '    Q8344A Optical Spectrum Analyzer
30  '    == sample program 5 ==
40  '    (set-up measurement condition
50  '     and read 2nd-peak<cursor data>,
60  '     spectral width data )
70  '****************************************
80  '
90  ISET IFC                        ' send 'IFC' signal
100 ISET REN                        ' 'REN' signal set to true
110 CMD DELIM = 0                   ' delimitter CR/LF
120 CMD TIMEOUT = 10                ' timeout set to 10sec
130 DEF SEG = &H60                  ' --
140 A% = PEEK(&H9F3)                '   |
150 A% = A% AND &HBF                '    -- clear SRQ bit of PC9801
160 POKE &H9F3,A%                   ' --
170 SPA = 8                         ' define Q8344A GP-IB address (8)
180 UNL=&H3F : MTA=&H5E : LA=&H20 : SDC=&H4 : GET=&H8
190 WBYTE UNL,MTA,LA+SPA,SDC;       ' initialize Q8344A
200                                 ' UNL,MTA(adr 30),LA of Q8344A,SDC
210 ON SRQ GOSUB *SSRQ              ' define SRQ interrupt routine
220 PRINT @SPA;"COH 0"              ' select 'SPECTRUM' mode
230 PRINT @SPA;"CEN 830nm"          ' 'CENTER' set to 830nm
240 PRINT @SPA;"SPA 20nm"           ' 'SPAN' set to 20nm
250 PRINT @SPA;"REF 0dBm,LEV 0" ' 'REF LEVEL':0dBm,'LEVEL SCALE':10dB/DIV
260 PRINT @SPA;"EAV 0"              ' 'AVERAGE' OFF
270 PRINT @SPA;"MSK 254"            ' enable only 'measurement end' bit
280 PRINT @SPA;"SRQ 1"              ' enable SRQ signal
290 WBYTE UNL,MTA,LA+SPA,GET;       ' start single measurement
300                                 ' UNL,MTA(adr 30),LA of Q8344A,GET
310 M.END = 0                       ' clear measure end flag
320 SRQ ON                          ' enable SRQ interrupt
330 IF M.END=0 THEN 330             ' wait measurement end
340 PRINT @SPA;"DEL 0,MSP 0"        ' terminator NL(EOI)
350                                 ' message separator ';'
360 PRINT @SPA;"CUD 2,CUR 1"        ' select '2nd-peak' and cursor ON
370 PRINT @SPA;"OCD"                ' request cursor data output
380 INPUT @SPA;LM1,LV1,D.LM,D.LV      ' read lambdal,L1,delta-lambda,delta-L
390 PRINT @SPA;"WTY 0,WPX 3"        ' select 'Pk-XdB' and X set to 3dB
400 PRINT @SPA;"SPW 1"              ' spectral width ON(execute calculation)
410 PRINT @SPA;"OSW"                ' request spectral width data output
420 INPUT @SPA;LAMBDA.0,S.WIDTH,N.PEAK  ' read lambda-0,width,no-of-peak
430 STOP
440 '
450 *SSRQ: POLL SPA,S               ' execute serial-poll and read status
460 M.END = 1                       ' set measure end flag
470 RETURN
480 '
490 END
```

- Explanation on program 5 for PC9800

Line No.	Description
10 to 80	Comment
90	"IFC" signal is transmitted.
100	"REN" signal is set to TRUE.
110	Delimiter for command setting is set to CR/LF (= CR/NL).
120	Time out duration at handshake is set at 10 seconds.
130 to 160	The SRQ bit of the PC9800's GP-IB interface is cleared.
170	The Q8344A's GP-IB address (8) is set as a variable.
180 to 200	The analyzer is initialized at power on.
210	Definition of the processing routine used when an interrupt by SRQ signal occurs.
220	Spectrum analysis mode is selected.
230	Center wavelength is set to 830nm.
240	Span is set to 20nm.
250	Reference level is set to 0dBm and the level scale to 10dB/div.
260	Averaging is set to OFF.
270	Only b0 (measure-end) in the status byte is made valid.
280	Mode to transmit SRQ signal is set.
290 to 300	Measurement starts.
310	Flag (variable) to indicate the end of measurement is cleared.
320	Interrupt by SRQ signal is allowed.
330	Waiting for end of measurement.
340 to 350	Terminator is set to CR/NL (EOI) and the data separator to ','.
360	Cursor data display mode is set to "2ND PEAK" with cursor set to ON. (When cursor is ON, 2ND PEAK calculation is executed.)
370	Output of cursor data is requested.
380	Cursor data is read (λ1, level1, $\triangle\lambda$, $\triangle$ level)
390	Spectral width calculation-0 (Pk-XdB) is selected and parameter XdB is set to 3dB.
400	Spectral width is set to ON (calculation is executed).
410	Output of the spectral width data is requested.
420	Center wavelength, spectral width and number of peaks data is read.
450	< Interrupt processing routine *SRQ > Serial poling is executed and the status byte read into the variable.
460	Flag to indicate end of measurement is set.
470	Return to the routine.

7. EXAMPLES OF MEASUREMENT

This chapter describes actual operation procedures using typical measurements of three devices: a laser diode, an LED and an optical filter.

7.1 Measuring Coherence of a Laser Diode

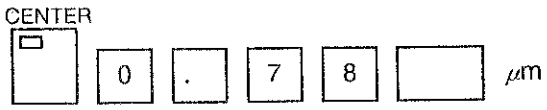
By analyzing the coherence of a laser diode having a center wavelength of 0.78 μm (Fabry-Perot type LD), to measure α (2nd peak distance and level data) and β (intermediate distance between the maximum and 2nd peaks, and level data) and output the results to a plotter.

(1) Turn power on.
After self-diagnosis is executed, the normal measurement screen is displayed.
(The measurement conditions at power off are restored. However, measurement operation remains at stop state.)

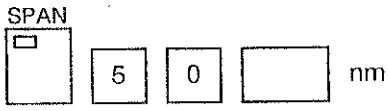
(2) Couple the output light of the laser diode to be measured to the fiber (SMF-10 μm or MMF-50 μm) and connect it to the input connector on the front panel of the analyzer.
