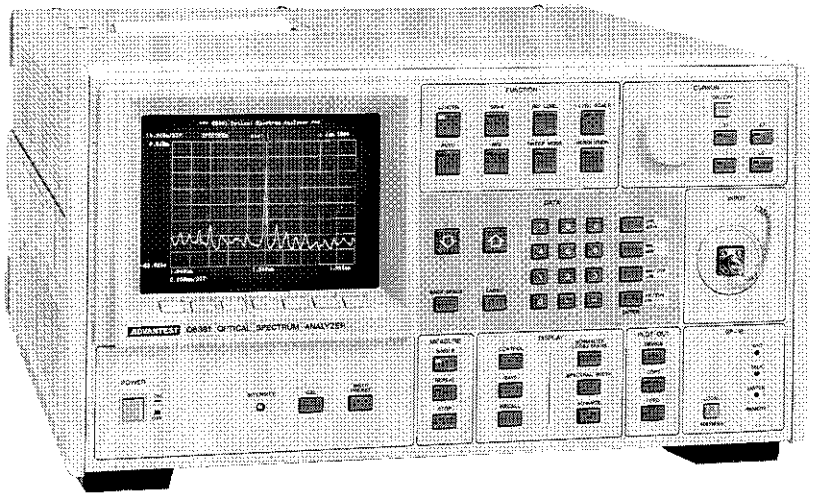
ADVANTEST®
ADVANTEST CORPORATION

INSTRUCTION MANUAL

Q8381/8382

OPTICAL SPECTRUM ANALYZER

MANUAL NUMBER OEG00 9103



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No. ESA001

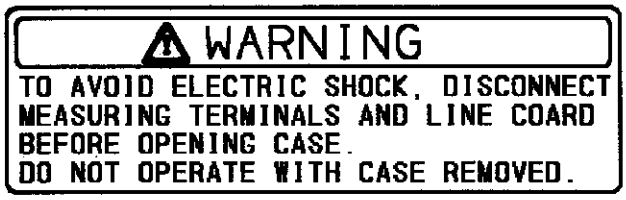
Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this equipment, please read the Instruction 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 equipment.

Careful attention to personal safety should be paid when operating and servicing this equipment. Please be sure to always use this equipment correctly and safely.

■Warning Labels

Warning labels such as shown below 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.



■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. Do not place anything heavy on top of the power cable.

●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 equipment.

●Be sure to plug the power cable into an electrical outlet which has a safety ground terminal. Grounding will be defeated if you use an extension cord which does not include a safety ground terminal.

●Be sure to use fuses rated for the voltage in question.

●Do not use this equipment with the case open.

●Do not place any heavy objects on top of this equipment. Also, do not place flower pots or other containers containing liquid such as chemicals on top of or near this equipment.

●Do not stick or drop metal or easily flammable objects into the ventilation outlets of this equipment.

●In the case of products which emit laser light, do not look directly at the output connector edge or the connected fiber output edge.

■Caution Symbols Used Within the Instruction Manual

Symbols indicating items requiring caution which are used in this instruction 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 equipment or relating to a restriction on operation

■Safety Marks on the Product

The following safety marks can be found on Advantest products.

 : Indicates that care in handling is required. A reference to the appropriate pages in the instruction manual is given to protect yourself and the product.

 : Represents a ground symbol. This indicates field wiring terminals which must be grounded before using the equipment to prevent electric shock.

 : Indicates dangerous high voltage. This is placed at locations where 1000 volts or more is input or output.

 : Indicates a frame (or case) terminal. This is placed on terminals connected to the outside frame (or case) of the product.

 : Indicates alternating current (current or voltage).

 : Indicates direct current (current or voltage).

 : Indicates alternating current (current or voltage) and direct current (current or voltage).

■Precautions when Disposing of this Equipment

Be aware of the following harmful substances when disposing of this product and be sure they are disposed of properly. If you have questions on how to dispose of this product, please contact your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

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).

■Replacement Parts

Some parts used in this equipment are expected to wear out over time due to friction or other causes. Please replace these parts periodically to ensure a set level of performance. If you have questions about replacement parts, please ask your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

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1. INTRODUCTION

This chapter explains how to use this manual, and outlines the product, notes on using the optical spectrum analyzer, and procedures for setting up and preparing for measurement. Read this manual before starting measurement.

1.1 How to Use this Manual

If this is your first time to use an optical spectrum analyzer, read this manual from the beginning. Look up any unfamiliar term in A.1 Description of Terms.

If you have experience in operating optical spectrum analyzers or have a through knowledge of them, look up any matter you wish to find out about through the table of contents.

CHPATER 1 INTRODUCTION	:	Read this chapter before starting measurement. This chapter describes notes on using the optical spectrum analyzer, and procedures for setting up and preparing for measurement.
CHAPTER 2 EXPLANATION OF PRODUCT PANEL FACE	:	This chapter names each part on the panel and briefly describes its function.
CHAPTER 3 FOR FIRST-TIME USERS	:	This chapter describes operations from preparing for measurement to starting measurement using simple examples of measurement, so that first-time users of this spectrum analyzer can get used to it quickly.
CHAPTER 4 OPERATION METHOD	:	This chapter describes how to perform measurement, and includes a functional description of this optical spectrum analyzer, to provide high-level measurement.
CHAPTER 5 FUNCTIONAL DESCRIPTION	:	This chapter describes softkeys and the corresponding softkey menu.
CHAPTER 6 GP-IB INTERFACE	:	This chapter describes command names used (names for programming each key), arrangements, reference programs, etc.
CHAPTER 7 PERFORMANCE	:	Check specifications of this optical spectrum analyzer as needed.
APPENDIX DESCRIPTION OF TERMS	:	Refer to the description of terms as needed.

APPEARANCE	: Drawings showing the dimensions are provided for the front, rear, and rear panel, and enlarged drawings are included also.

1.2 Overview of Products

This optical spectrum analyzer employs a grating spectral system.
Q8382 is composed of Q8381 and Q83811 preselector.
Features of this optical spectrum analyzer are as follows:

(1) Features

① Wide Dynamic Range

- Ideal for spectrum analysis such as DFB laser diode.

The grating spectral system permits 50dB of wide dynamic range to be obtained at a location of 5mm from the peak wavelength, and 40dB at 1nm.

When the Q83811 optical preselector is used, a dynamic range of 60dB at 1nm away from a peak wavelength and 50dB at 0.5nm can be obtained.

② High Speed Measurement

The high grating drive system and high speed processing system provides measurement time of 1 or less seconds at 50nm span LOG indication.

③ One-Touch Measurement of Spectrum Pulse Duration for three Types of Definitions

This optical spectrum analyzer permits one-touch measurement of pulse duration with reference to three types of definition: XdB, RMS, and ENVELOPE methods.

④ Automatic Setting Function for Simplified Operation

The automatic function is provided for setting the wavelength and level to optimum values corresponding to input signals.

⑤ Automatic Peak Search Function

The measurement spectrum peak is detected automatically, and its wavelength and level are always displayed.

⑥ Cursor Function for Easy-to-Read Screen Data

This function allows two cursors to be used, for the wavelength axis and level axis, and not only simple wavelength and level of screen data but also difference in wavelength and level can be read easily.

⑦ Built-In High Speed Printer

The built-in high speed thermal printer, with printing speed of ten seconds or less, permits measurement data to be recorded.

⑧ GP-IB Supplied as Standard Device

This optical spectrum analyzer is equipped with a fully remote GP-IB, so it is ideal as an automatic measurement system component.

Measurement data can be output directly to the plotter by using this GP-IB.

1.3 Before Use

Upon delivery of this optical spectrum analyzer, check its appearance for scratches and other damage caused during transportation. Check the standard accessories for quantity and standard according to Table 1-1.

If there is any damage or missing accessory, contact your nearest office or dealer.

Addresses and telephone numbers of our offices are listed at the end of this manual.

1.3.1 Appearance and Accessory Check

Table 1 - 1 Q8381 Standard Accessories

[Q8381]

Name	Standard	Part code	Quantity	Remarks
Power cable	A01402	-	1	With two-pin adapter
Power fuse	EAWK4A	DFT-AA4A	2	90VAC to 250VAC
Printing paper	A09075		1	114mm wide thermal paper
Instruction manual	-	J8381	1	Japanese
	-	E8381		English

[Q83811]

Name	Standard	Part code	Quantity	Remarks
GI fiber cable 50/125μm	-	DCB-HH2586x01	1	(30cm)
Interface cable	-	DCB-2245x02	1	(50cm)
Power supply cable	-	DCB-SS3330x01	1	(50cm)

Use the part code (standard) when you order additional accessories.

1.3.2 Environmental Conditions and Precautions

(1) Do not use the optical spectrum analyzer in locations subject to dust, direct sunlight, and corrosive gas.

(2) This optical spectrum analyzer has built-in cooling fans to prevent the internal temperature rising. Pay attention to ventilation around this analyzer. Do not allow the rear of the analyzer to be obstructed. Do not use it standing sideways.

(3) This optical spectrum analyzer incorporates precision mechanical parts, so do not use this analyzer at places where:

① Vibration is strong, or
② This analyzer may fall down.

(4) Connect the GND terminal on the rear panel to the external ground to prevent electric shock.

(5) Do not connect the power cable to the AC line when the POWER switch is set to ON.

(6) Check that the source voltage is within the range specified on the rear panel.

(7) Use this optical spectrum analyzer in a horizontal position. The internal structure is designed so that accurate values are obtained only when it is used horizontally.

(8) Do not connect an optical fiber equipped with an off-specification connector to the input terminal. Connecting a bare fiber to this optical spectrum analyzer may cause damage to the optical system.

1.3.3 Power Supply and Fuses

(1) Power Cable

CAUTION

When the attached adapter is used together with the power plug, keep the ground wire of the adapter out of touch with the AC line.

If they touch, not only this analyzer but also other devices can be damaged.

The power cable plug has three pins; the middle round pin is used for grounding. When it is inserted in the 3-pole outlet, the middle pin is grounded.

When the power plug is inserted in the outlet together with the adapter, either the ground wire ((a) in Figure 1-1 of the adapter or the GND terminal on the rear panel must be connected to the external ground.

The attached adapter (A09034) conforms with the Electrical Equipment Regulations.

The widths of two blades A and B of the adapter (A09034) are different. Inset the adapter in the outlet in the correct direction.

If the adapter (A09034) cannot be inserted in the outlet, purchase the optionally available adapter (KPR-13).

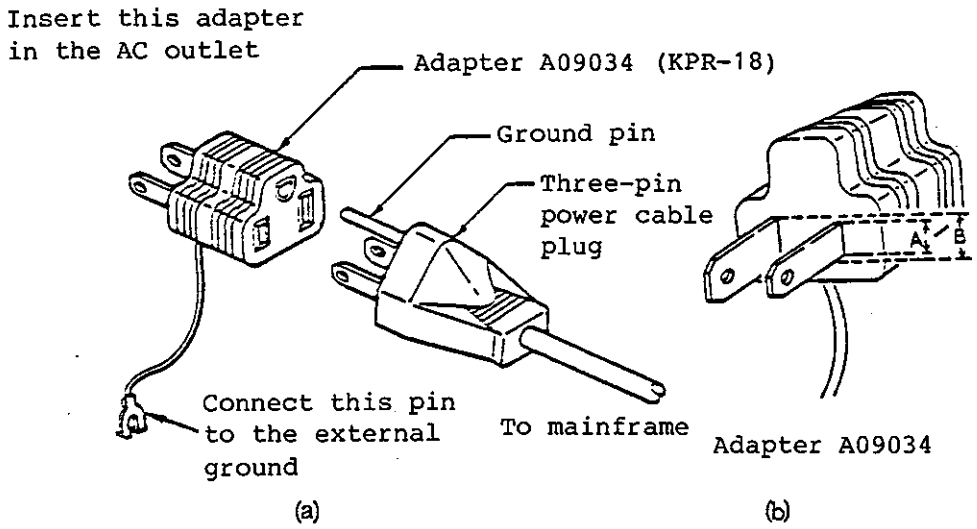


Figure 1 - 1 Power Cable Plug and Adapter

(2) Power Supply

Before connecting the power cable to the AC line, check that the POWER switch is set to the OFF position (the switch is released).

This optical spectrum analyzer works within the range from 90VAC to 250VAC without switching the voltage.

(3) Fuse

To replace a fuse:

① Disconnect the power cable plug from the outlet,
② Remove the fuse holder cap on the rear panel,
③ Confirm that the fuse is blown, then replace it with a new one.

Power Voltage and Fuse Standard

Power voltage	Fuse standard (part code)	Rated current
AC90V to AC250V	EAWK4A (DFT-AA4A)	4A

1.3.4 CRT Display

The brightness adjustment knob for the CRT display is on the lower left side of the front panel. Adjust it to the ambient brightness.

1.3.5 Destruction of Circuit Element by Power Supply Line CMV Loop

This optional spectrum analyzer can be used together with peripheral devices such as desk top computer and plotter. When connecting peripheral devices, pay attention to the common mode noise voltage (CMV) which can cause the wrong grounding for the source power.

If the power supply line is not grounded, a voltage (CMV) of approximately 50VAC is generated between terminals a1 and a2 and between b1 and b2 by the loop shown in Figure 1-2.

If the a1-a2 circuit is closed with the b1-b2 circuit open, the input/output circuit elements or circuits 1 and 2 may be broken or deteriorated. To prevent this, the power supply line must be grounded without fail. If the power cable plug is pulled out or inserted into the outlet instead of operating the POWER switch, the similar CMV may be generated instantaneously. Use the POWER switch.

If it is unavoidable to use an ungrounded power line, insert the power plug and set the POWER switch to ON after connecting ground terminals GND1 and GND2 and signal cables.

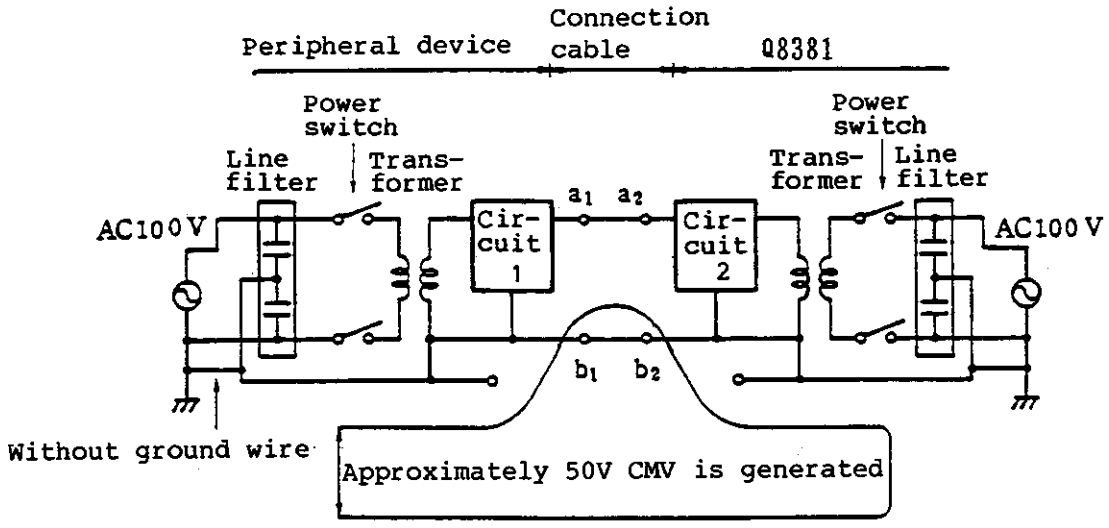


Figure 1 - 2 Power Line CMV Generation Loop

1.3.6 Self-Diagnostic Function

When the optical spectrum analyzer is powered, all key lamps on the panel are lit and the self-diagnostic function is executed automatically. If the results of self-diagnosis are acceptable, an electronic sound is issued for about 15 seconds to indicate that the analyzer is usable.

This optical spectrum analyzer has a built-in Ni-Cd battery to hold the conditions set before it is turned off.

The Ni-Cd battery is automatically charged when the optical spectrum analyzer is powered up. If it is fully charged, it can retain the panel information for about one month. If the optical spectrum analyzer is not used for more than one month, the setting conditions and measurement data may disappear, so care must be taken.

The message shown below is displayed on the screen during self-diagnosis. If self-diagnosis is completed without any error, the screen is set in the ordinary measurement mode.

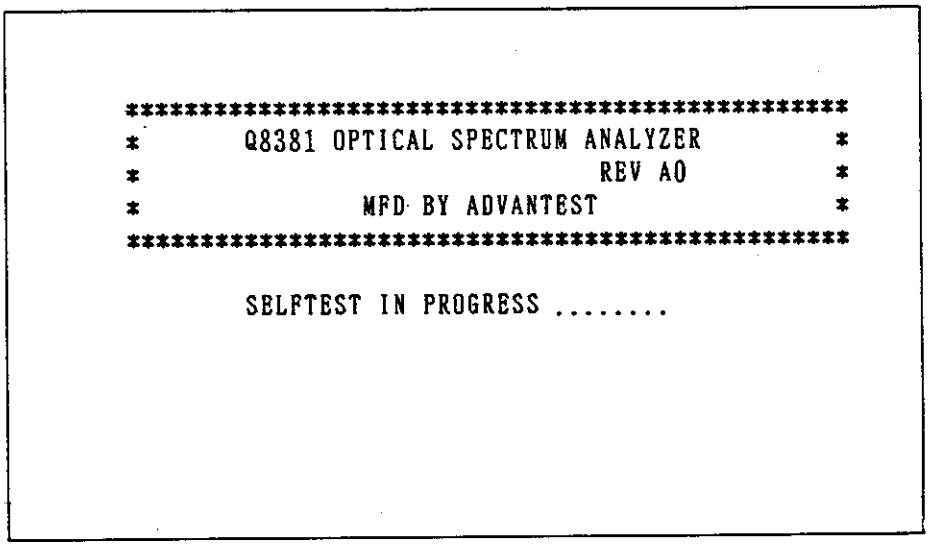


Figure 1 - 3 CRT during Self-Diagnosis

If any error is detected during self-diagnosis, a corresponding message is displayed on the screen.

In this case, contact the ADVANTEST CE Center (in Yokohama CE Center), your nearest office or dealer.

Addresses and telephone numbers of our offices, dealers and CE Center are listed at the end of this manual.

1.3.7 How to Set the Initial State

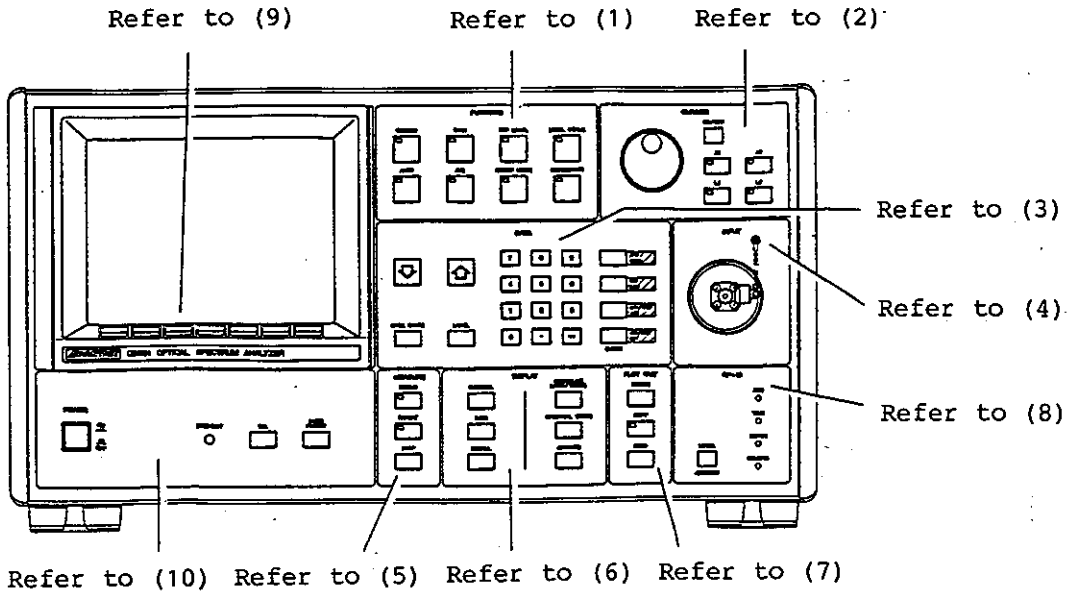
This optical spectrum analyzer stores setting conditions immediately before the power is turned off. Setting conditions set before the power is turned off resume when the power is turned on.

Press the INSTR PRESET key on the panel to clear the current setting conditions and initialize the optical spectrum analyzer.

2. DESCRIPTION OF PRODUCT PANEL FACE

This chapter names each part on the panel of the optical spectrum analyzer and briefly describes its function.

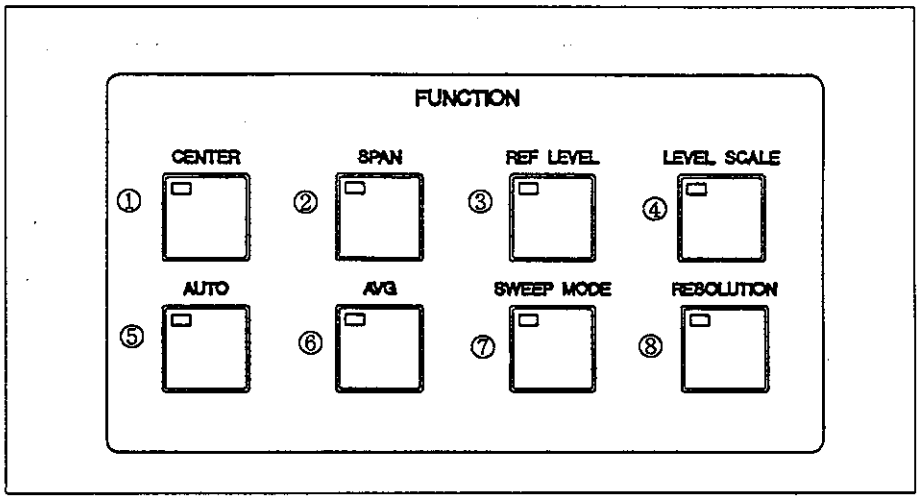
2.1 Description of Front Panel



Each part and its function are described in order of the above numbers (1) to (10).

(1) FUNCTION Section

This section is used to set basic measurement conditions of this optical spectrum analyzer.



① CENTER key : Sets the analysis center wavelength.

② SPAN key : Sets the analysis wavelength span, START and STOP wavelengths.

③ REF LEVEL key : Sets the input sensitivity.

④ LEVEL SCALE : Vertical axis scale

⑤ AUTO key : Sets the wavelength range and sensitivity automatically.

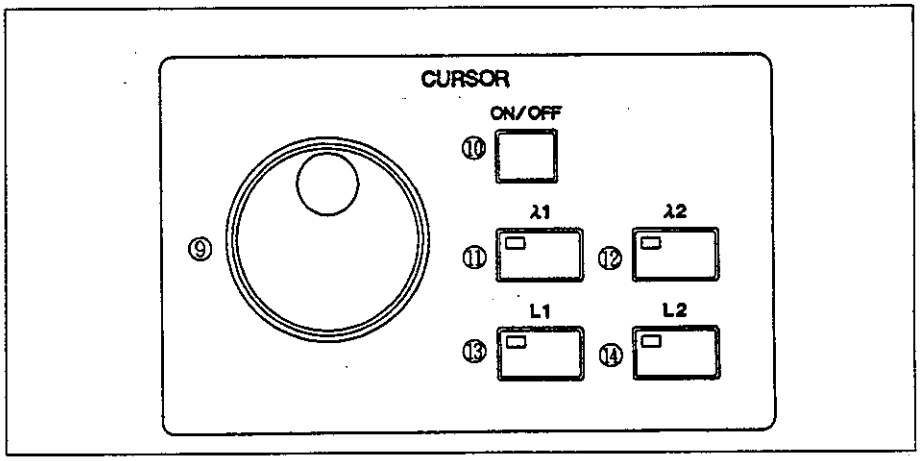
⑥ AVG key : Sets the number of averaging.

⑦ SWEEP MODE key: Sets the sweep mode.

⑧ RESOLUTION key: Sets the wavlength resolution.

(2) CURSOR Section

This section performs the cursor control on the screen.



⑨ Knob : Moves the cursors. Allows set data to change continuously.

⑩ ON/OFF key : Performs ON/OFF control of the cursor display.

⑪ λ1 : Displays or erases the wavelength cursor 1.

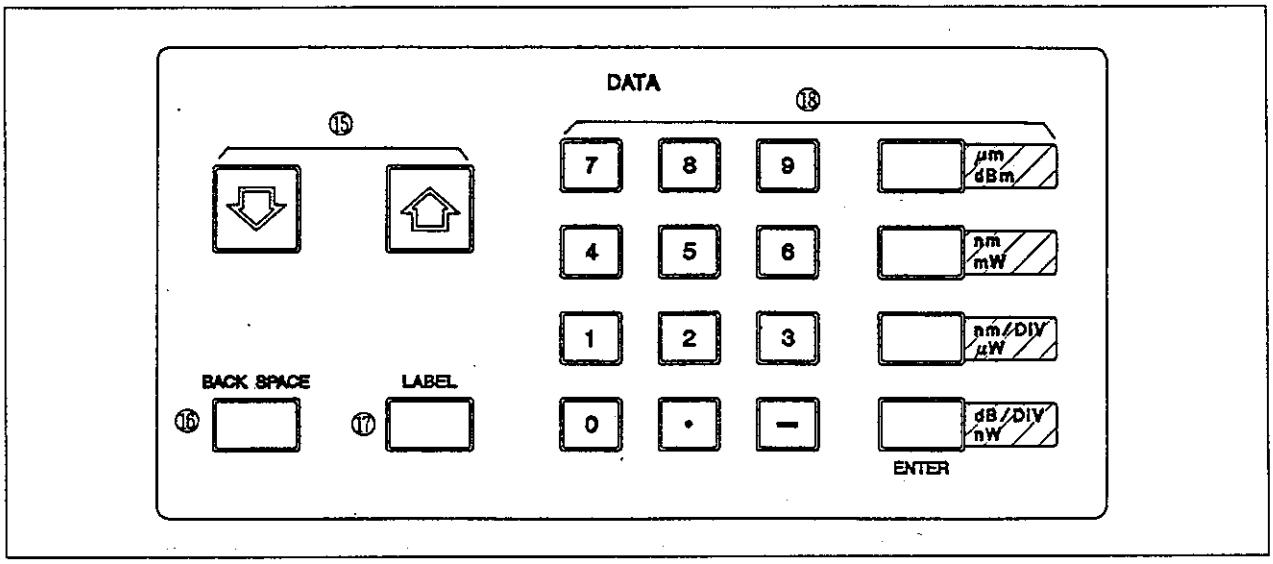
⑫ λ2 : Displays or erases the wavelength cursor 2.

⑬ L1 : Displays or erases the level cursor 1.

⑭ L2 : Displays or erases the level cursor 2.

(3) DATA Section

This section is used to change setting values.



⑮ Arrow key : Moves the cursor. Permits setting data to change in steps.

⑯ BACK SPACE key: Deletes input data.

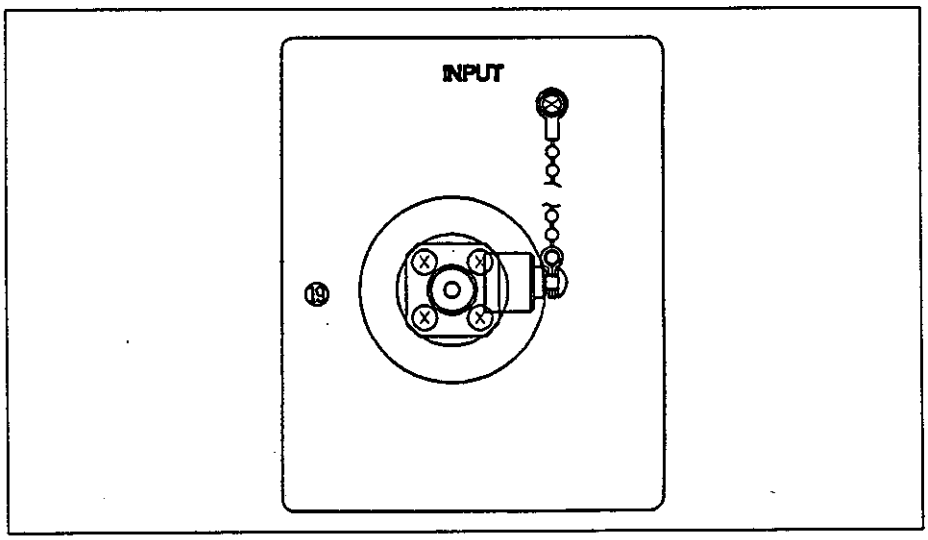
⑰ LABEL key : Sets the label data.

⑱ Numeric and unit keys
: Numeric keys for setting values. Sets the unit (input terminator).

ENTER key : Setting terminator other than four unit keys

(4) INPUT

This is the input part for optical signals.



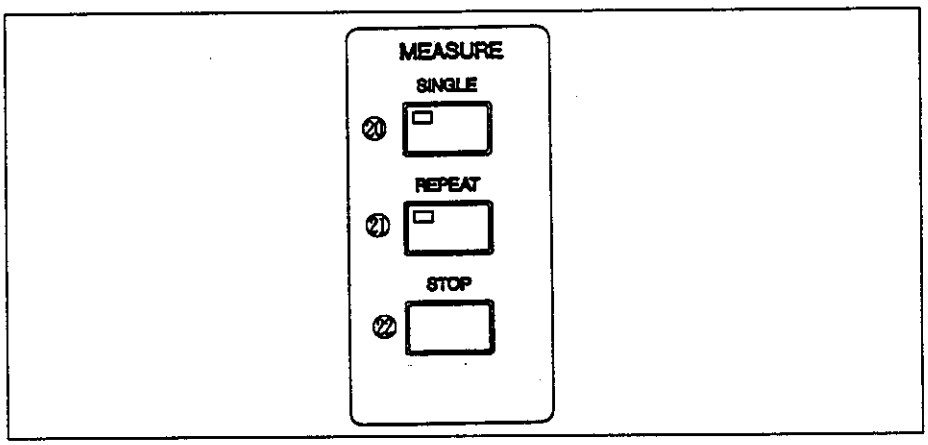
⑲ INPUT terminal: Input terminal for optical signals

CAUTION

Do not plug a bare fiber or the like in back of the terminal.
If do, the optical system may be damaged.

(5) MEASURE Section

This section performs sweeping control.



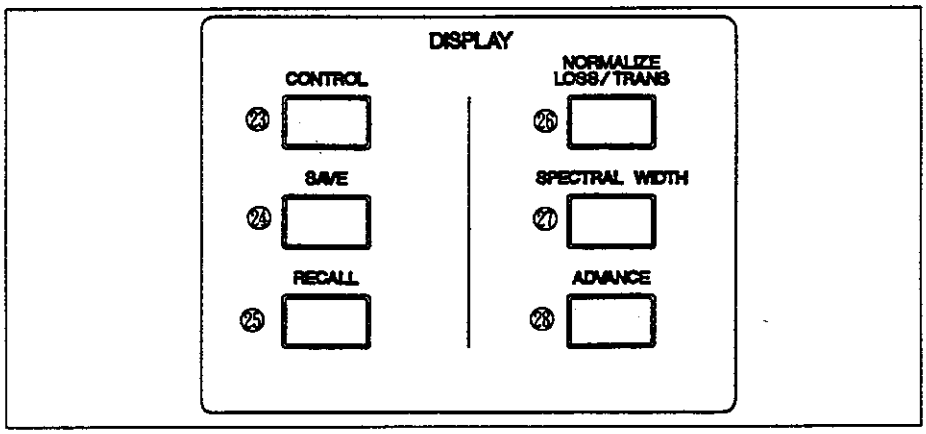
⑳ SINGLE key : Executes one time sweeping.

㉑ REPEAT key : Repeats sweeping.

㉒ STOP key : Stops sweeping.

(6) DISPLAY Section

This section is used to select display/analysis function.



㉓ CONTROL key : Sets the display mode (superimpose or division into two parts).

㉔ SAVE key : Saves measurement data and setting conditions.

㉕ RECALL key : Recalls measurement data and setting conditions.

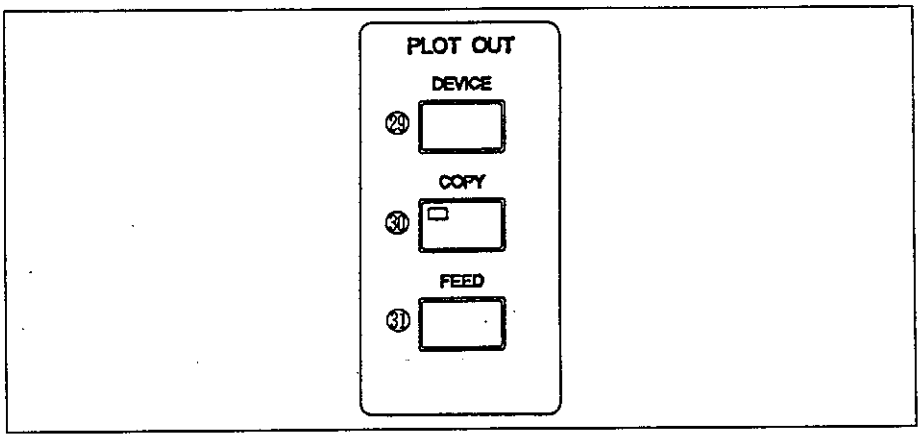
㉖ NORMALIZE key : Performs normalization of measurement data.
LOSS/TRANS
- Loss characteristic measurement
- Transparent characteristic measurement

㉗ SPECTRAL WIDTH key
: Performs duration width operation.

㉘ ADVANCE key : Sets high-level analysis.
- Preselector control using the preselector

(7) PLOT OUT Section

This section performs data output to the outside.



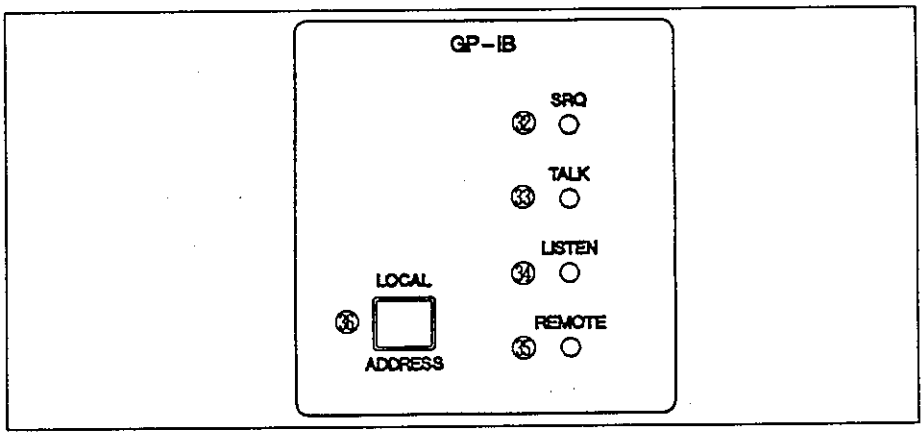
㉙ DEVICE key : Specifies a device.
- Printer
- Plotter
- Clock

㉚ COPY key : Executes data output.

㉛ FEED key : Paper feeding

(8) GP-IB Section

This section is used to display the GP-IB status and switch remote/local.



㉜ SRQ lamp : Lights during service request sending.

㉝ TALK lamp : Lights when data transfer is enabled.

㉞ LISTEN lamp : Lights when data receiving is enabled.