(Insert the fiber, aligning it with the connector key position, and screw firmly in place. The fiber should be fixed in the proper position so that it will not vibrate. If the fiber vibrates, measurement data may fluctuate.)

(3) First of all, determine the center wavelength and the optimum reference level in the spectrum analysis mode. Press the corresponding display key.

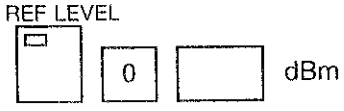
① Set the center wavelength:
(0.78 μm)



② Set the wavelength span:
(50nm)



③ Set the reference level:
(0dBm)



Confirm on the Softkey menu, that the system is set to LASER mode (the characters LASER of LASER/LED are reversed).

④ Execute a single measurement:

⑤ Set the optimum reference level:
[TOTAL PWR]

⑥ Set the peak wavelength as the center wavelength:
CENTER [PEAK]

⑦ Repeat measurement to confirm that the proper wavelength and reference level have been specified:
SINGLE

(4) Select coherence analysis mode and execute measurement.

① Select coherence analysis:
COHERENCE [COHERENCE]

② Set the span: (5.2mm)
SPAN [5.2 mm]

③ Set the Y-axis scale to Linear:
LEVEL SCALE [LIN/LOG]

Press the LIN/LOG so that the characters LIN are reversed.

④ Execute a single measurement:
SINGLE

The values α and β are calculated by the auto search function and displayed at the upper left of the waveform data column along with the coherence data.

(5) Output the measurement data to the plotter.

① Connect the analyzer to a plotter using a GP-IB cable (the AC cable should be disconnected before connecting the GP-IB cable). Set the plotter address to Only mode (LISTEN ONLY).

② Set the GP-IB address of the analyzer to Only mode (TALK ONLY).

LOCAL
ADDRESS [ONLY]

③ Check the plotter interface specification: "GP-GL" (TYPE: AT) or "HP-GL" (TYPE: HPGL), and set the type.

DEVICEL [PLOTTER] [TYPE: AT] or [TYPE:HPGL]

(If required, use the Softkeys to set the plotter size.)

④ Start output to the plotter.

COPY

Note: Unless the plotter address is set to Only mode, "no plotter!!"

7.2 Measuring the Spectral Half-width of an LED

Measure an LED having a center wavelength of 1.31 μm and obtain the spectral half-width. Output the measurement results to the built-in printer (optional).

(1) Turn the power switch of the analyzer on, and connect the light to be measured to a fiber (see section 7.1).

(2) Set the measurement conditions including the center wavelength and span, and execute measurement.

① Set the center wavelength: (1.31 μm)

CENTER [ ] [1] [.] [3] [1] [ ] μm

② Set the wavelength span: (200nm)

SPAN [ ] [2] [0] [0] [ ] nm

③ Set the reference level: (–10dBm)

REF LEVEL [ ] [–] [1] [0] [ ] dBm

④ Set LED mode:
[LASER/LED]

Press [LASER/LED] so that the characters LED are reversed. In this case, REF LEVEL is displayed in XX/nm units.

⑤ Execute a single measurement:

SINGLE [ ]

⑥ Set the optimum reference level:
[TOTAL PWR]

If the LED has a wide spectral width, the peak level will be small and the power level, which is the sum of the entire spectra, will a large.
As the power of the light to be measured is completely absorbed by the analyzer's internal photo sensor, "OVERLOAD" occurs if the reference level is set according to the peak level.

⑦ Set the peak wavelength as the center wavelength:

CENTER [ ] [PEAK]

⑧ Repeat measurement:

SINGLE [ ]

(3) Execute spectral half-width calculation (using XdB attenuation method).

① Execute/display the spectral half-width calculation:

SPECIAL WIDTH
[ ]

When the spectral half-width calculation is executed by the specified calculation method, the center wavelength, spectral half-width and the number of peaks are displayed. The calculation method can be selected using the Softkeys. To use the XdB attenuation method, press [Pk-XdB] (the characters Pk-XdB are reversed).
To change the value of X, the following operation is required.
(Set 3 for XdB)

[parameter] [XdB] [3] [ ]
ENTER

To execute spectral half-width calculation using this modified value, press the SPE. CTRUL WIDTH key.

(4) Output the measurement results to the printer.

① Specify printer as the output device:

DEVICE
[ ] [PRINTER]

② Printer output starts

COPY
[ ]

Printing starts about 1.5 seconds after the key is pressed.

Note: If no paper is set in the printer, "no printer paper!!" appears on the screen. If the printer head is raised, "printer head up!!" appears.

7.3 Measuring the Loss Wavelength Characteristics of an Optical Filter

Measure the loss wavelength characteristics of an optical filter, using a TQ8111 white light source produced by our company. Since the power level per resolution is small in measure loss wavelength characteristics using a white light source, averaging is required. (An example of optical filter measurement is given below. An optical fiber can also be measured using the same panel operation.)

(1) Turn the power switches on the analyzer and the TQ8111 white light source on.
Warm up the devices for about 10 minutes to permit stabilized measurement.

(2) Connect the analyzer to the CH2 white light source using a GI-50 μm fiber (if equipped with 200 μm option-10 input, fiber with a core diameter of up to 200 μm can be connected).
In this example a CH2 white light source is used, and the filter to be measured is placed in its internal chamber.

(3) First, measure the reference data to obtain the loss characteristics (the spectrum of the white light source output to CH2). In this example, the wavelength range is set to 1.0μm to 1.6 μm.

① Set the Start wavelength:
(1.0 μm)

SPAN [ ] [START] [1] [.] [0] [ ] nm

② Set the Stop wavelength:
(1.6 μm)

[STOP] [1] [.] [0] [ ] nm

③ Set the reference level:
(AUTO)

REF LEVEL [ ] [AUTO]

As the measurement sensitivity is required, select the AUTO mode so that the optimum reference level is set for every measurement (when the Softkey [AUTO] Softkey is pressed, the characters AUTO are reversed).

④ Set LED mode:
[LASER/LED]
Since the wavelength range to be analyzed is wide, use LED mode so that the difference in resolution caused by the wavelength can be absorbed.