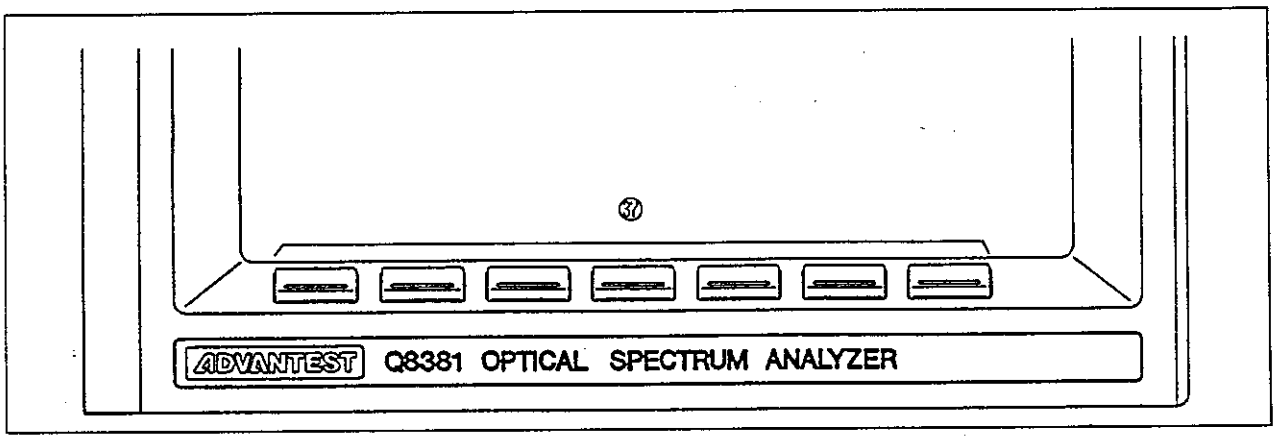
㉟ REMOTE lamp : Lights when the optical spectrum analyzer is controlled externally.

㊱ LOCAL key : Sets the local state (the panel is valid). (The LOCAL key is enabled when the REMOTE lamp lights.)

ADDRESS key : Sets GP-IB addresses (The ADDRESS key is enabled when the REMOTE lamp goes off.)

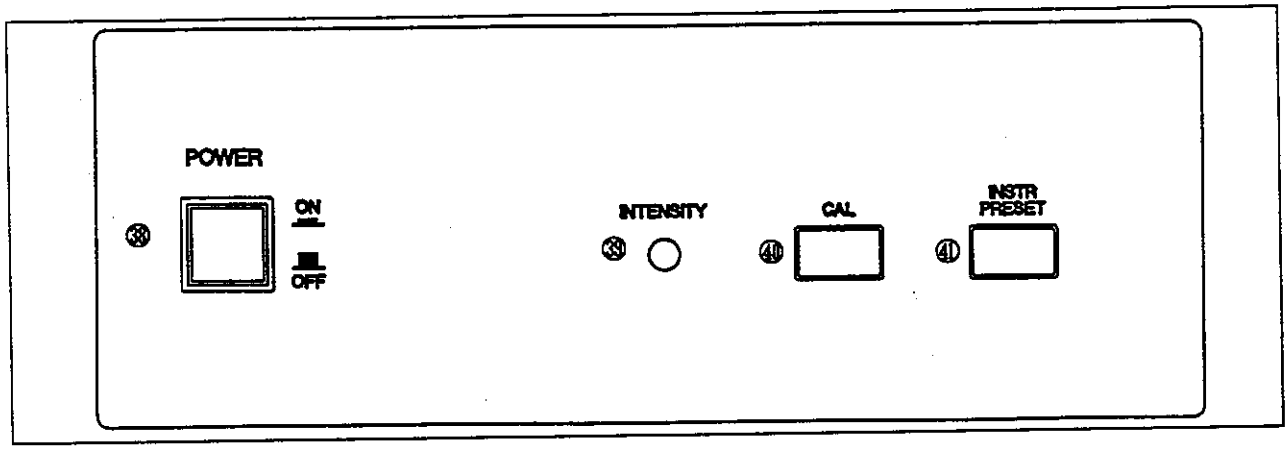
(9) Softkey

This part is used for selecting and setting with the softkey menu.



㊲ Softkey : Selecting and setting with the softkey menu. Softkey menu refers to the display menu of functions corresponding to various conditions.

(10) Others



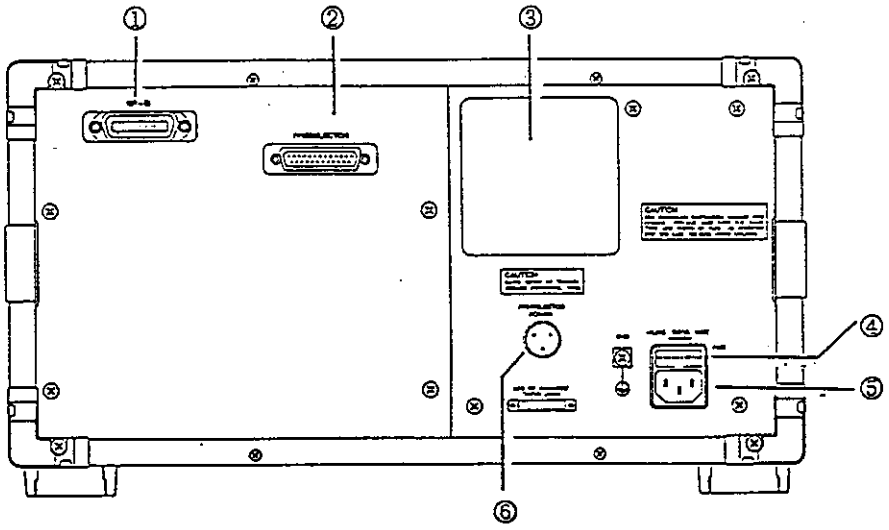
(38) POWER switch : Power switch

(39) INTENSITY knob
: CRT brightness adjustment volume

(40) CAL key : Calibrates the wavelength and level.

(41) INSTR PRESET key
: Initializes setting conditions.

2.2 Description of Rear Panel



① GP-IB connector

② Preselector (Q8381) control connector (option)

③ Fan

④ Fuse

⑤ AC power outlet

⑥ Power supply connector for the preselector (Q83811)

3. FOR FIRST-TIME USERS

This chapter describes preparing for measurement through to starting measurement using simple examples so that First-time users of this spectrum analyzer can get used to it quickly.

3.1 How to Read the Screen

The CRT display displays not only measurement data but also various setting conditions. Figure 3-1 shows an example of display on the CRT screen and how to read the screen data.

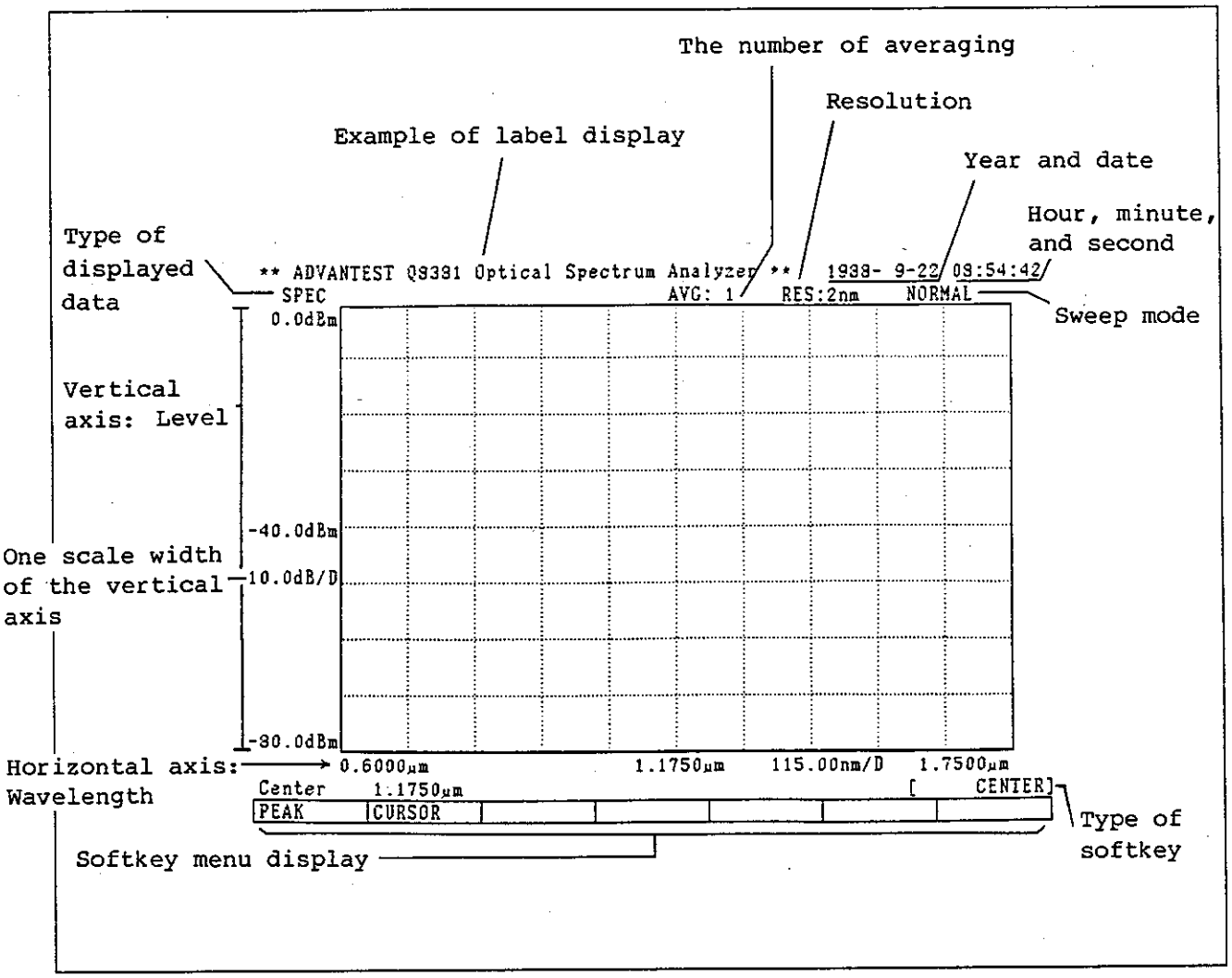


Figure 3 - 1 How to Read CRT Display Screen Data (Initial Screen of Q8381)

3.2 Important Keys

The purpose of this section is to acclimatize you to the FUNCTION section by executing a simple measurement procedure.

This key section is a collection of keys that are used for basic setting of the optical spectrum analyzer. It consists of the following eight keys:

(1) CENTER : Sets the analysis center wavelength.

(2) SPAN : Sets the sweep width of analysis wavelength. Sets start/stop wavelength.

(3) REF LEVEL : Sets input sensitivity.

(4) LEVEL SCALE: Sets vertical axis scale. (Selects LIN/LOG.)

(5) AUTO : Sets optimum measurement conditions automatically.

(6) AVG : Sets the number of averaging of measurement data. 1 to 1024 times can be set.

(7) SWEEP MODE : Sets sweep mode corresponding to the level of the input signal to be analyzed. Selects it from four types: RAPID, NORMAL, ADAPTIVE, and HIGH SENS.

(8) RESOLUTION : Sets wavelength resolution.

This section explains the three keys, CENTER, SPAN, and REF LEVEL together with measurement example.

3.2.1 Starting Measurement

Set up this optical spectrum analyzer according to the notes in Chapter 1. Then, measure the wavelength using a He-Ne laser as a light source.

(1) Ground the Power Cable (Two-pin adapter is used.)

Ground the power cable referring to (1) in Section 1.3.3.

(2) Connect the Power Cable

Connect the power cable to the outlet after checking that the power switch of this optical spectrum analyzer is turned off.

(3) Turn On the Power

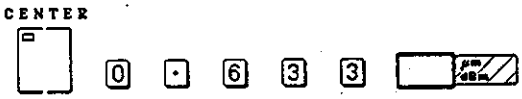
Turn on the power switch. Press the POWER switch. If no error is detected in self-diagnosis, the initial screen (Figure 3-1) is displayed on the screen and 'WELCOME TO Q3881!' is displayed.

(4) Measure the He-Ne Laser Wavelength

Input a beam to be measured from the He-Ne laser to the OPTICAL INPUT of this optical spectrum analyzer. (In this measurement example, the center wavelength and level are assumed to be 0.663µm and -10dBm, respectively.)

3.2.2 Setting the Center Wavelength (CENTER Key)

Press the CENTER key to set the center wavelength to 0.633µm.



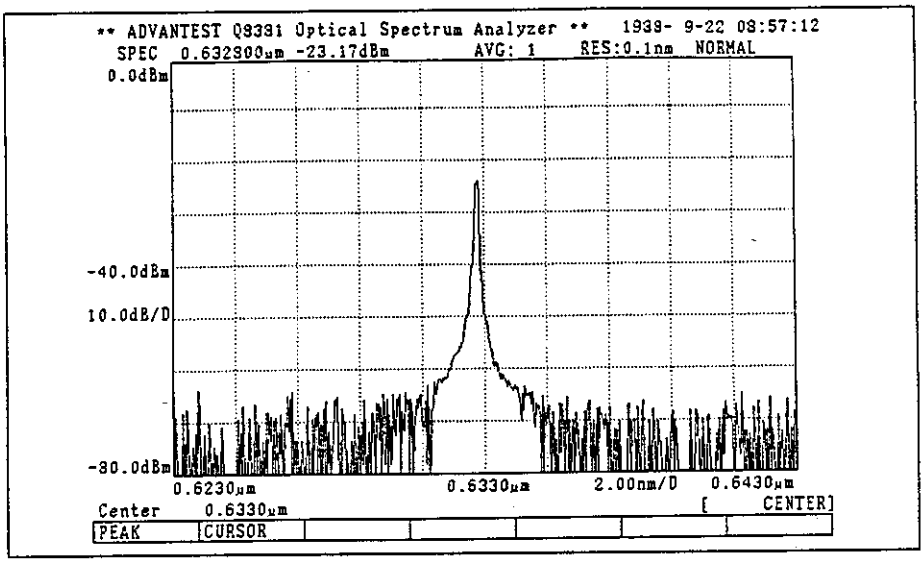


Figure 3 - 2 Setting Center Wavelength to 0.633µm

The center wavelength was set using the CENTER key. Functions of the CENTER key are described below.

Set the analysis center wavelength with either numeric keys, the knob, or softkeys.

The current set value is displayed at the bottom of the CRT screen when the CENTER key is pressed.

CENTER X.XXXXµm

Softkey menu is as follows:

[CENTER]

PEAK	CURSOR					

Description for each Operation

① Setting by the Knob

If the knob is turned clockwise or counter-clockwise, the current set value is increased or decreased by steps of approx. 1/100 of the current set span.

② Numeric Input

If numeric keys are pressed, the current set value is cleared and the input value is displayed sequentially. To set an input value, press the unit key (μm or nm) last.

Setting outside the measurement enable wavelength (0.6 to 1.75μm) is ignored and an alarm is issued (a buzzer sounds twice). If the setting exceeds the measurement range in accordance with span.

To cancel all the previously input digits, press the CENTER key to input a new digit again. To delete the final input digit, use the BACK SPACE key.

③ If the  or  key is pressed, the current value is increased or decreased by steps of approx. 1/500 of the current set span.

④ If the PEAK is pressed (setting to the peak value), the peak level wavelength obtained by the auto peak search function is set as a center wavelength.

⑤ If the CURSOR is pressed (setting to the cursor value), the wavelength at the X cursor position is set as the center wavelength. If two cursors are displayed, the wavelength at the middle position between two cursors is set.

When the X cursor is set to OFF, pressing this key is ignored.

3.2.3 Setting the Wavelength Span (SPAN Key)

Set SPAN to '50nm'.

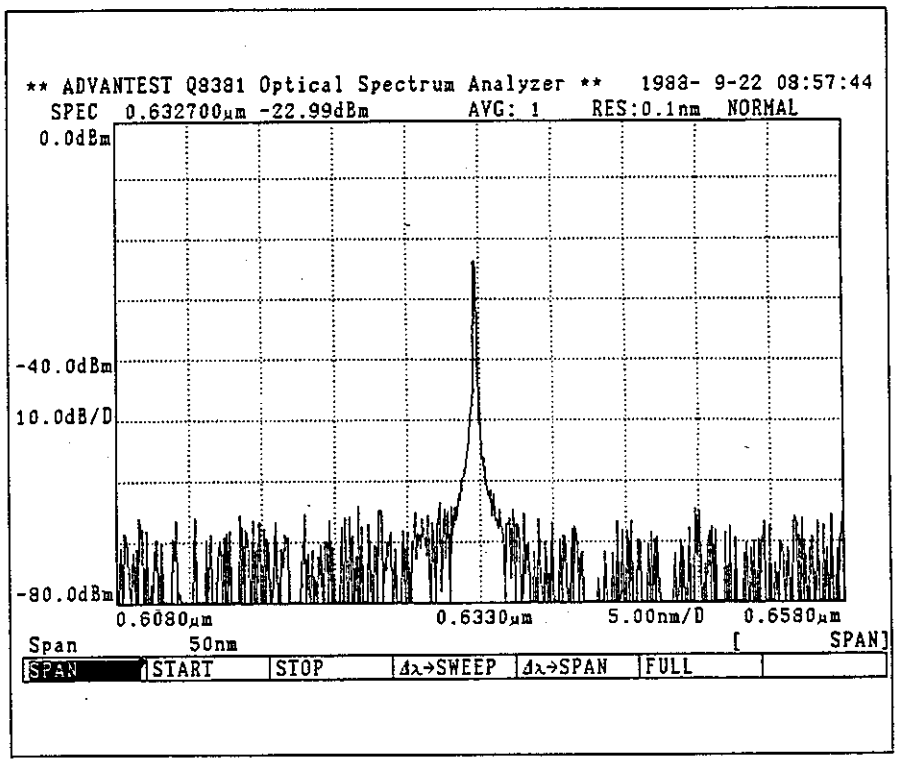


Figure 3 - 3 Setting the Wavelength Span to 50nm

Press the SPAN key to set the analysis wavelength span (sweep width). The analysis wavelength span can be set by numeric input, the knob, or the softkeys. Start and stop wavelengths can be set simultaneously with them. When the SPAN key is pressed, the current setting value is displayed on the bottom of the screen as shown below.

SPAN XXXXnm

The softkey menu is as follows:

[SPAN]

SPAN	START	STOP	Δλ→SWEEP	Δλ→SPAN	FULL	

Description for each Operation

① If the knob is turned (setting by the knob), the analysis setting span is increased or decreased (1-2-5 step).

② If the numeric key is pressed (numeric value input), the current setting value display is cleared, and the input numeric value is displayed sequentially. Input value is set by the terminator key (μm, nm, nm/DIV).

③ If the  or  key is pressed, the setting value is increased or decreased. (1-2-5 step).

* When '0' is set as the span, only the center wavelength is measured.

Description of Softkey Menu

① SPAN

Press the SPAN key to set the span (sweep width). To change the set value, use numeric input or the knob after pressing the SPAN key consecutively.

② START

Press the START key to set the start (sweep start) wavelength. To change the set value, use numeric input or the knob after pressing the START key consecutively.

③ STOP

Press the STOP key to set the stop (sweep stop) wavelength. To change the set value, use numeric input or the knob after pressing the STOP key consecutively.

④ $\Delta\lambda \rightarrow$ SWEEP

Press the $\Delta\lambda \rightarrow$ SWEEP key to sweep a division between two X cursors partially (PARTIAL SWEEP). All span sweep mode and partial sweep mode is inserted each time this key is pressed.

Number of measurement points in the partial sweep mode depend on the division width. When either X cursor is set to OFF, or the center wavelength or a span is changed, the partial sweep mode is cleared automatically.

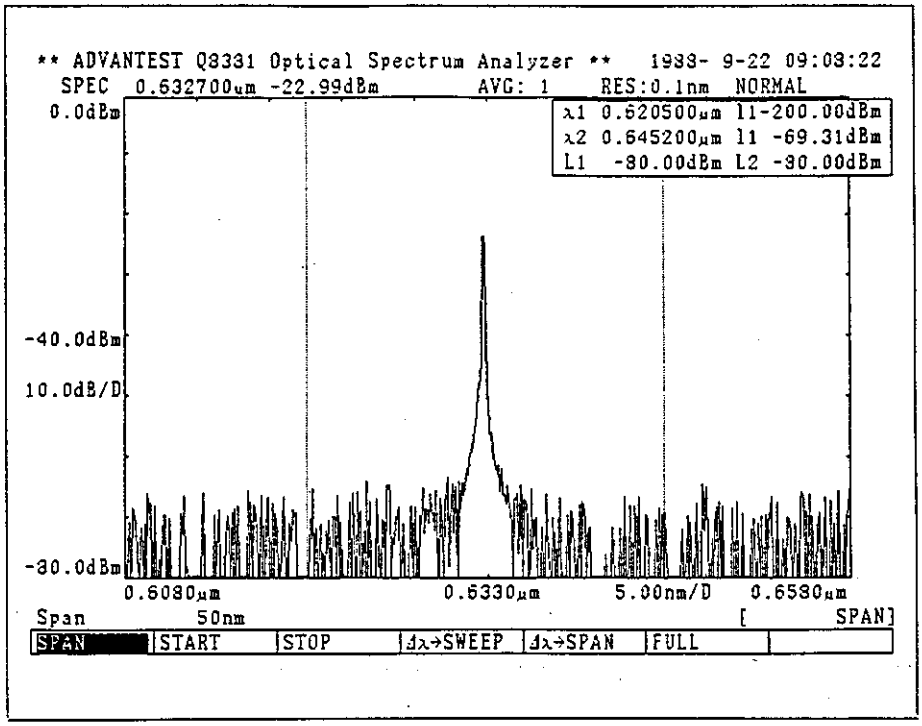


Figure 3 - 4 Partial Sweep Mode (PARTIAL SWEEP)

⑤ Δλ → SPAN

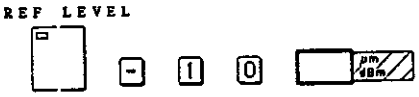
Press the Δλ → SPAN key to set a division between two X cursors as the span.

⑥ FULL

Press the FULL key to set the maximum span (1.15μm ranging from 0.6μm to 1.75μm).

3.2.4 Setting the Input Sensitivity (REF LEVEL Key)

Set the REF LEVEL to -10dBm.



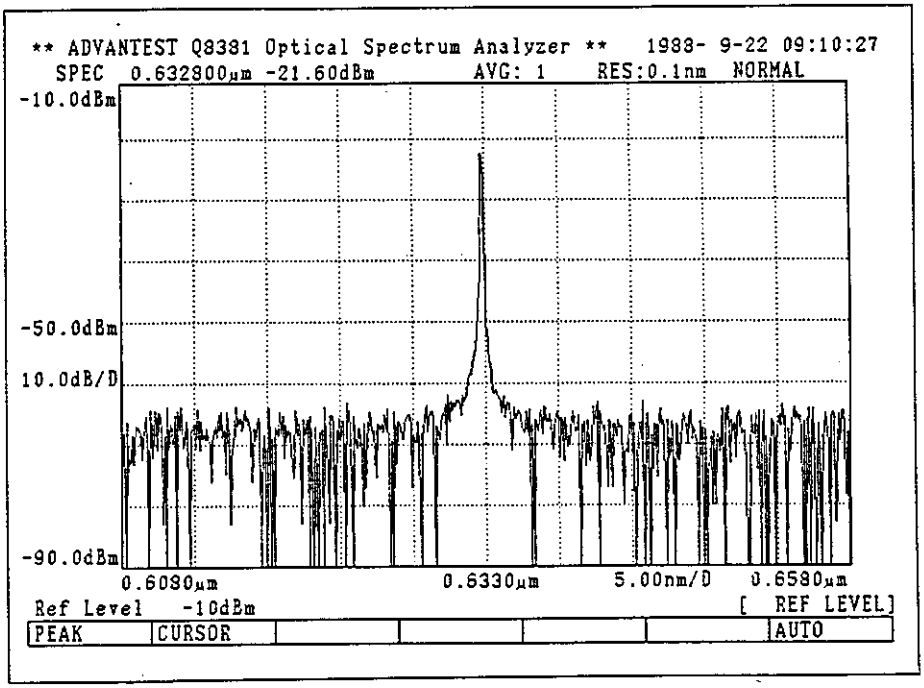


Figure 3 - 5 Setting the Input Sensitivity to -10dBm

The REF LEVEL key is used to set the input sensitivity of the measurement system to provide the optimum display of the level of signal to be measured.

When the REF LEVEL key is pressed, the current set values are displayed on the bottom of the screen as shown below.

REF LEVEL XXdBm (LOG display)
REF LEVEL XXxW (LINEAR display)

The softkey menu is as follows:

Softkey Menu Display

[REF LEVEL]

PEAK	CURSOR					AUTO

Description for each Operation

① If the knob is turned (setting by the knob), the set value increases or decreases in step of 1/2 (0.5 DIV) of the level scale for LOG display. The set value changes in 1-2-5 step for the LIN display.

② If the numeric keys are pressed, the current set value is cleared and input numeric values are displayed sequentially. Input value is set by the terminator key (dBm, mW, μW, or nW).

③ If the  or  key is pressed (same as the knob), the set value is increased or decreased in steps of 1/2 (0.5 DIV) of the level scale. The set value changes in 1-2-5 step for the LIN display.

Description of the Softkey Menu

① PEAK

Set the value where the peak level obtained by the auto peak search function becomes approx. 95% on the screen as REF LEVEL.

② CURSOR

Set the Y cursor position as REF LEVEL (when one Y cursor is used). When two Y cursors are used, the upper cursor is set as REF LEVEL and the lower cursor position is set as the lowest level. (For the LOG display, the LEVEL SCALE is changed automatically according to the level between two cursors.)

The lowest level is initialized automatically when setting of REF LEVEL and LEVEL SCALE are changed. For the LOG display, the initial value is that determined by the relationship between REF LEVEL and LEVEL scale, and for the LIN display, it is 0.

③ AUTO

This key is used to set the mode (AUTO level mode) where the REF LEVEL changes automatically to provide optimum measurement data. The AUTO level mode is set to ON/OFF each time this key is pressed. When the AUTO level mode is set to ON, 'AUTO' is displayed inverted.

MEMO

4. OPERATION METHOD (FOR HIGH-LEVEL MEASUREMENT)

This chapter explains the measurement method together with functional explanation of this optical spectrum analyzer to provide high-level measurement.

4.1 FUNCTION Section

4.1.1 LEVEL SCALE Key

This key is used to switch a scale for vertical axis (LIN/LOG) or LOG scale together with numeric keys, knob, arrow key, and softkeys.

When the LEVEL SCALE key is pressed, the current set values shown below are displayed on the bottom of the screen.

LEVEL SCALE XXX (LIN)
LEVEL SCALE XdB/DIV (LOG)

The softkey menu is as follows:

Softkey Menu Display

〔LEVEL SCALE 〕

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

Description of the Softkey Menu

① LIN/LOG

This is used for setting the LIN scale.

② 10dB/D, 5dB/D, 2dB/D, 1dB/D, 0.5dB/D, and 0.2dB/D

These are used for setting the LOG scale to 10, 5, 2, 1, 0.5, or 0.2dB/DIV.

Description of each Key

① Knob and Arrow Key

The knob and arrow key are used for switching the scale for LOG scale (from 10dB/DIV to 0.2dB/DIV).

Set value is increased by pressing the  key or turning the knob clockwise, and decreased by pressing the  key or turning the knob counter-clockwise.

② Numeric Key

When numeric keys are pressed, the current set value is cleared and input numeric values are displayed sequentially. Input values are set by the terminator key (dB/DIV). When any numeric value other than six types scales, the nearest scale is set.

4.1.2 AUTO Key

This key is used for automatically setting the optimum measurement conditions, including wavelength and level, according to input signals.

The AUTO key is effective for the measurement of ambiguous input where neither wavelength nor level are known. When the AUTO key is pressed, the following key softkey menu is displayed. Then, execute the automatic optimum conditions setting function using the softkeys.

[AUTO]

FULL	0.6 ~ 1.0	0.9 ~1.75				

① FULL

This key is used to search the optimum condition within the entire wavelength range (0.6μm to 1.75μm) to set it.

② 0.6 to 1.0

This key is used to search the optimum condition within the range from 0.6 to 1.0μm to set it.

③ 0.9 to 1.75

This key is used to search the optimum condition within the range from 0.9 to 1.75μm to set it.

4.1.3 AVG Key

The AVG key is used to set the number of averaging for measuring a low level signal to be measured steadily. The number is set using either numeric keys, knob, arrow key, or softkeys. (The number of averaging is always displayed on the top of the screen.)

When the AVG key is pressed, the current number of averaging is displayed on the bottom of the screen as shown below.

The softkey menu is as follows:

Softkey Menu Display

[AVG]

1(OFF)	2	5	10	20	50	100

Description of the Softkey Menu

① Knob and Arrow Key

The set value is increased by using the key or turning the knob clockwise, and decreased by using the key or turning the knob counter-clockwise in 1-2-5 step.

② Numeric Keys

The current setting value is cleared and input numeric values are displayed sequentially. Input values are set by the terminator key (ENTER). Values that can be input range from 1 to 1024.

③ Softkey

Since the typical number of averaging is assigned to each softkey, press the softkey for the desired number of averaging to set it.

4.1.4 SWEEP MODE Key

This optical spectrum analyzer provides four types of sweep modes to meet the various measurement items.

Either sweep mode is selected by using the softkeys. Select the optimum mode according to the measurement time and necessary dynamic range. (Sweep mode is always displayed on the top of the screen.)

The softkey menu is as follows:

Softkey Menu Display

[SWEEP MODE]

RAPID	NORMAL	ADAPTIVE	HIGH SENS			

Description of the Softkey Menu

Table 4 - 1 Each Sweep Mode and Its Function

	Sweep mode	Measurement time	Dynamic range	Functional outline	Main application
①	RAPID	Short	Small	Fixed range	Measuring the peak wavelength at short time
②	NORMAL	Normal	Normal	AUTO range (up to -50dBm)	Measuring the high level area around the peak in comparatively short time
③	ADAPTIVE	Long	Large	AUTO range (up to -60dBm)	Measuring the low level area steadily
④	HIGH SENS	Longest	Large	AUTO range (up to -70dBm)	Measuring the low level area steadily

4.1.5 RESOLUTION Key

This key is used for setting the wavelength resolution. Six types of resolution, o.1nm, 0.2nm, 0.5nm, 1nm, 2nm, and 5nm are provided. The slit width in the optical system changes for each resolution. Resolution is set by using the numeric keys, knob, arrow keys, or softkeys. (Resolution is always displayed on the top of the screen.) Set the optimum resolution according to the sweep width. Since the number of sweep points is 500, set the resolution R to meet the following expression:

$$R[nm] \geq \frac{SPAN[nm]}{500}$$

If the resolution R does not meet the above expression, the peak level may not be measured normally. When the RESOLUTION key is pressed, the current setting value is displayed on the bottom of the screen as shown below.

RES X.Xnm

The softkey menu is as follows:

Softkey Menu Display

〔RESOLUTION〕

0.1nm	0.2nm	0.5nm	1.0nm	2.0nm	5.0nm	

Description of each Key

① Knob and Arrow Key

The set value is increased by using the  key or turning the knob clockwise, and decreased by using the  key or turning the knob counter-clockwise.

② Numeric Keys

The current setting value display is cleared and input values are displayed sequentially. Input values are set by the terminator key (nm). If any value other than the above six types, the nearest value is set.

③ Softkey

Since six types of resolution are assigned to the softkeys, press the softkey corresponding to the desired resolution to set it.

4.2 DATA Section (Setting the Label)

The DATA section consists of numeric keys for changing each set value, arrow keys, and the LABEL key for changing one comment line (label).

(1) Numeric keys: [0]~[9], [.], [-]

(2) Arrow keys : [BACK SPACE], [↓], [→]

(3) LABEL key : [LABEL]

See 4.1 FUNCTION Section for numeric keys and arrow keys. The method of label setting is described here.

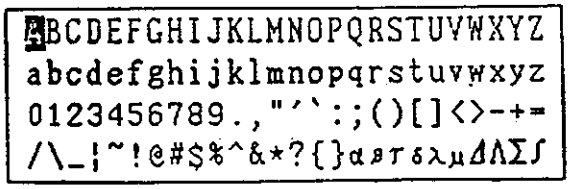
This optical spectrum analyzer is provided with one line (maximum forty-eight characters) label area where option setting, including a comment for measurement data, can be made.

When the equipment is initialized, '**ADVANTEST Q8381 Optical Spectrum Analyzer**' is displayed on the label area located on the top of the screen.

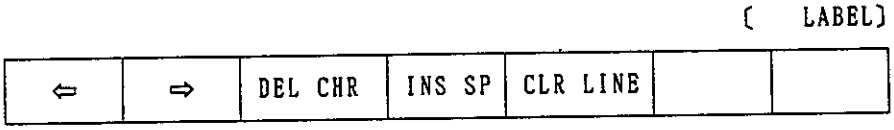
When the LABEL key is pressed, the list of characters (character menu) which can be set is displayed on the lower right screen and the soft key menu is displayed as shown below. Use the softkeys, knob, arrow keys, or numeric keys to change setting.

To end the LEVEL setting mode, press the LABEL key again.

Chracter Menu Display



Softkey Menu Display



Description of the Softkey Menu

① ⇦

Moves the cursor in the label data to the left.

② ⇨

Moves the cursor in the label data to the right.

③ DEL CHR

Deletes a character on the cursor position in the label data.

④ INS SP

Inserts a space to the cursor position in the level data. Data on the right side of the cursor position is shifted to the right by one character.

⑤ CLR LINE

Deletes all label data.

Description of each Key

① Knob

Moves the cursor in the character menu horizontally to select the character to be input.

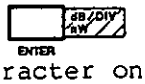
② Arrow Key ( , )

Move the cursor vertically in the character menu to select the character to be input.

③ BACK SPACE Key (

)

Deletes a character located immediately before the cursor in the label data.

④ ENTER Key (

)
Sets the character on the cursor position in the character menu to the cursor position in the label data.

4.3 CURSOR Section

This section controls the cursors to analyze measurement data. It consists of the knob and ON/OFF key of each cursor.

When the cursors are turned on, the following softkey menu is displayed to enable the user to select the mode of data to be read out from the cursor.

Softkey Menu Display

NORMAL	⊿MODE	2ND PEAK	POWER			

Description of the Softkey Menu

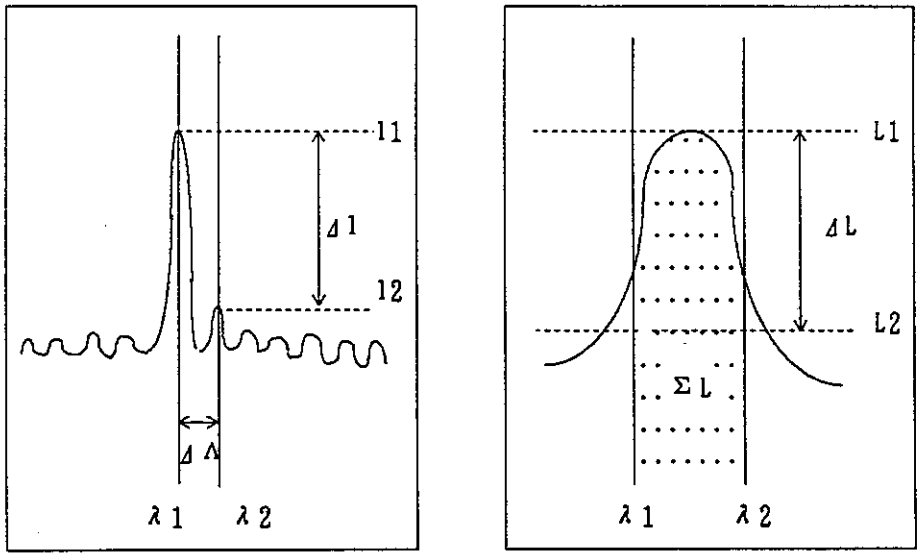
Cursor data is displayed in the special area on the upper right of the screen. Data displayed by each mode is as follows:

① NORMAL
- λ1 l1: Wavelength of X cursor 1 and level display
- λ2 l2: Wavelength of X cursor 2 and level display
- L1 L2: Level display of Y cursors 1 and 2

② ΔMODE
- λ1 l1: Wavelength of X cursor 1 and level display
- ΔΛ Δ1: Difference between wavelengths of X cursors 1 and 2 and level difference display
- L1 ΔL: Level display of Y cursor 1 and level difference display between Y cursors 1 and 2

③ 2ND PEAK
- λ1 l1: Peak wavelength and level display
- ΔΛ Δ1: Difference between wavelengths of the peak and second peak and level difference display

④ POWER
- λ1 : Wavelength display of the X cursor 1
- λ2 ΣL: Display of the wavelength of X cursor 2 and total level between cursors 1 and 2



Functional Description of each Key

① ON/OFF Key (ON/OFF)

This key is used to control the cursor display.