Press [LASER/LED] so that the characters LED are reversed.
At this time, REF LEVEL is displayed in XX/nm units.

⑤ Set the number of averaging times: (16 times)

AVERAGE [16] [ON/OFF]

Press [ON/OFF] so that the characters ON are reversed.

⑥ Measure the reference data:

SINGLE

The data for the specified number of measurements is measured and averaging executed. While averaging is in progress, "average in progress..." is displayed. The number of measurements X in AVG: X/N which appears at the upper right of the CRT is incremented as measurement proceeds and measurement is completed when X = N.

(4) Save the data obtained in step (3) in the reference memory and select the loss characteristics measurement mode.

① Save the measurement data in the reference memory:

NORMALIZE
LOSS/TRANS
[SAV REF]

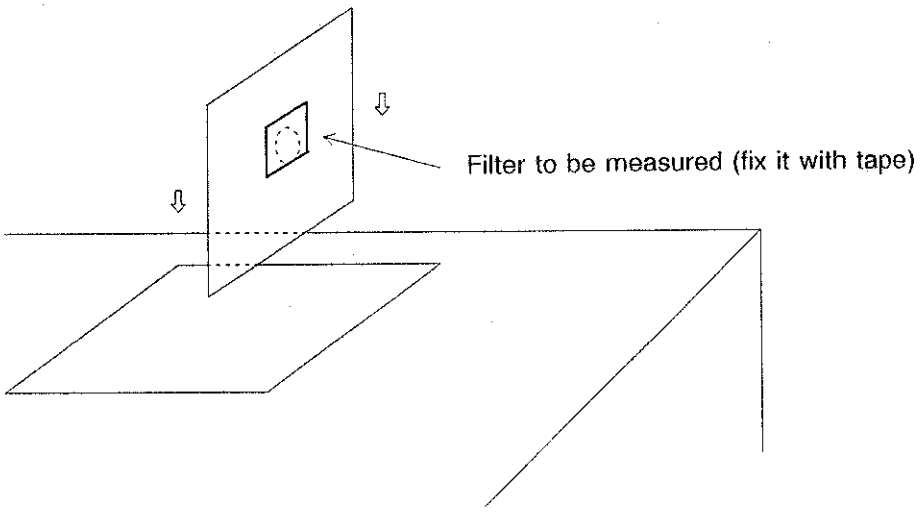
Press the NOMALIZE key to display the Softkey menu required for measuring the loss characteristics.

② Select loss measurement mode:

[LOSS]

When [LOSS] is pressed, the characters LOSS are reversed and the loss measurement mode is set. At this time, the characters "SPEC" indicating the type of analysis data are replaced with "LOSS" at the upper left of the CRT, and the Y-axis display unit is changed from dBm to dB. The data obtained in step (3) disappears from the CRT.

⑤ Insert the filter to be measured in the chamber of the TQ8111 white light source.



(6) The loss wavelength characteristics of the filter can be obtained by measuring the spectrum of the white light source after passing it through the filter.

① Measure the filter transparency data: SINGLE

By dividing (or deleting if LOG scale is used) the measurement data by the data saved in the reference memory in step (4), LOSS data is displayed. If averaging is in progress, the current LOSS data (after averaging the current number of measurements) is displayed until the specified number is reached.

Note 1: If LOSS or TRANS is ON, the REF LEVEL key can be used to raise or lower the display (used to modify the lowest level in case of LOSS and the highest level in case of TRANS (the initial value is 0dB in either case)).

Note 2: In this example, LOSS is obtained by calculation between the reference memory and the measurement data. If the measurement data is saved in measurement data memory 1 (using the [SAV MEAS1] Softkey) with the [MEM NORM] Softkey set to ON, calculation is executed between the reference memory and measurement data memory 1. While MEM NORM mode is ON, the displayed data is not modified by measurement.

8. PRINCIPLE OF OPERATION

This chapter describes the operating principle of the analyzer using its block diagram.

8.1 Explanation of the Operation Principle

A basic illustration of the analyzer is shown in the block diagram in Fig. 8-1.
The analyzer consists of three blocks: interferometer, measurement controller (FFT block) and display processing block.
The operating principle is briefly described below based on the block diagram.

(1) Interferometer (Michelson interferometer)
The measurement light is fed into the collimator through a 50 μm GI fiber (or a 200 μm GI fiber if option-10 is used). The light is modified into parallel beams in the collimator and divided into two parts by the beam splitter: one for the moving mirror and the other for the fixed mirror. Both beams are reflected by the mirrors and returned to the beam splitter for rejoining. When the two beams become one, interference is caused by the difference in their routes.
An interferogram (interference curve) can be obtained by moving the movable mirror continuously to modify the route difference. Since the interferogram is a spectrum of the light which has undergone Fourier conversion (discovered by A. A. Michelson in 1902), it can be obtained by sampling at a definite interval by A/D converter and executing FFT processing.

The Q8344A is equipped with a He-Ne gas laser (having wavelength of 632.991nm) which is passed through the same route as the light source to be measured but through a different optical system so that an interferogram can be obtained. As the He-Ne laser is a single spectrum with significantly high interference, the interferogram obtained accurately indicates the position of the moving mirror (route difference). Consequently, sampling at a definite interval not affected by mirror movement error is possible by multiplying the interferogram by four (or eight) using the PLL circuit and executing clock sampling in the A/D converter. (The PLL circuit is used to satisfy the FFT sampling theory that "sampling frequency should be more than twice of the frequency to be measured"). By using this He-Ne reference light source, measurement with high wavelength accuracy can be executed without calibration.
Although only one measurement light detector is shown in the block diagram, two types of photodiodes are actually used, an Si photodiode for the short wavelength region and an InGaAs photodiode for the long wavelength region, in order to cover a wide wavelength range.
The light accepted by the photodiode undergoes current-voltage conversion before being fed into the A/D converter which has a 16-bit accuracy (polarity + 15bits) and range in 1dB units.

(2) Measurement control block (FFT block)

This block controls the movable mirror drive as well as the range of the measurement system and executes signal processing of the A/D conversion data.