When this key that has been set to OFF is pressed, either operation shown below is executed according to the former condition.

- When the cursor is displayed previously and measurement conditions such as CENTER, SPAN, and REF LEVEL are not changed, the cursor displayed previously is resumed.

- For other cases, LED of λ1 lights and the X cursor 1 is displayed on the peak wavlength position.

* When the cursor read out mode is set to 2ND PEAK, the X cursor 1 and X cursor 2 are set in the peak and the second peak, then displayed automatically regardless of the former condition.

② λ1, λ2, L1, and L2 Keys (λ1 , λ2 , L1 , L2)

λ1, λ2, L1, and L2 keys correspond to X cursor 1, X cursor 2, Y cursor 1, and Y cursor 2.

When no cursor is displayed and any key is pressed, the corresponding LED lights and the corresponding cursor is displayed. That cursor can be moved by the knob or arrow keys. When the cursor is displayed with the corresponding LED off, and the corresponding key is pressed, the LED lights and the cursor can be moved.

When a key is pressed with the LED off, the corresponding cursor disappears.

When a key of the FUNCTION section or DISPLAY section is pressed, the lit LED goes off.

4.4 MEASURE Section

This section is provided with keys to control the execution of measurement operation.

4.4.1 SINGLE Key

When this key is pressed, sweep and measurement is executed once, and analysis and display are done. During measurement, a LED lights and it goes off when measurement completes.

4.4.2 REPEAT Key

This key is used to execute sweep and measurement repeatedly, and to perform analysis and display. The LED lights until the SINGLE key or STOP key is pressed.

4.4.3 STOP Key

This key is used to stop sweep and measurement. When this key is pressed, the LEDs of SINGLE key and REPEAT go off and measurement stops.

If the SINGLE key or REPEAT key is pressed during sweep, the sweep operation stops and sweep operation restarts from the START wavelength.

4.5 DISPLAY Section

This section is a block for setting the display format, analyzing the measurement data, and processing data memory. It consists of six types of keys as shown below.

(1) CONTROL key : Sets the display mode.

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

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

(4) NORMALIZE LOSS/TRANS key : Normalizes the measurement data with saved data or peak level and displays it.

(5) SPECTRAL WIDTH key: Operates the spectrum width.

(6) ADVANCE key : Performs the advanced waveform analysis.

4.5.1 CONTROL Key

When the CONTROL key is pressed, the following softkey menu is displayed and display mode is set using the softkeys.

Softkey Menu Display

[CONTROL]

GRAPH CLR	S.IMPOSE	DUAL	3D		GRID	

Description of the Softkey Menu

(1) GRAPH CLR

Clears the displayed waveform data.

(2) S.IMPOSE

Controls superimpose mode. Superimpose mode is turned on/off each time this key is pressed.

(3) DUAL

Data is displayed on the screen divided into two parts horizontally.

Setting conditions before this key is pressed are displayed on the lower screen and setting conditions after this key is pressed are displayed on the upper screen.

Changing measurement conditions and cursor processing are enabled only for data on the upper screen. If this key is pressed in the two-screen display mode, the mode is changed to normal one-screen display mode.

(4) 3D

Set ON/OFF and display conditions of the three-dimensional display mode.

Three-dimensional display function

① Maximum number of : 16(stored in the internal memory)displays
② Display angle : -75° to +75°(by 15° steps)
③ Others : The system has a cursor function, data recall function etc.

On pressing this key, the following key menu is displayed.
Soft key menu display
Explanation of the soft key

(4)-1 3D ON/OFF

Sets ON/OFF three-dimensional display mode.
This key toggles the mode from ON to OFF, the three-dimensional data measured is stored in the internal memory and the latest data is displayed in normal display mode.
Caution in the application of three-dimensional display mode

- If there is meaured data under the condition that the three-dimensional display mode is ON, the measurement conditions cannot be changed.
- When three-dimensional measured data is recalled, the current waveform axis conditions are automatically replaced by the preceding oneg.

(4)-2 INC ANGLE

Increases the display angle by 1 step (15°). The maximum angle (counterclockwise) is +75°.

(4)-3 DEC ANGLE

Decreases the display angle by 1 step (15°). The minimum angle (conuterclockwise) is -75°.

(4)-4 CSR NEXT

Moves the cursor to the next measured data.

If the cursor is on the latest data, it moves to the oldest.
The data number set by this menu is displayed on the upper right of the CRT.

(4)-5 DELETE

Deletes the preceding measured data.

(4)-6 more

On pressing this key, the following soft key menu is displayed.
Soft key menu display

[3D (2)]

CLEAR	INC N	DEC N	N LOCK	ROLL	RECALL	prev menu

Soft key menu explained

(4)-6-1 CLEAR

Clears all three-dimensional display data memory already taken and stored in the memory.

(4)-6-2 INC N

Increases the unmber of data displayable by 1. (Up to a maximum of 16 data)
The maximum number of displayable data is 16. The current number of date and maximum number are displayed in an X/M format at the bottom right of the CRT.

(4)-6-3 DEC N

Decreases the number of displayable data by 1.

(4)-6-4 N LOCK

Sets whether sweep operation should stop or not when measurement of the maximum number of displayable data is completed.
If the "N LOCK" is turn-over-indicated, the sweep operation stops when the measurement of the maixmum number of data is completed in the lock mode.
If "N LOCK" is normally indicated, measurement of the maximum number is continued under "LOCK OFF", and the old data is deleted when the measured data exceeds the maximum number.
This key toggles the lock mode ON/OFF control.

(4)-6-5 ROLL

Sets the display mode of measured data exceeding the maximum displayable number.
If "ROLL" is turn-over-indicated, the system deletes the oldest data and displays the latest data as the initial data under ROLL OFF.
This key toggles the ROLL mode ON/OFF control.

(4)-6-6 RECALL

Recalls and displays three-dimensional data already measured.
This key is useful only when there is no display data .
"Three-dimensional data already measured" means the data displayed just before the three-dimensional display mode set to is OFF.

(4)-6-7 prev menu

Returns the soft key menu to the previous menu.

(4)-7 prev menu

Returns the soft key menu to the previous menu.

(5) GRID

This key is used to delete grids in the data display frame. Use this key when analysis data is hard to observe because of internal grids. When this key is pressed again, grids appear again.

4.5.2 SAVE and RECALL Keys

These keys are used for saving measurement data and panel setting into the internal memory and recalling these data from the internal memory.

Memory for four screens and nine types of memory are provided for measurement data and panel setting.

When the SAVE key and RECALL key are pressed, the softkey menu is as shown below. Then, operate the softkey to execute SAVE/RECALL operation.

[SAVE]

SAV REF	SAV MEAS1	SAV MEAS2	SAV MEAS3		SAV PANEL	

[RECALL]

RCL REF	RCL MEAS1	RCL MEAS2	RCL MEAS3		RCL PANEL	

Description of the Softkey Menu

① SAV REF, RCL REF

The SAV REF key is used to store the displayed data into the reference memory (used for NORMALIZE processing) and the RCL REF key is used to read out it from the reference memory.

② SAV MEAS 1 - 3, RCL MEAS 1 - 3

The SAV MEAS 1 to 3 keys are used to store displayed data into measurement data memory 1 to 3 and the REC MEAS 1 to 3 keys are used to read them out from the measurement data memory 1 to 3.

③ SAV PANEL, RCL PANEL

The SAV PANEL key is used to store the panel setting conditions into memory 1 to 9 and the RCL PANEL key is used to read them out from memory 1 to 9. Press either key of numeric keys 1 to 9 following the above keys to select a memory number and execute the SAVE/RECALL operation by using the NETER key.

4.5.3 NORMALIZE (LOSS/TRANS) Key

This key is used to normalize measurement data using data stored in the reference memory or maximum spectrum value to display it.

This key is effective when transparent or loss characteristic of optical parts for the wavelength is measured by using this optical spectrum analyzer together with a white light source.

When this key is pressed, the softkey menu is displayed as shown below.

Softkey Menu Display

(NORMALIZE)

PK. NORM	REF NORM	LOSS	TRANS	SAV REF	SAV MEAS1	FUNC MENU

Description of the Softkey Menu

① PK.NORM (Peak Normalize)

Displayed data is normalized with the maximum spectrum value and it is moved so that the maximum spectrum value becomes the highest scale on the screen.

At that time, the vertical scale expresses relative dB units (dB).

While peak normalize function is executed, 'PK.NORM' is displayed inverted. If this key is pressed again, this mode is cleared and 'PK.NORM' is displayed normally.

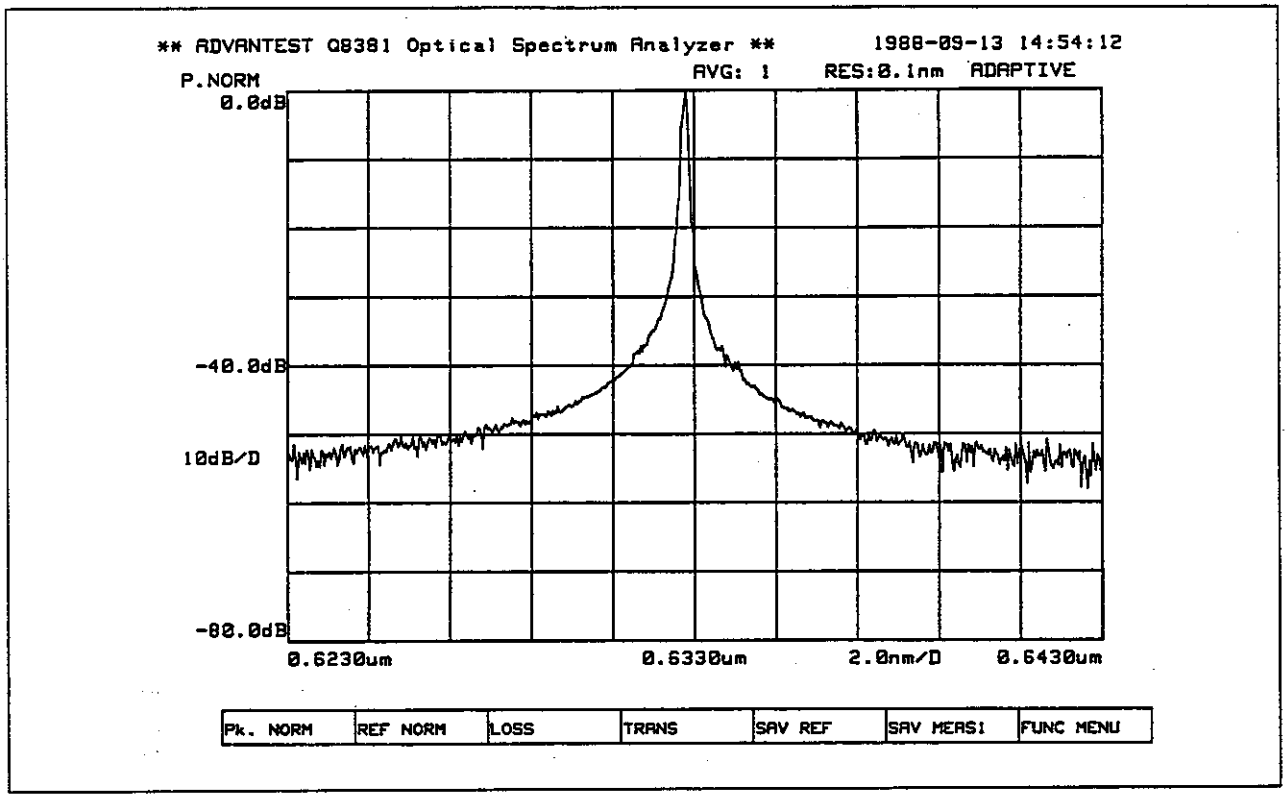


Figure 4 - 1 Peak Normalize Function

② REF NORM (Refference Normalize)

This key is used to operate data stored in the reference memory (REF) and data of measurement data memory (MEAS1) and display the results. Types of operation are switched according to the LOSS/TRANS setting as follows.

LOSS : Normalized = Refference/MEAS1 (Loss characteristic)
TRANS: Normalized = MEAS1/Refference (Transparent characteristic)

Press the softkey LOSS or TRANS when the REF NORM mode is set to ON for switching LOSS/TRANS ('REF NORM' is displayed inverted). 'TRANS' is set when the equipment is initialized.

* Linear display is disabled when LOSS is set.

Example of procedure (for measuring optical fiber wave length loss characteristics by cutback method)

②-1 Obtain data for the long optical fiber before cut.

②-2 Press the SAV MEAS1 key to save the data in measurement memory 1.

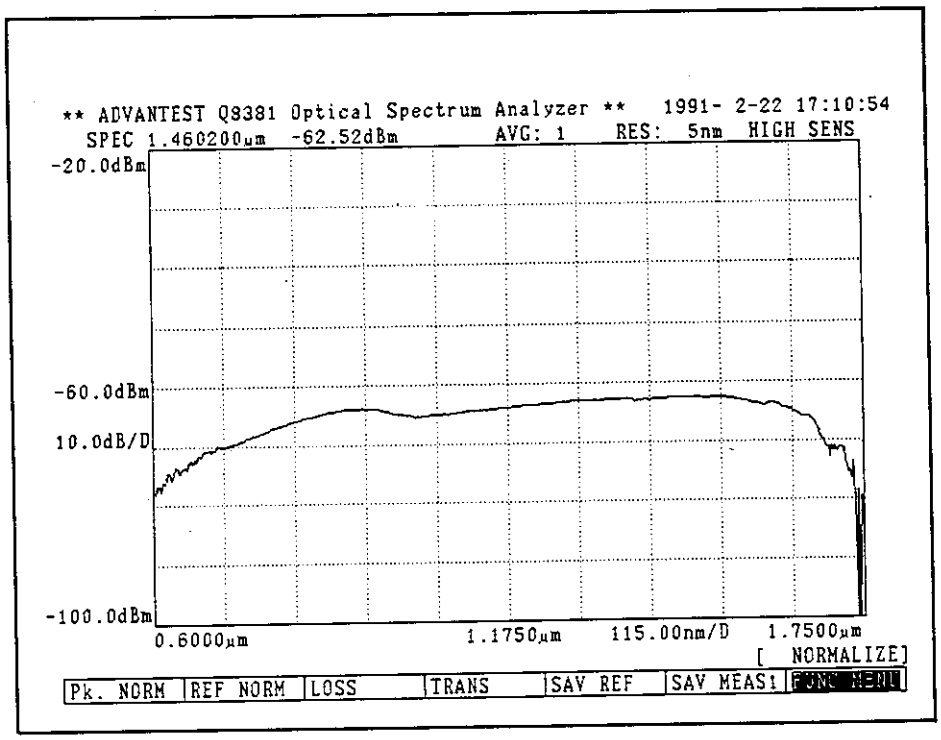


Figure 4 - 2 Example of LOSS NORMALIZE -a (MEAS1 data)

②-3 Cut back the optical fiber, then obtain data for the short fiber.

②-4 Press the SAV REF key to save the data in the reference memory.

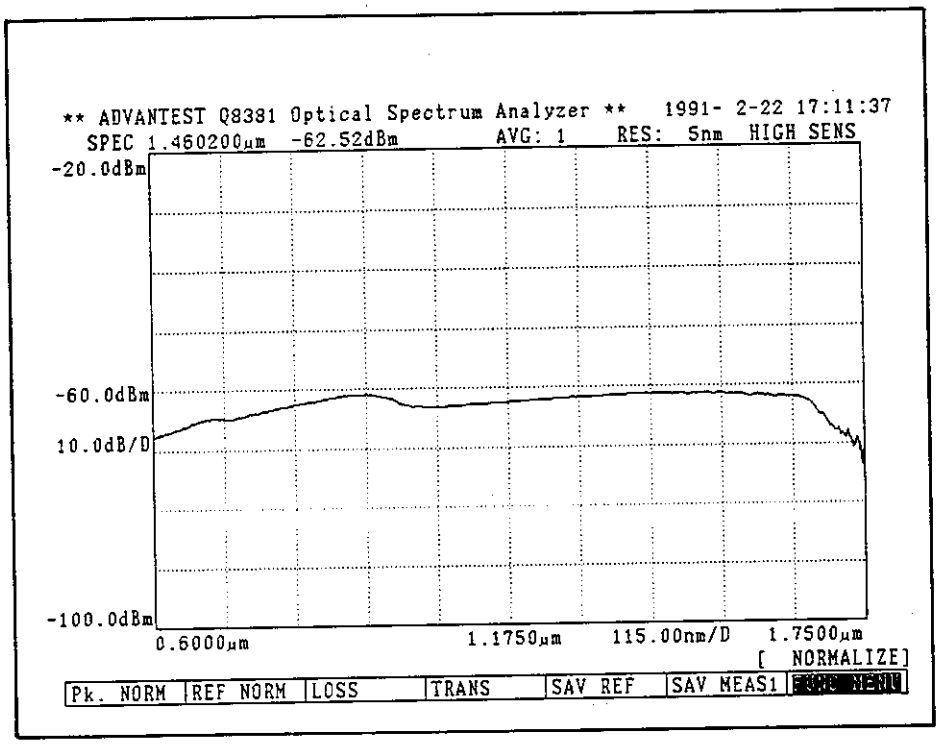


Figure 4 - 2 Example of LOSS NORMALIZE data -b (REF data)

②-5 Press the REF NORM and LOSS keys, and REF NORM and LOSS displays are inverted and operation result appears.