The A/D converter operates in the 100kHz frequency range, and a digital filter is used to improve resolution. The digital filter improves resolution by enlarging a particular frequency region. This zoom processing normally operates in parallel with interferogram sampling. (In the block diagram, transfer of the A/D-converted data to the digital filter and of the digital filter zoom results to the buffer memory are executed at real time, —RUNNING-ZOOM).

The A/D-converted data is always stored in buffer memory 1. The data in memory 1 is used to analyze the measured data under different wavelength conditions, which is referred to as the HOLD-ZOOM function. That is, A/D-converted data is normally fed directly to the digital filter, but in HOLD-ZOOM mode, the previous measurement data is fed from buffer memory 1 to the digital filter of which the center wavelength and multiplication factor have been modified.

Data from the digital filter is stored in buffer memory 2 as a 1024-point complex number. Using DSP (Digital Signal Processor), window processing, FFT processing and power calculation are executed on this 1024-point data to obtain spectrum data.

The data obtained is sent via dual-port memory to the display processing block.

During coherence analysis of the latter half of the 1024-point data, i.e. 513-point data, the squares of the real number and imaginary parts are summed up respectively and normalized with the peak value (data of light route difference 0).

(3) Display processing block

This block is used to control the measurement system based on the conditions set by the panel keys or via the GP-IB interface, and executes measurement data output (display, GP-IB and printer).

Data transfer with the measurement system is executed via the dual-port memory. Measurement conditions including center wavelength, span and reference level are transmitted and the measurement data after FFT processing is received. Sensitivity correction and display scaling are performed on the measurement data and the results displayed.

This block also executes cursor processing and analysis such as spectral half-width and normalization calculation.

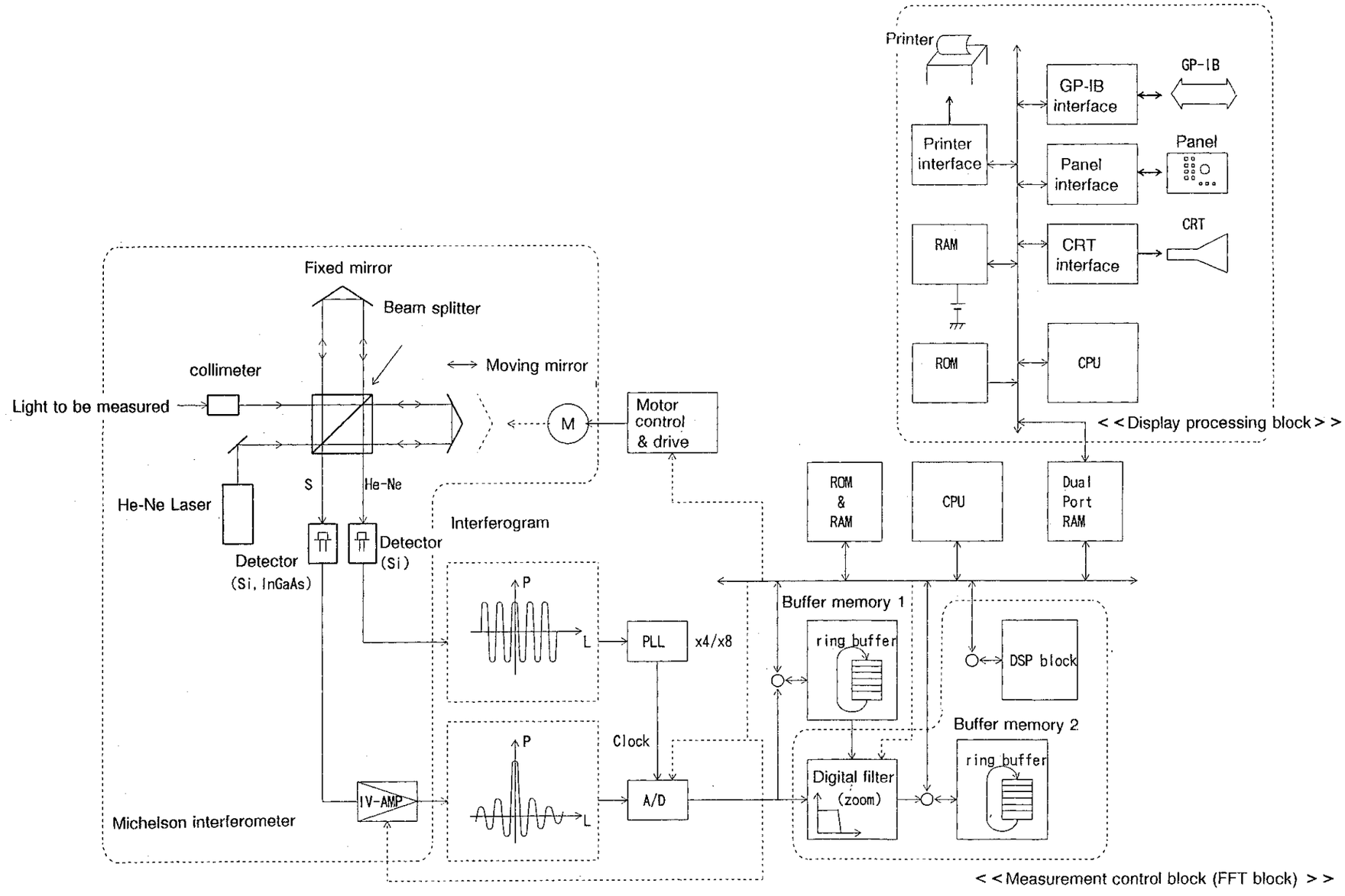


Fig. 8-1 Outline of the internal block diagram

9. PERFORMANCE

Wavelength	Measurement range	0.35 to 1.75 μm
	Maximum resolution (1)	Approx. 0.05nm (@0.85 μm) Approx. 0.1nm (@1.31 μm)
	Accuracy	±0.1nm (value of wavelength in vacuum)
	Sweep width	0.1 to 140nm/div
Level	Measurement range (Input sensitivity)	–70 to +10dBm (0.7 to1.6 μm) –60 to +10dBm (0.45 to 1.7 μm) –45 to +10dBm (0.35 to 1.75 μm) (minimum level is span 50nm, after averaging 16 times)
	Accuracy	±2.0dB or below (at wavelengths of 0.85 μm and 1.31 μm)
	Linearity (2)	±1.0dB/25dB or below ±0.5dB/10dB or below
	Scale	0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/DIV and LINEAR
Processing function	Measurement time (3)	1.5 seconds or less (Single mode, AVG:1, Trigger > until data out)
	Memory function	32 screens (measurement data) with battery backup 10 screens (measurement condition) with battery backup
	Display	Superimpose, dual-screen and 3-dimensional Cursor function
	Calculation/ Analysis	• Coherence analysis (±10.4mm), spectral half-width calculation, automatic peak search, averaging, normalizing (LOSS/TRANS) and automatic optimum measurement condition setting

Notes:

(1) Resolution means the wavelength difference between n data and (n + 1) data.