LOSS = Reference/Measurel

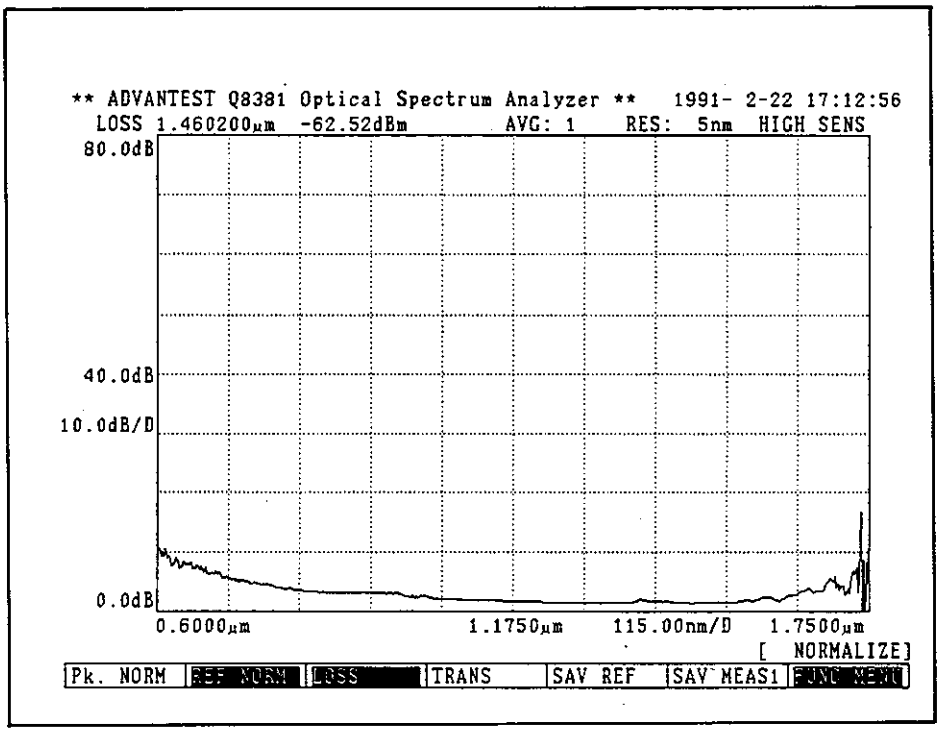


Figure 4 - 2 Example of LOSS NORMALIZE data -c (NORMALIZE)

②-6 Change the level scale for easy observation of the result.

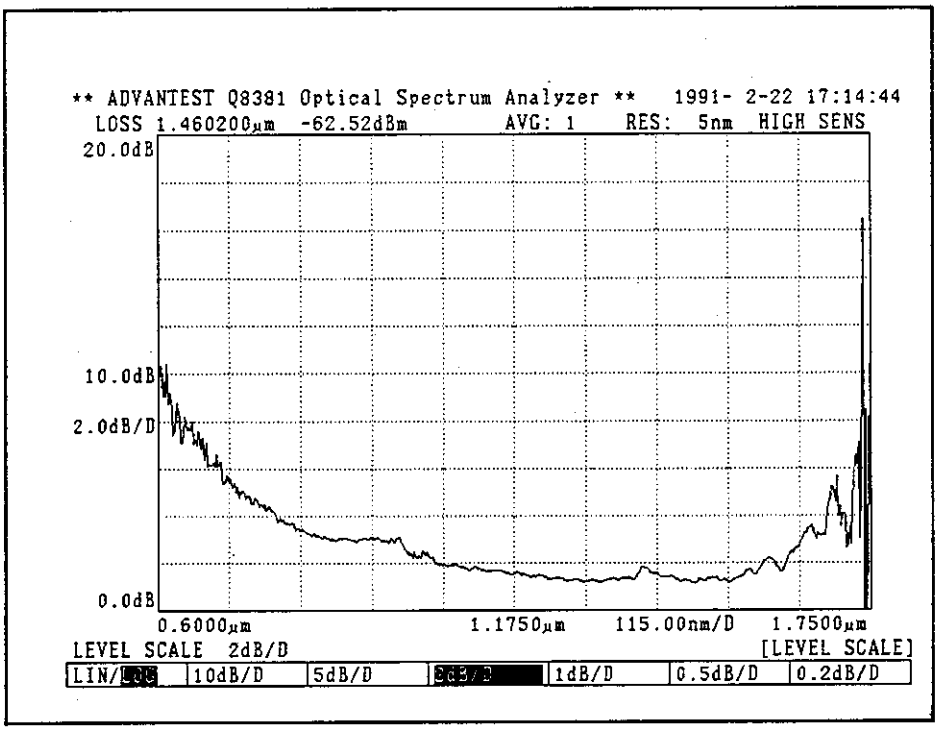


Figure 4 - 2 Example of LOSS NORMALIZE data -d (LEVEL SCALE CHANGE)

* The REF NORM function is convenient if reference data is obtained after measurement data is.

③ LOSS and TRANS

These keys are used to perform operation between the data in reference memory 1 and the data on the screen (or current measurement data) to display the results.

LOSS : Normalized = Refference/Measure
TRANS: Normalized = Measure/Refference

The above processing is effective only when the REF NORM mode is set to OFF. (When it is set to ON, the above operation is done with measurement memory 1 data instead of the current measurement data.)

Normalizing is set to ON/OFF each time these keys are pressed.

Example of procedure (for measuring filter transparent ratio)

③-1 Obtain reference data.

③-2 Press the SAV REF key to save the data in the reference memory.

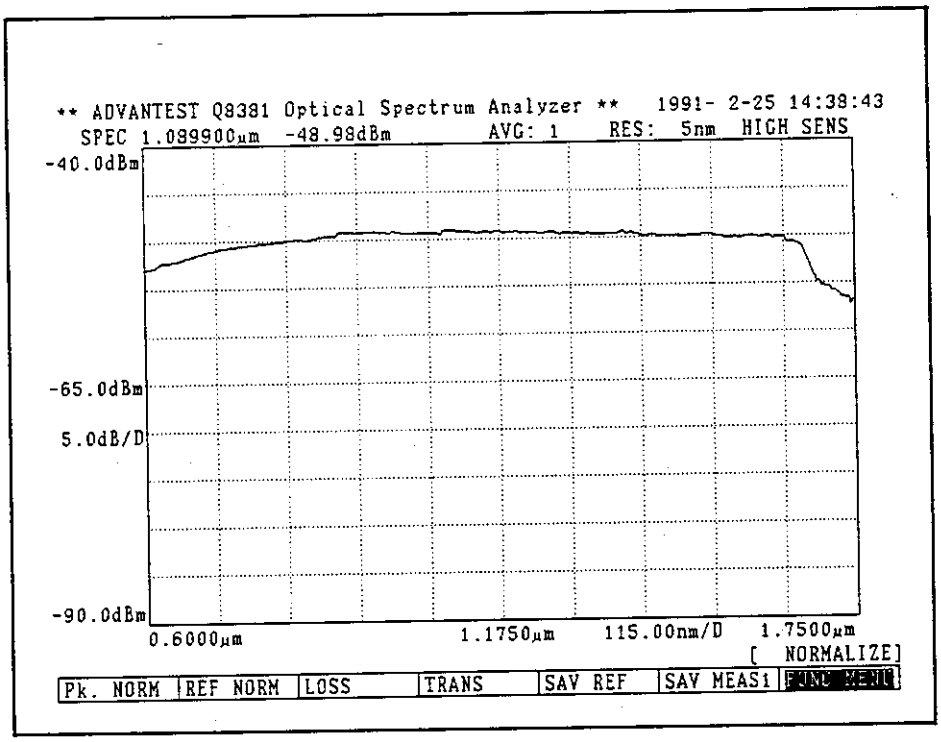


Figure 4 - 3 Example of TRANS NORMALIZE data -a (REF data)

③-3 Press the MEASURE (SINGLE or REPEAT) key to start measurement.

③-4 Press the TRANS key to dispaly transparent ratio.

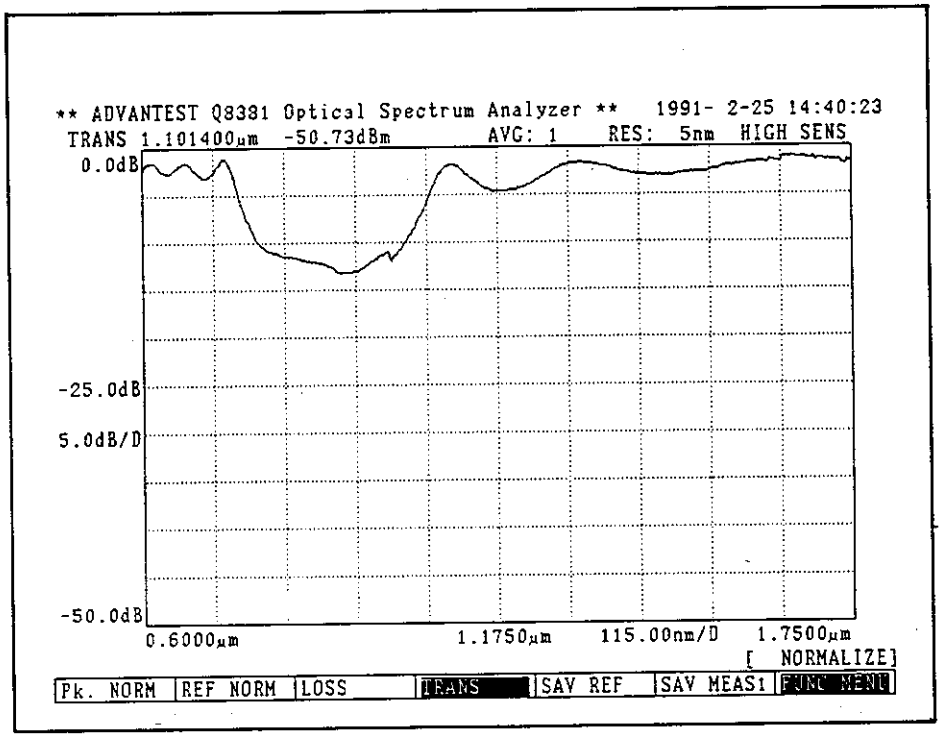


Figure 4 - 3 Example of TRANS NORMALIZE data -b (LOG indication)

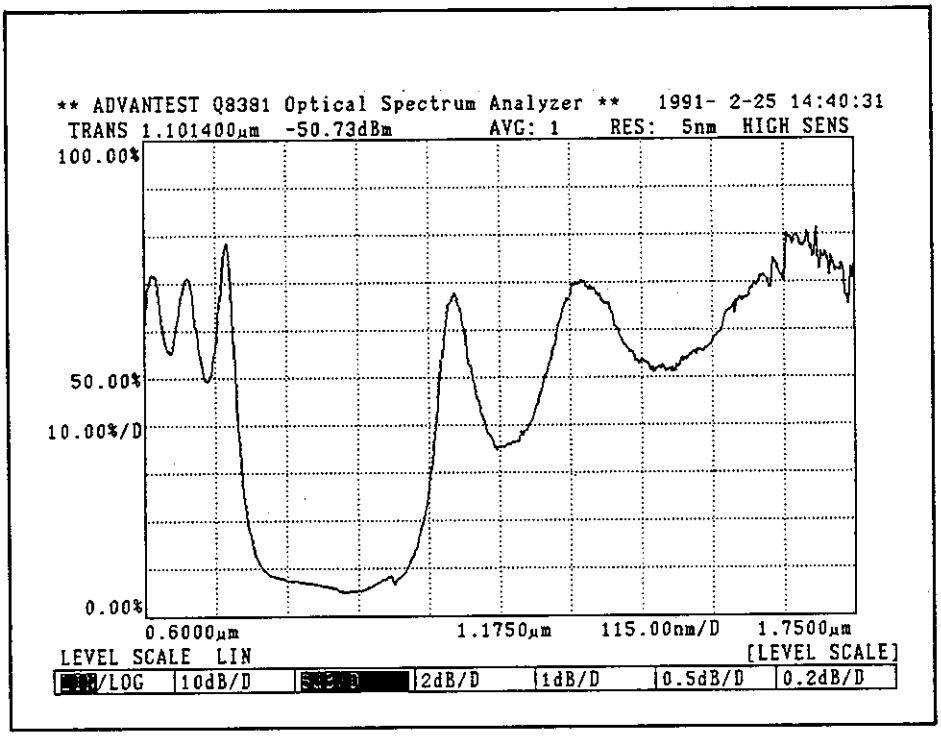


Figure 4 - 3 Example of TRANS NORMALIZE data -c (LINear indication)

④ SAV REF

This key is used to store displayed data in the reference memory.

⑤ SAV MEAS1

This key is used to store displayed data in the measurement data memory 1.

⑥ FUNC MENU

When a key in the FUNCTION section is pressed, the FUNC MENU key is used to determine whether a softkey menu corresponding to that function key is displayed or not. Display mode of the FUNCTION menu is switched each time this key is pressed.

When a character of FUNC MENU is displayed inverted, the FUNCTION menu display is set to ON, and if it is displayed normally, the FUNCTION menu display is set to OFF.

When the FUNCTION menu display is set to OFF, no softkey menu corresponding to any key in the FUNCTION section is displayed.

4.5.4 SPECIAL WIDTH Key

When the SPECIAL WIDTH key is pressed, the softkey menu is displayed as shown below. The center wavelength and duration width are calculated and displayed on the upper right on the screen.

Description of the Softkey Menu

〔SPEC WIDTH〕

Pk-XdB	ENVELOPE	RMS	(GAUSS)	PK RMS	parameter	FUNC MENU

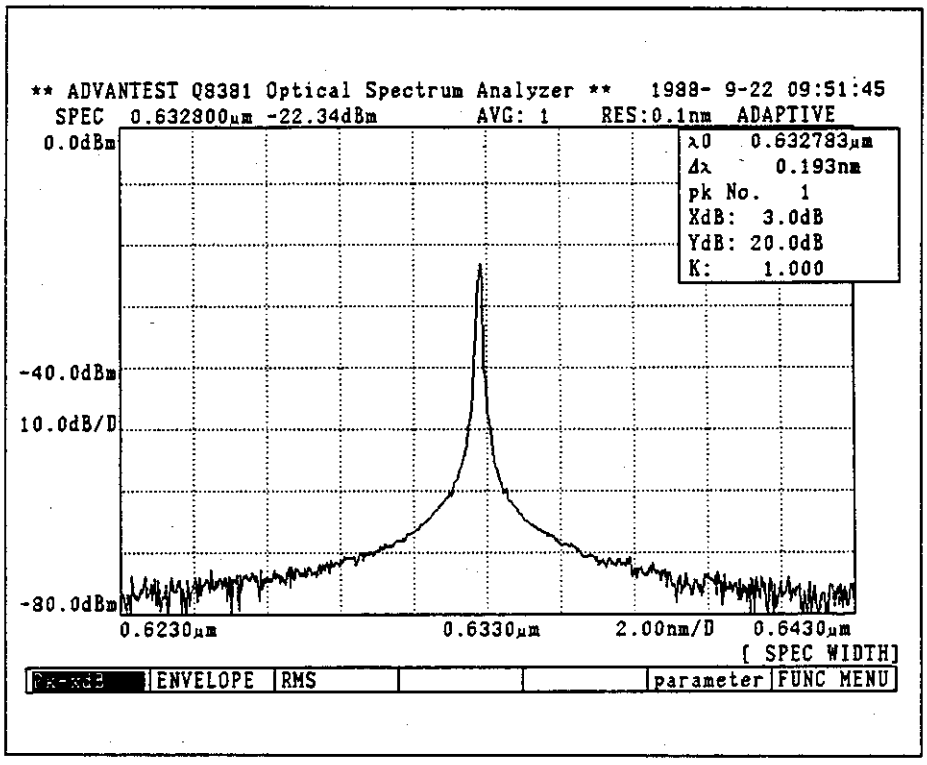


Figure 4 - 4 SPECIAL WIDTH Display

Description of Screen Display Data

① λ 0 X.XXXX Indicates the center wavelength. '0' is displayed if an error is generated during calculation.

② Δλ X.XX — Indicates duration width. '0' is displayed if an error is generated during calculation in the same way as the center wavelength.

③ PK No. XX — Indicates the number of peak values (maximum value).

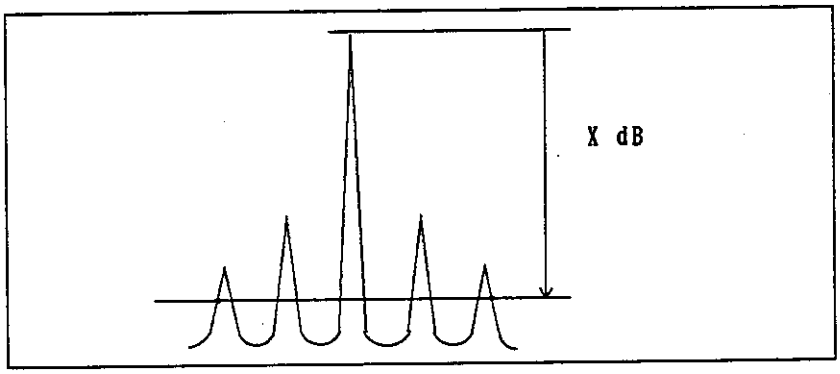
When two cursors are set, data in a division between two cursors is analyzed. If no cursor is set or only one cursor is set, all displayed data is analyzed.

Description of the Softkey Menu

The following calculation methods 1 to 3 are provided for the center wavelength and duration width of this optical spectrum analyzer:

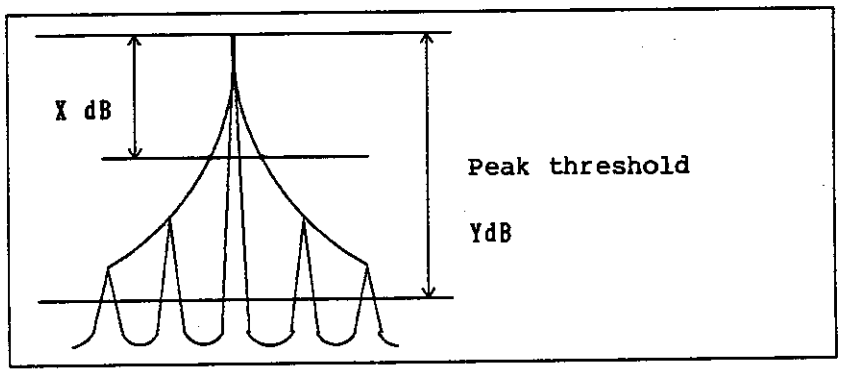
① Pk-XdB (XdB method)

The center of spectrum width at a point where attenuation from the maximum spectrum peak value is XdB is assumed to be the center wavelength. The spectrum width at a point where attenuation from the cursor data is XdB is assumed to be duration width.



At the cross-point, dot resolution is insufficient generally. So, a value between cross-points is calculated by interpolation.

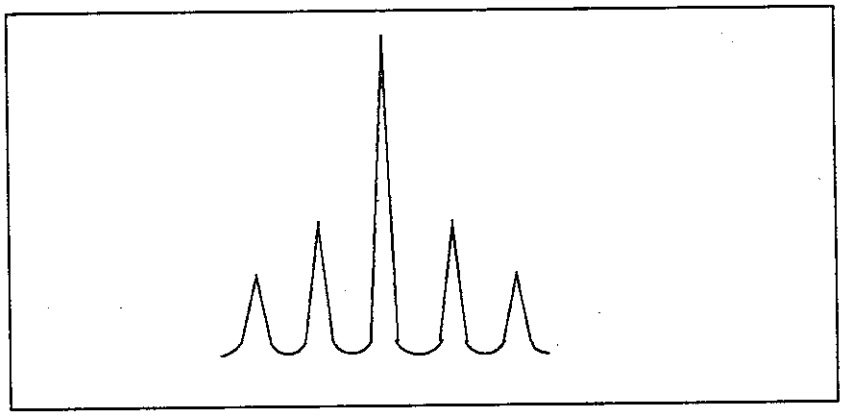
② ENVELOPE (Envelope method)



Draw a line through each peak larger than the peak threshold and calculate the duration width using cross-points with a horizontal line lower than the maximum peak value by XdB, assuming that a line is an envelope. Then, the center of the duration width is assumed to be the center wavelength.

③ RMS (RMS method)

The indicated average wavelength of the spectrum is calculated; it is assumed to be the center wavelength. The standard deviation from this center wavelength is assumed to be the duration width.



The following expressions can be obtained where the spectrum value at i is xi:

$$\text{Center wavelength} \quad (\lambda o) = \frac{1}{\Sigma \chi i} \Sigma \lambda i \chi i$$

$$\text{Duration width} \quad (\Delta \lambda) = \sqrt{\frac{1}{\Sigma \chi i} \Sigma (\lambda i - \lambda o)^2 \chi i}$$

④ Parameter

Parameter for duration width operation is set. When this key is pressed, the softkey menu is displayed as shown below.

Softkey Menu Display

[parameter]

XdB	YdB	K				prev menu

Description of the Softkey Menu

④-1 XdB

This key is used to set the descending level difference X from the peak which is used for XdB or envelope method.

To change setting, input a value using the numeric keys and press the ENTER key. Initial value of X is 3dB.

④-2 YdB

In the envelope method, peak count is not performed for a peak lower than the maximum peak value by YdB or more. This key is used to set a value of Y.

To change setting, enter values using the numeric keys and press the ENTER key. Initial value of Y is 20dB.

④-3 K

This key is used to set a coefficient multiplied by a calculated duration width. Value to be set ranges from 0 to 100. Initial value of K is 1.0.

④-4 prev menu

This key is used to return the softkey menu to the previous display.

4.5.5 ADVANCE Key

This key is used to perform high-level waveform analysis. When the ADVANCE key is pressed, the softkey menu is displayed as shown below. Then, press a softkey to specify processing.

Softkey Menu Display

[ADVANCE]

SPECTRUM			CURVE FIT	INPUT	SYNC	FUNC MENU

① SPECTRUM

This key is used to specify a normal spectrum analysis function.

② CURVE FIT

This key is used to display the measured spectrum waveform provided with curve-fitting of the specific functional waveform.

③ FUNC MENU

This key is used to determine whether the corresponding softkey menu is displayed or not when a key in the FUNCTION section is pressed. For details, see item 6 in Section 4.5.3.

The following descriptions ④ and ⑤ are displayed only when the Q83811 Pre-selector is connected to Q8381:

④ INPUT

The INPUT key switches the pre-selector input.
When this key appears in normal video, the optical signal is input to Q8381 directly without passing though the pre-selector output in the "THROUGH" mode. When this key appears in reverse video, the optical signal is input to Q8381 through the pre-selector spectrum analysis. Each time this is pressed, the pre-selector input is switched on or off.

⑤ SYNC

The SYNC key synchronizes Q8381 with the pre-selector spectrum analysis system. To use the pre-selector, this key must be pressed for the synchronzation after the operation for wave length determination is selected.
When this key is pressed, Q8381 is automatically synchronized with the pre-selector spectrum analysis system, and a beep occurs at the end of the synchronization. (This key is ineffective if pressed during the operation for determining the wave length.)
Note that this key appears in reverse video during the synchronization, and returns to normal video at the end; this key is ineffective if pressed during operation for determining the wave length; also, this key interrupts the operation if pressed during the synchronization .

4.6 PLOT OUT Section

This section is used to output measurement data (plot output or printer output) or to set a clock. It consists of the following three keys:

(1) DEVICE: Specifies an output device or sets a clock.
(2) COPY : Starts data output.
(3) FEED : Feeds printing sheets.

4.6.1 DEVICE Key

This key is used to specify an output device or set a clock. When the DEVICE key is pressed, the softkey menu is displayed as shown below.

Softkey Menu Display

[DEVICE]

PRINTER	PLOTTER				CLOCK	

Description of the Softkey Menu

① PRINTER

This key is used to select a built-in printer as an output device. When a printer is selected, 'PRINTER' is displayed inverted. In initial state, an output device is a printer.

② PLOTTER

This key is used to select a plotter as an output device. Digital plotter that can be connected with this optical spectrum analyzer is 98XX series plotter manufactured by ADVANTEST or HP-GL specification plotter manufactured by Hewlett Packard. When this key is pressed, the softkey menu is displayed as shown below. Then, set the plotter type, output data type, output size, and other conditions.

Softkey Menu Display

[PLOTTER]

TYPE:AT	TYPE:HPGL	DATA:ALL	DATA:SIG	PAPER ADV	plot size	prev menu

Description of the Softkey Menu

②-1 TYPE:AT

This key is used to set a plotter manufactured by ADVANTEST. (Initial state)

②-2 TYPE:HPGL

This key is used to set HP-GL plotter manufactured by Hewlett Packard.

②-3 DATA:ALL

This key is used to graph all information (excluding the softkey menu) displayed on the screen. (Initial state)

②-4 DATA:SIG

This key is set to graph only the waveform information displayed on the screen.

②-5 PAPER ADV

This key is valid for a plotter provided with a paper feed function. It is used to determine whether paper feeding is performed automatically after graphing completes. Automatic paper feed function is turned on/off for each pressing of this key. When the automatic paper feed function is selected, 'PAPER ADV' is displayed inverted.

②-6 plot size

This key is used to specify graph size (the number of graphs in one sheet, specifications of width and length).

When this key is pressed, the softkey menu is displayed as shown below. Then, press a softkey to specify size.

②-7 prev menu

This key is used to return the softkey menu to the previous display.

Softkey Menu Display

[plot size]

A4(H1)	H2	H4	V1	V2	V4	prev menu

Description of the Softkey Menu

②-6-1 A4 (H1)

This key is used to make one graph on an A4-size sheet set sideways (initial state).

②-6-2 H2

This key is used to make two graphs on an A4-size sheet set sideways.

②-6-3 H4

This key is used to make four graphs on an A4-size sheet set sideways.

②-6-4 V1

This key is used to make one graph on an A4-size sheet set lengthways.

②-6-5 V2

This key is used to make two graphs on an A4-size sheet set lengthways.

②-6-6 V4

This key is used to make four graphs on an A4-size sheet set lengthways.

②-6-7 prev menu

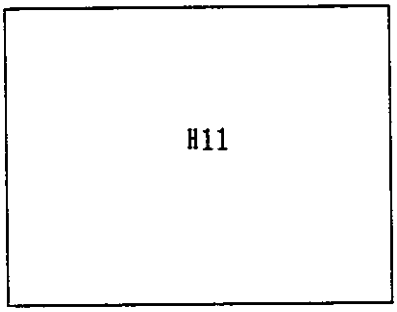
This key is used to return the softkey menu to the previous display.

* Each graph position can be specified using the  and  keys when multiple graphs are made. (Normally, graphs are made in the preliminary determined order.)

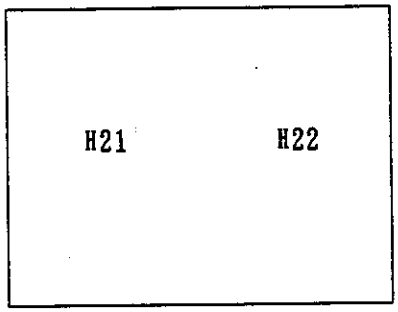
  Information of the next graph position is displayed on the softkey menu. When a mode is changed, the graph position returns to the initial position automatically.

- Graph position and order in each mode

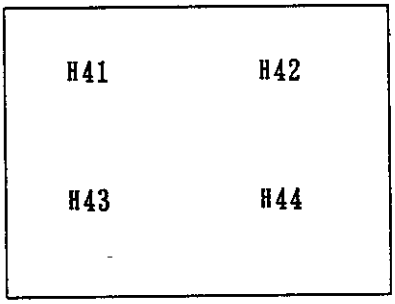
A4(H1)

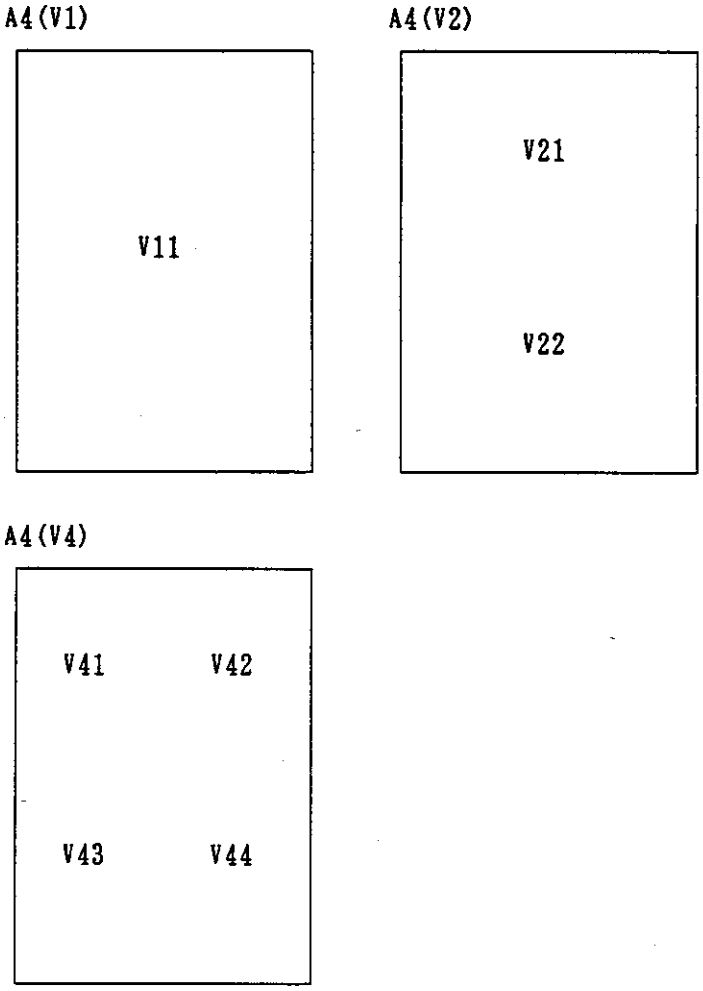


A4(H2)



A4(H4)





③ CLOCK

This optical spectrum analyzer incorporates a battery backup clock function to display date and time data on the upper right of the screen.

This softkey is used to change date and time. When this key is pressed, the softkey menu is displayed as shown below. Then, select an item to be changed using the softkeys and change the details using the  and  keys. Each set value is increased by the  key and decreased by the  key.

Softkey Menu Display

[CLOCK]

YEAR	MONTH	DAY	HOUR	MINUTE	ADJ SEC	prev menu

Description of the Softkey Menu

③-1 YEAR

This key is used to change the year.

③-2 MONTH

This key is used to change the month.

③-3 DAY

This key is used to change the day.

③-4 HOUR

This key is used to change the hour.

③-5 MINUTE

This key is used to change the minutes.

③-6 ADJ SEC

This key is used to adjust the seconds in units of thirty seconds. When the clock indicates thirty to fifty-nine seconds, pressing this key resets the seconds to 0 and increments the minutes by 1.

③-7 prev menu

This key is used to return the softkey menu to the previous display.

④ BUZZER

This key is used to control whether or not to sound the buzzer depending on the condition. When this key is pressed, the softkey menu is displayed as shown below.

Softkey Menu Display

[BUZZER]

BEEP	WARNING					prev menu

Description of the Softkey Menu

④-1 BEEP

This key is used to set whether or not to sound the buzzer when a panel key is pressed.
If BEEP is displayed inverted, the buzzer sounds each time panel key is pressed.

④-2 WARNING

This key is used to whether or not to sound the buzzer when an invalid measurement condition is set.
When WARNING is displayd inverted, a low sound buzzer is generated if an invalid setting is made.

④-3 prev menu

This key is used to return the softkey menu to the previous display.

4.6.2 COPY Key

This key is used to start data output. When this key is pressed, data output to the printer or plotter starts according to the conditions set by the DEVICE key. The LED lights during data output. The LED goes off automatically when output completes. When this key is pressed again, plotter output stops.

4.6.3 FEED Key

This key is used to perform paper feed. When a printer is selected as an output device, pressing this key allows paper to be fed by approx. 5mm.

4.7 GP-IB Section

This section is used to perform GP-IB address setting, switching to local operation, and GP-IB status display.

It consists of the LOCAL/ADDRESS key and LEDs for four statuses.

4.7.1 LOCAL (ADDRESS) Key

This key works as the key to switch from the remote state to local state while the REMOTE lamp lights. (Other keys on the panel are enabled in the local state.)

This key works for setting a GP-IB address when the REMOTE lamp goes off.

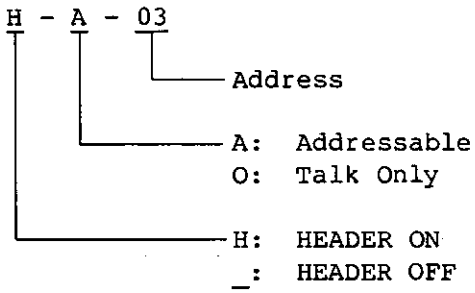
When this key is pressed, the softkey menu is displayed as shown below and the current set value is displayed on the menu. Then, change the setting using the softkeys.

Softkey Menu Display

[GPIB]

HEADER	ONLY	ADR UP	ADR DOWN			

How to Read Displayed Set Value



Description of the Softkey Menu

① HEADER

This key is used to determine whether the header is added or not when data is sent.

The HEADER key is turned on/off each time this key is pressed. When the HEADER key is turned on, 'HEADER' is displayed inverted.

② ONLY

This key is used to switch talk only mode (effective for plotter output only) and addressable mode (mode for receiving an address specification from the external controller).

Switching between ONLY and ADDRESSABLE is done each time this key is pressed. When the ONLY mode is selected, 'ONLY' is displayed inverted.

③ ADR UP, ADR DOWN

Addresses 0 to 30 can be set for this optical spectrum analyzer. The ADR UP and ADR DOWN keys permit the address to be increased and decreased. The  key and  key have the same functions as ADR UP and ADR DOWN.

4.7.2 Status Lamps

The following four LED lamps show the GP-IB status:

SRQ lamp : Lights when a service request signal is sent.

TALK lamp : Lights during talker status where data can be sent.

LISTEN lamp: Lights during listener status where data can be received.

REMOTE lamp: Lights when the equipment is controlled externally. Other panel keys are invalid when the REMOTE lamp lights.

4.8 Other Keys

The INSTR PRESET key and CAL key are provided for initializing this optical spectrum analyzer and calibrating the wavelength and level.

4.8.1 INSTR PRESET Key

This key is used to initialize the panel setting of this optical spectrum analyzer. In the initial state, the FUNCTION section is set as follows:

CENTER : 1.125µm
SPAN : FULL (1150nm)
REF LEVEL : 0dBm
LEVEL SCALE: 10dB/D
AVG : 1
SWEEP MODE : NORMAL
RESOLUTION : 2nm

Data and panel setting stored in memory are not changed.

To change the initial state, press the keys in the order as shown below.

SAVE 9 9 ENTER

The above operation allows the current panel setting to be stored as initialization.

To return the current setting to that initialized at the delivery of this optical spectrum analyzer, press the keys in the order as shown below.