(2) At 0dBm input or below.

(3) When start wavelength is 0.4 um or below and the measurement is either in short or long wavelength region.

Input/Output	Input connector	FC type(4)
	Data output	GP-IB standard equipment Direct output to the plotter (5) Built-in printer (printing speed 8 seconds or less) [optional]
General specifications	During operation	Temperature +10 °C to +40 °C, relative humidity 85% or below (No condensation allowed)
	During storage	Temperature –10°C to +50 °C, relative humidity 90% or below (No condensation allowed)
	Power source	90 to 132VAC/198 to 250VAC, 48Hz to 66Hz, 180VA or below
	External dimensions	Approx. 424(W) × 221(H) × 500(D) mm
	Weight	Less than 27kg (including optional printer)

Notes:

(4) Consult with our staff for other connectors (SMA(2.5), ST or DIN).

(5) Plotters which can be connected:
R9833 (made by ADVANTEST)
7575A, 7440A, 7470A (made by HP)

- Optional equipment
  Option-01: Built-in printer
  Option-10: 200 μm input
  Option-40: Power source voltage regulator (198 to 250VAC)

APPENDIX 1 EXPLANATION OF TECHNICAL TERMS

Avalanche photodiode

This photodiode uses the avalanche effect and is often used as photo sensor in optical fiber communications. When a p-n junction semiconductor is subject to high reverse-bias voltage (100 to 200V), slight carrier shift occurs, generating carriers one after another. As a result, the current increases with increasing speed. This is known as the avalanche effect.

Dark current

Output current of a photo sensor when no light is present.

Automatic power control (APC)

Current feeding in such a that optical output is kept at a definite level.
When a laser diode is driven by a constant current, its optical output decreases or oscillation stops as the temperature increases and optical output increases as the temperature decreases. If the temperature decreases significantly, the optical output may exceed the maximum nominal value. In order to protect the laser diode and obtain stable optical output, an APC circuit is provided so that the laser diode monitoring light is received by the photodiode and fed back to the drive circuit.

Visible light

Light which can be seen by the human eye. Wavelength of 380 to 780nm.

Fundamental mode

0-order distribution in an electromagnetic field. Also known as single lateral mode.

Core and cladding

Optical fiber consists of core and cladding. As the refractive index of the cladding is lower than that of the core, light entering the core propagates within the core repeating total reflection at the boundary between the core and the cladding.
"50/125" means that the core diameter is 50 μm and the cladding diameter is 125 μm.

Luminous flux

$$F = Km \int_{380}^{780} V(\lambda)\, d\lambda$$

Unit: lm (lumen)
Km: Maximum visibility 680lm/W
V (λ): Standard relative visibility
Value decided by CIE
λ = 1.0004 at = 555nm (yellow-green)
P (λ): Spectral distribution

luminous intensity

$$i = \frac{dF}{d\omega}$$

Unit: Cd (candela)

F : Luminous flux ω: Solid angle

When expressed in units of energy, it is known as radiant intensity.

Coherence

1. Opposite of random, and a temporary relationship between two or more waves.
2. If the wavelength, phase and wavefront are homogeneous, the light is assumed to be coherence. There are two types of coherence: temporal coherence and spatial coherence. Temporal coherence means that the wavelength is identical and the phase is continuous, while spatial coherence means that the light can be focused to one point through a lens. Light with interference ability, having an identical wavelength and a phase at a definite relationship, such as laser, is called coherence.

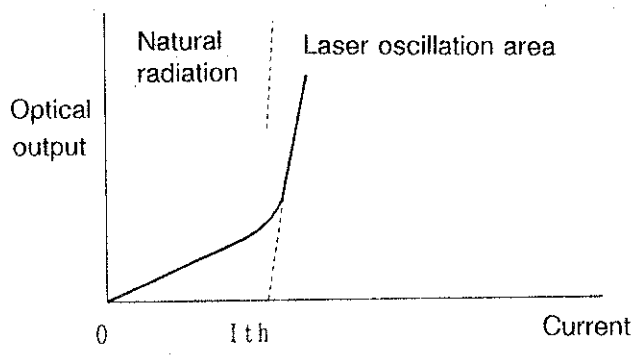
Coherent

Light having an frequency, phase and wavefront is called coherent.

The light of a laser diode used in optical communication has significantly high coherence, although not perfect.

Threshold current

Minimum current required for laser oscillation. As the area where natural radiation changes into laser oscillation cannot be determined strictly, the point where the optical output zero line intersects the extension of the current-optical output characteristics at the time of laser oscillation is normally used as the threshold.



Responsibility

Current which can be taken out when a unit of radiation flux has entered the light sensor.

$$R = \frac{I}{P} = 0.806 \times \eta \times \lambda \times M(A/W)$$

η: Quantum efficiency, λ: Wavelegnth, M: Reproduction factor

Light sensor

A photodiode applying optical electromotive force or optical conductivity used in the optical fiber communications. Two types of photodiode are used: p-n junction and pin types. The photodiode that makes use of the avalanche effect caused when reverse- bias voltage is applied is called avalanche photodiode. In addition to these diodes which are mainly used in measuring instruments, thermopiles, which are not wavelength-dependent, are used as detectors in reference power meters.

Spectrum

Light is usually composed of sinusoidal waves. The wavelength axis components are called the spectrum. A white light source has a flat spectrum while that of a laser diode is concentrated in a narrow range.

Spectral width and full width at half maximum, $\triangle\lambda$

In light emitting elements, the interval between two wavelengths where the energy concentration of the light emitting spectrum is 1/2 the maximum value.

Short wavelength region

The light wavelength used in optical fiber communications ranges from approximately 0.8 to 1.5 μm which is in the vicinity of infrared rays.
Light around 0.8 μm is called the short wavelength region, developed earlier than the other region for use in optical fiber communications.

Long wavelength region

In optical fiber communications, the region from approximately 1.0μm to 1.5 μm is referred to as long wavelength region. It is used for long-distance communication because the transfer loss of the optical fiber is low.

Direct modulation

The modulation signal is used as the drive current to illuminate the light source. The method by which a light modulator is used is known as external modulation.

Wavelength

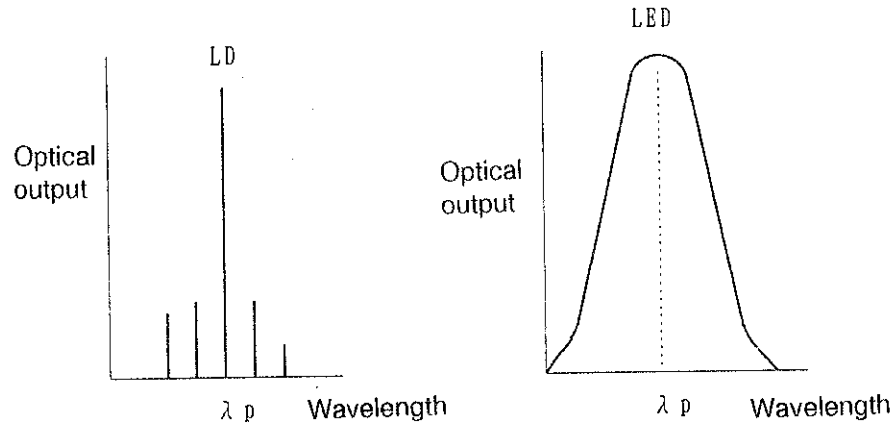
A wavelength of which the force distribution of the light emitting spectrum is located at the center.

Light emitting diode (LED)

A semiconductor emitting element. As with a laser diode, the light used is emitted when the carrier fed into the p-n junction boundary of the semiconductor is reconnected. LEDs emit light as natural radiation, while laser diodes emit light as induced radiation. The LED is known for its long life, high stability, cheapness and good linearity. Since the power input to the fiber is small and it cannot be modulated at high speed, the LED is an ideal light emitting element for comparatively short-distance, small-capacity or analog systems.

Emission peak wavelength

The wavelength where the energy concentration of the light emitting spectrum is maximum.



Optical output

Optical power output from a specific optical fiber.

Optical fiber

Optical waveguide consisting of internal material having a high refractive index and external material having a low refractive index so that light passes through the fiber even when it is bent. A fiber having a diameter of about 0.12mm consists of core and cladding, both made of quartz glass but having different refractive indexes. It is characterized by a wide bandwidth, low loss and no induction.

Optical fiber connector

Removable connector used to connect an optical fiber to another optical fiber or device. Normally, the end of one fiber is brought into direct contact with the end of the other via the connector with strict centering. Unlike an electrical connector, the mechanical accuracy of an optical fiber connector needs to be very high, a connection loss 0.5 1dB attained, and care taken to keep the end of the connector clean.

Output power from fiber-end

Optical output at the fiber-end of the light emitting element attached to the fiber. Optical output from the light emitting element itself deteriorates due to loss at the fiber connection so that fiber transfer loss be comes the output power.

Multi-mode fiber

Optical fiber with multiple waveguide modes in which multiple modes of light (light at various angles to the center axis of the optical fiber) propagate through the core simultaneously. The difference in core refractive index distribution is used to distinguish step, graded and other types fibers. They all having a large core diameter (50 100 m) and can be connected easily compared with single mode fiber. However, as different modes propagate at different speeds, the transfer region is comparatively narrow (mode dispersion).

Monitor output

Light emitted from the rear surface of a laser diodechip.

Monitor current

When the light emitted from the rear surface of a laser diode chip is received by a built-in monitor diode. The output of this diode is called monitor current.

Quantum efficiency

1) Light emitting element (light emitting diode or laser diode)
   The ratio of the number of carriers caused by current application to the photons generated (internal quantum efficiency) or photons radiated outside (external quantum efficiency).
   Quantum efficiency is expressed:

$$\eta = \frac{q\lambda}{hc} \cdot \frac{P}{I} = \frac{\lambda}{1.24} \cdot \frac{P}{I}$$

   h: Plank constant, c: Light speed in vacuum,
   q: Electron charge, λ: Wavelength (μm), P: Optical output, I: Current
   Note: In the case of a laser diode, differential quantum efficiency is also used.

2) Light sensor (PIN photodiode APD)
   The ratio of the photons received to the number of carriers generated.
   In this case, quantum efficiency η' is expressed:

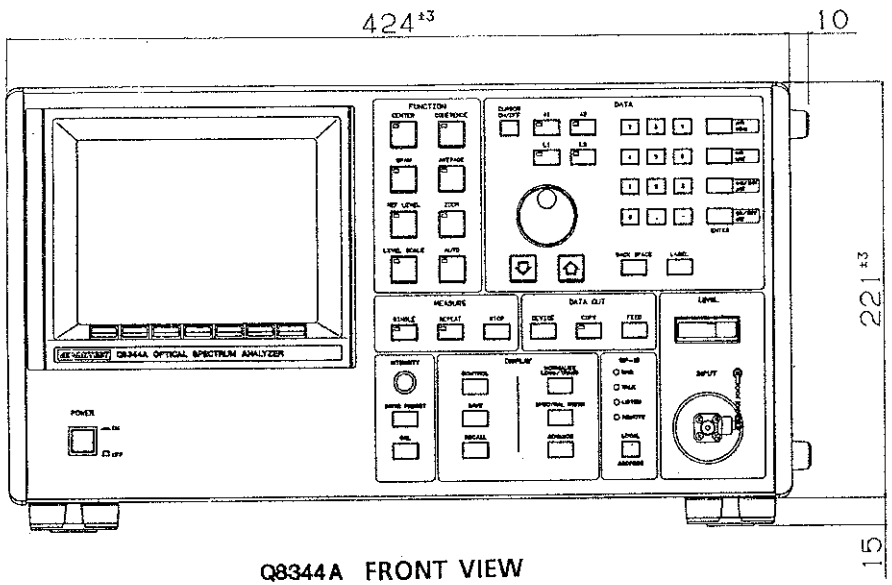
$$\eta' = \frac{hC}{q\lambda} \cdot \frac{I}{P} = \frac{1.24}{\lambda} \cdot \frac{I}{P}$$

   The quantum efficiency of an avalanche diode is expressed by a reproduction factor of 1.

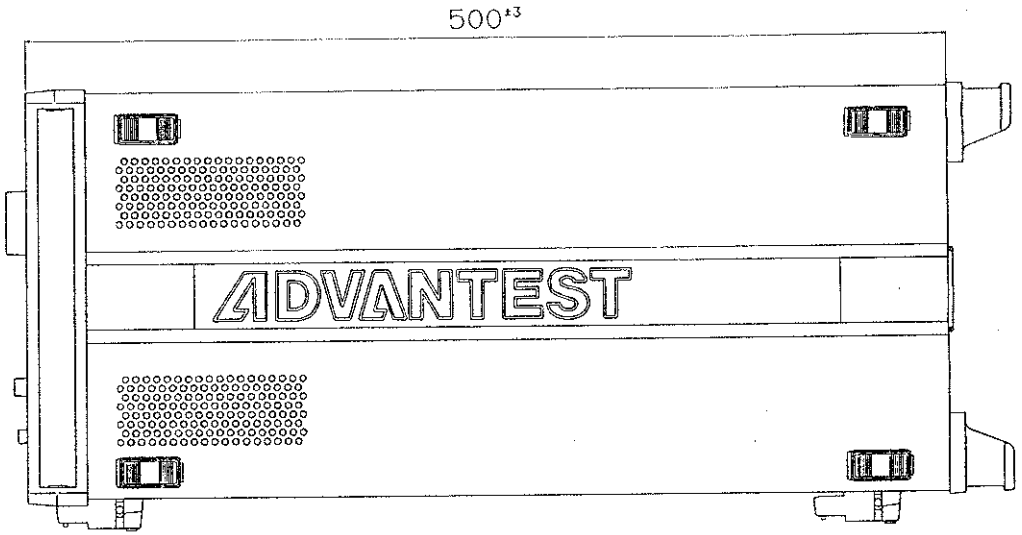
Laser diode (LD)

A semiconductor light emitting element.
Laser stands for Light Amplification by Simulated Emission of Radiation.
An oscillator applying this principle is called a laser diode.
A laser diode has a high optical output, is capable of being directly modulated at high speed, and shows high fiber connection efficiency. LEDs are mainly used, however, because of their light emission stability. This problem has now been solved, permitting laser diodes to be used as long-distance, high-speed light emission sources.

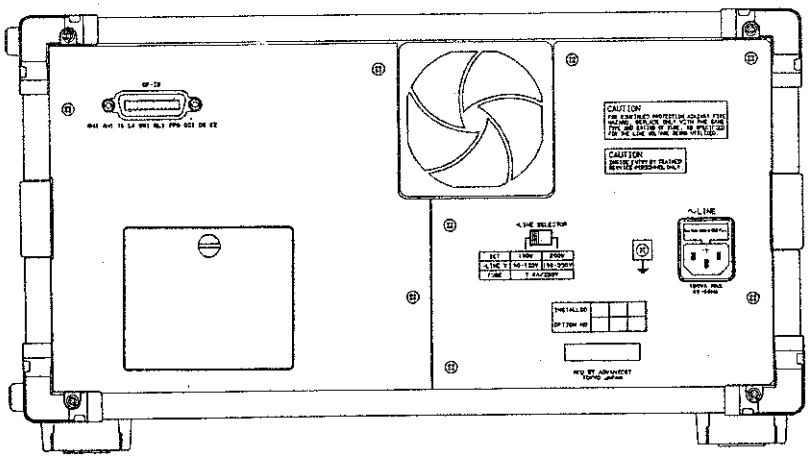
ALPAHBETICAL INDEX



Q8344A FRONT VIEW



Q8344A SIDE VIEW



Q8344A REAR VIEW

Unit; mm

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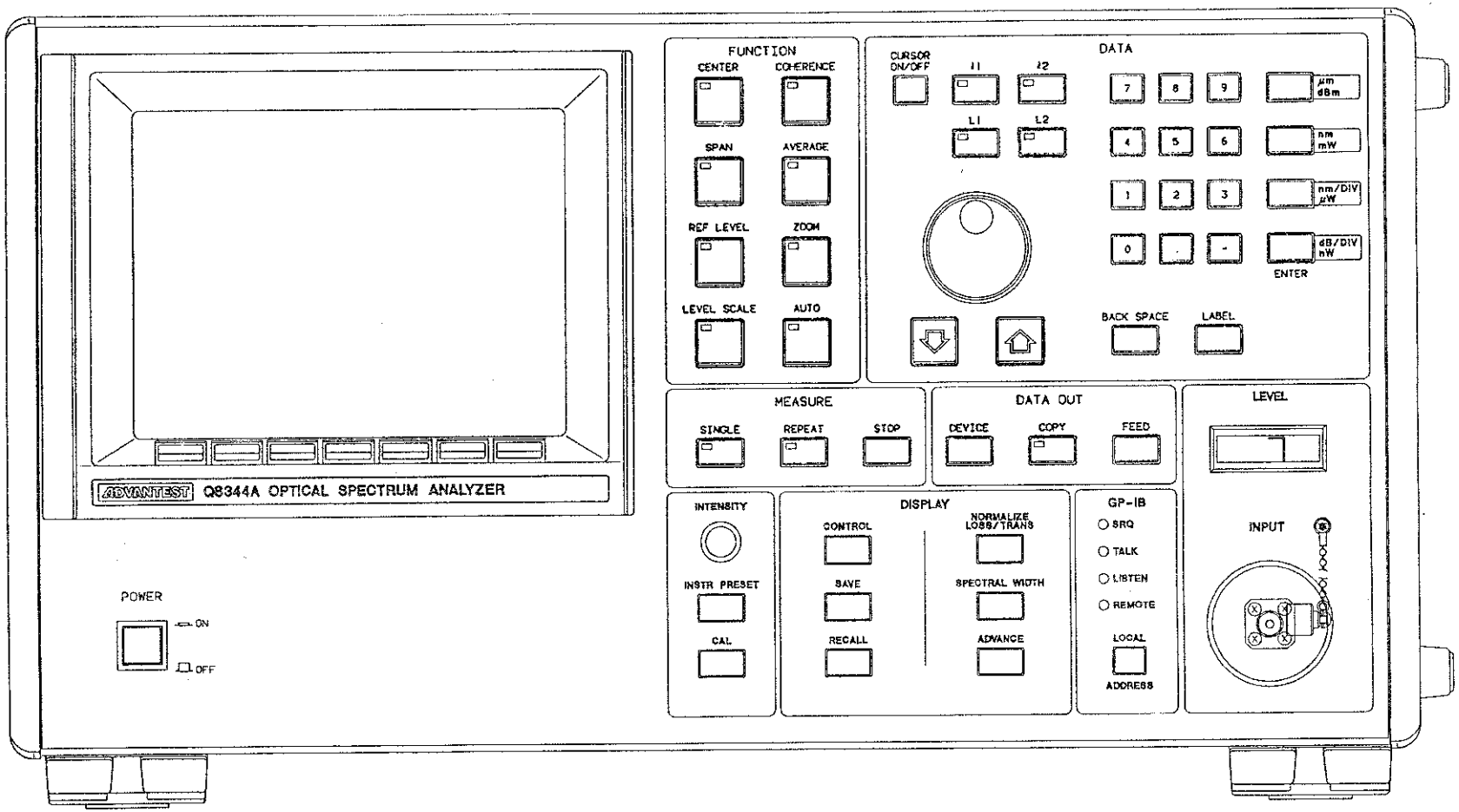
Q8344A
EXTERNAL VIEW



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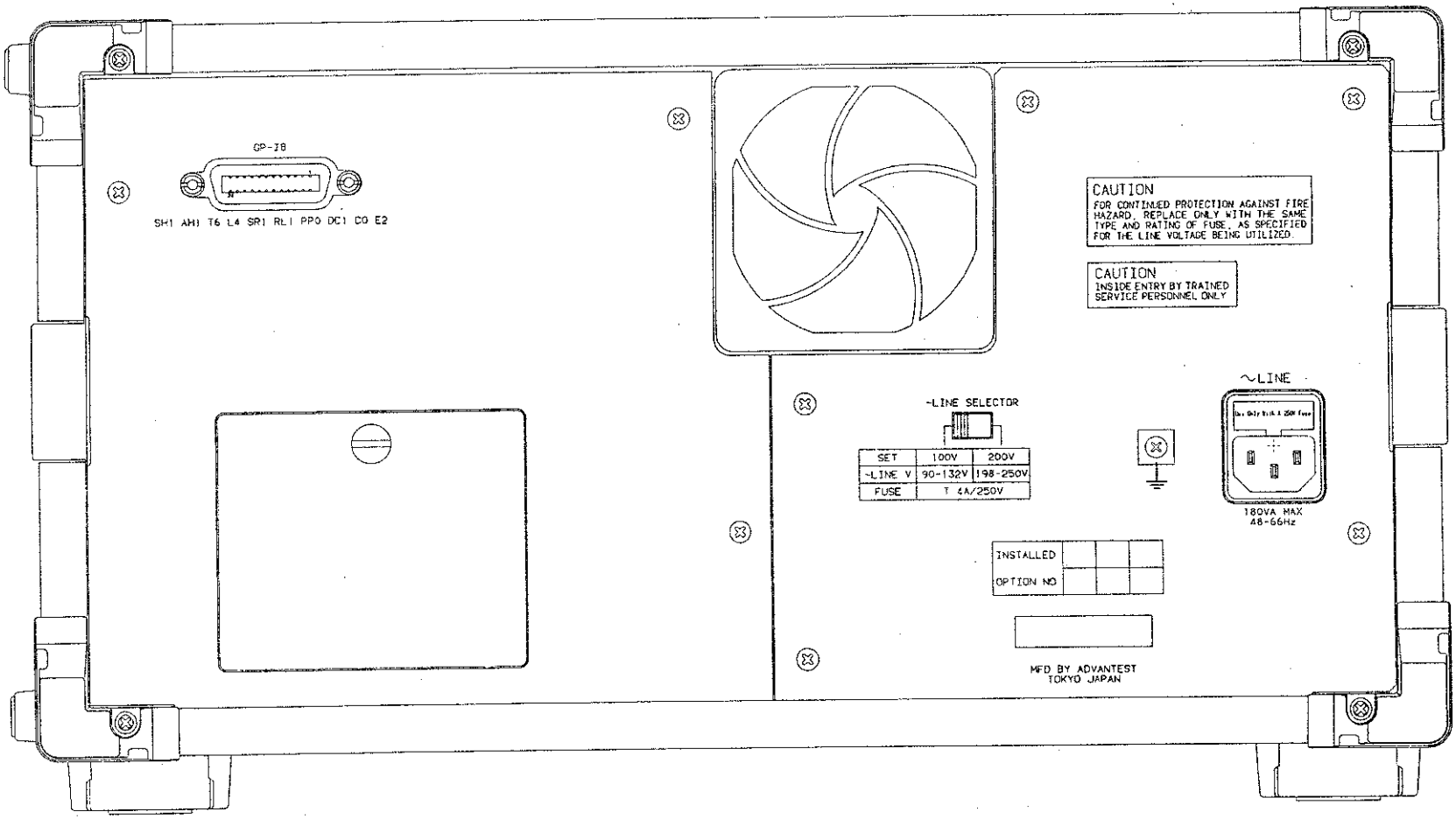
Q8344A

FRONT VIEW



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Q8344A
REAR VIEW

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2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

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   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

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   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

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Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

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