SAVE 0 0 ENTER

4.8.2 CAL Key

This key is used to calibrate the wavelength or level of this optical spectrum analyzer. Enter a signal whose wavelength or level is known accurately, execute the measurement, and press the CAL key.

The softkey menu is displayed as shown below. Then, execute calibration using the softkeys.

Softkey Menu Display

[CAL]

λ	LEVEL				EXECUTE	CAL VALID

Description of the Softkey Menu

① λ

Enter known wavelength data using numeric keys following this key. When the key is pressed, ' ' is displayed inverted, indicating that a wavelength can be calibrated in this state. When this key is pressed again, the wavelength calibration mode is cleared.

② LEVEL

Enter known level data using the numeric keys following this key. When the LEVEL key is pressed, 'LEVEL' is displayed inverted, indicating that a level can be calibrated in this state. When this key is pressed again, the level calibration mode is cleared.

③ EXECUTE

This key is used to execute calibration. Either selected wavelength or level is calibrated. Or both are calibrated.

④ CAL VALID

This key is used to make calibrated data valid. In the valid state ('CAL VALID' is displayed inverted), a calibrated wavelength or level is displayed.

When this key is pressed again, a calibrated value becomes invalid and a wavelength or level is displayed according to the calibration data at the delivery of this optical spectrum analyzer.

Example of calibrating the wavelength by entering a 1.556μm wavelength

① CAL

② λ1 (λ2) . 1 . 5 5 6

: 'λ:1.556μm' is displayed above the softkey menu.

③ EXECUTE : Executing the calibration

④ CAL VALID : Calibrated data becomes valid.

* The following error message is displayed if calibrated data has ±9.9nm or more difference or ±9.9dB or more difference after execution of calibration.

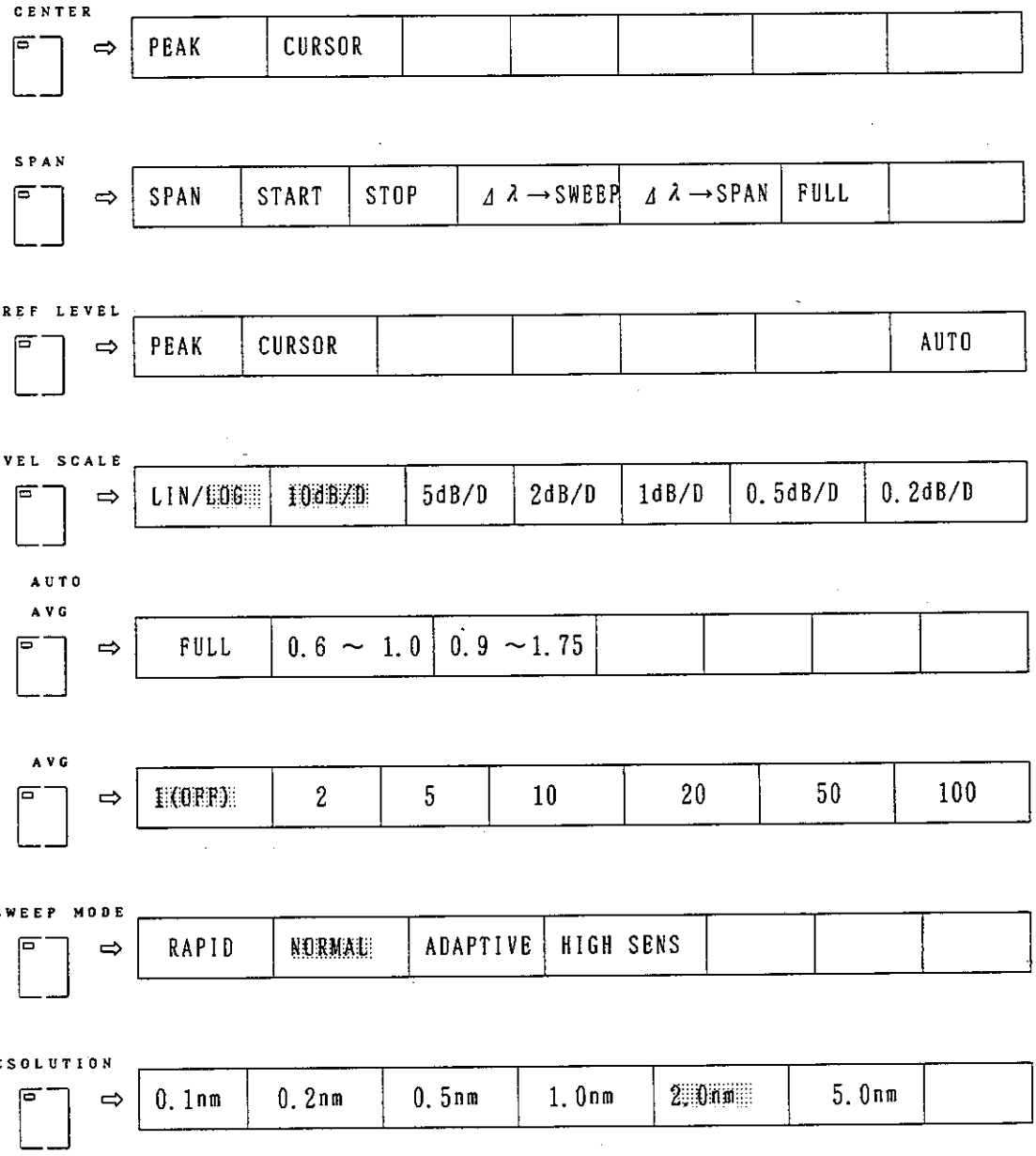
"illegal calibration source!!"

5. FUNCTIONAL DESCRIPTION

This chapter lists softkey menus in Section 5.1 and describes the functions and the softkey menus of the keys in Section 5.2. Refer to both sections as necessary.

5.1 Softkey Menu

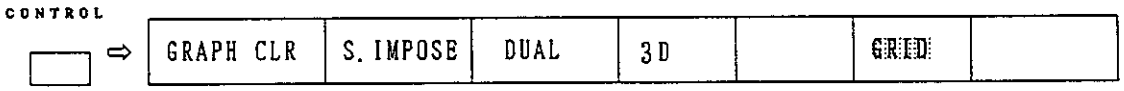
(1) FUNCTION Section

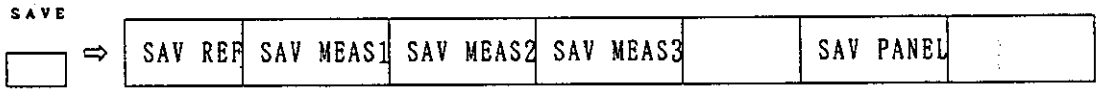


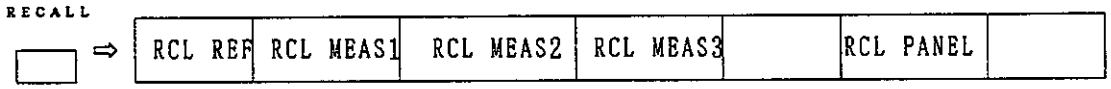
(2) CURSOR Section

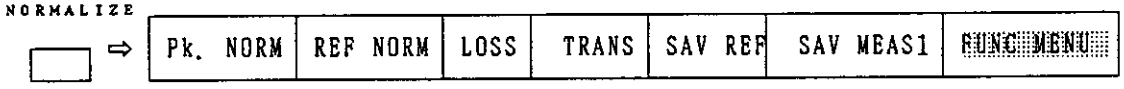
(3) DATA Section

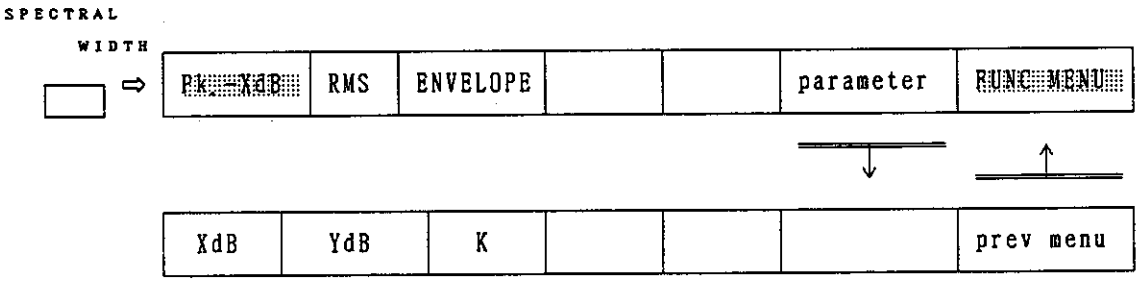
(4) DISPLAY Section

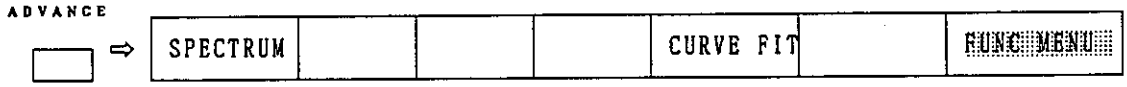




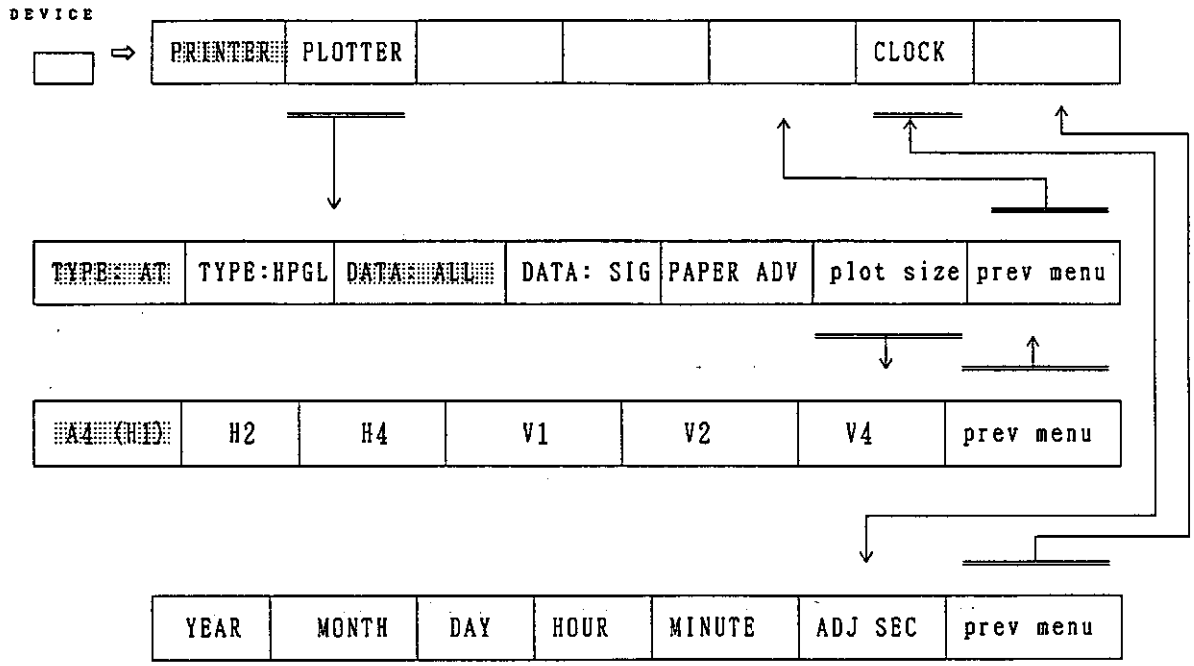




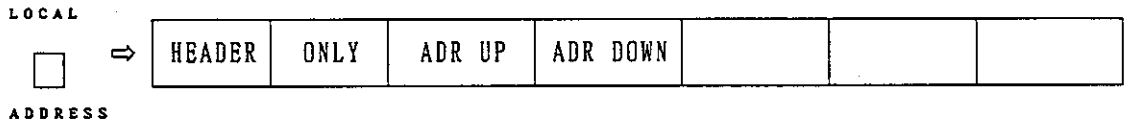




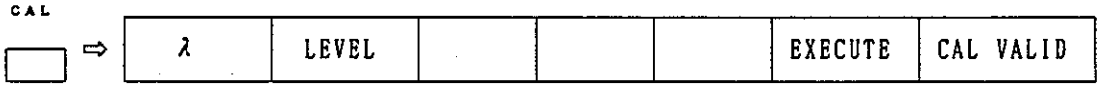
(5) PLOT OUT Section



(6) GP-IB Section



(7) Other



5.2 Functions and Softkey Menus of Keys

Keys can be classified into three types according to what they do when pressed: instantly perform function; display sofkey menu; and act as input data terminator initiating operation according to the setting conditions. The softkeys function is three different ways: instantly perform function; select something; or display sub-menu. The knob is used to set FUNCTIONs (CENTER, SPAN, REF LEVEL, etc.) and to move the cursor. Because the cursor, if turned on, takes priority over the knob, turn off the cursor before using the knob in the FUNCTION section.

5.2.1 FUNCTION Section

The FUNCTION section contains keys that are used to set the most basic measuring conditions of the optical spectrum analyzer.

CENTER

Sets center wavelength. Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
PEAK	Sets the peak level wavelength as the center wavelength.
CURSOR	Sets the cursor wavelength as the center wavelength. When two cursors are being used, sets the wave in the middle of the two cursors as the center wavelength.

SPAN

Sets wavelength range span, start wavelength, and stop wavelength. Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
SPAN	For setting the wavelength span.
START	For setting the start wavelength.
STOP	For setting the stop wavelength.
Δλ→SWEEP	Sets the portion sandwiched by the two cursors to partial sweep mode.
Δλ→SPAN	Sets the portion sandwiched by the two cursors as a span.
FULL	Sets the maximum span (1.15μm between 0.6μm and 1.75μm)

REF LEVEL

Sets the input sensitivity to match the input signals. Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
PEAK	Sets the input sensitivity to match the input signals.
CURSOR	Sets the cursor position level to REF LEVEL. When two cursors are being used, the portion sandwiched by the two cursors is set as the FULL level.
AUTO	Selects the mode that optimizes REF LEVEL to match the input signals.

LEVEL SCALE

Sets the level axis scale. Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
LIN/LOG	Switches between linear and log.
10dB/D	Sets 10dB/DIV scale.
5dB/D	Sets 5dB/DIV scale.
2dB/D	Sets 2dB/DIV scale.
1dB/D	Sets 1dB/DIV scale.
0.5dB/D	Sets 0.5dB/DIV scale.
0.2dB/D	Sets 0.2dB/DIV scale.

AUTO

Automatically optimizes wavelength, level, and other conditions to match the input signals.

[Softkey Menu Display]	[Softkey Function]
FULL	Sets the optimum condition found in the entire wavelength range.
0.6 ~ 1.0	Sets the optimum condition found in the 0.6μm to 1.0μm range.
0.9 ~ 1.75	Sets the optimum condition found in the 0.9μm to 1.75μm range.

AVG

Sets the number of averaging processing. Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
1(OFF)	Sets the number of averaging processing to 1(OFF).
2	Sets the number of averaging processing to 2.
5	Sets the number of averaging processing to 5.
10	Sets the number of averaging processing to 10.
20	Sets the number of averaging processing to 20.
50	Sets the number of averaging processing to 50.
100	Sets the number of averaging processing to 100.

SWEEP MODE

Sets the sweep mode. (Select the mode that best matches the measuring signal level and measuring time.)

[Softkey Menu Display]	[Softkey Function]
RAPID	Selects RAPID (high-speed measuring).
NORMAL	Selects NORMAL (that accurately measures up to -50dBm).
ADAPTIVE	Selects ADAPTIVE (that accurately measures low level).
HIGH SENS	Selects HIGH SENS (that accurately measures high level).

AVG

Sets wavelength resolution. Use the numeric keys, knob, arrow keys, and softkeys.

0.1nm	Sets resolution at 0.1nm
0.2nm	Sets resolution at 0.2nm
0.5nm	Sets resolution at 0.5nm
1.0nm	Sets resolution at 1.0nm
2.0nm	Sets resolution at 2.0nm
5.0nm	Sets resolution at 5.0nm

5.2.2 CURSOR Section

The CURSOR section contains keys that are used to control the cursor for analyzing measured data.

ON/OFF

Turns the cursor display on or off. When it is on, the following softkey menu is displayed. Select the cursor data display format using the softkey.

[Softkey Menu Display]	[Softkey Function]
NORMAL	Mode that displays wavelength and level of the cursor position.
⊿MODE	Mode that displays wavelength difference and level difference of the cursor position.
2ND PEAK	Mode that displays wavelength difference, level difference between the peak and the second peak.
POWER	Mode that displays the level power between two wavelength cursors.

λ1

Turns the wavelength cursor 1 on or off.

λ2

Turns the wavelength cursor 2 on or off.

L1

Turns the level cursor 1 on or off.

L2

Turns the level cursor 2 on or off.

* The λ1, λ2, L1 or L2 cursor can be moved only when its associating LED is lit.

5.2.3 DATA Section

The DATA section contains numeric keys and arrow keys that are used to reset conditions and label keys that are used to enter comments.

LABEL

Resets labels (comments). Use the numeric keys, knob, arrow keys, and softkeys.

[Softkey Menu Display]	[Softkey Function]
⇦	Moves the cursor to the left within the label data range.
⇨	Moves the cursor to the right within the label data range.
DEL CHR	Deletes the character under the cursor if the cursor is within the label data range.
INP SP	Inserts a space at the cursor, shifting the character under the cursor to the right, if the cursor is within the label data range.
CLR LINE	Deletes all the label data.

Also use the following keys to reset labels.

Knob	Moves the cursor to the right or left within the character menu.
Arrow keys	Moves the cursor up or down within the character menu.
BACK SPACE	Deletes the character to the left of the cursor, if the cursor is within the label data range.
ENTER	Enters the character under the cursor within the character menu to the label data cursor position.

5.2.4 DISPLAY Section

The DISPLAY section contains keys that are used to set display formats, analyze measurements, and control data memory.

CONTROL

Sets display modes. Use softkeys.

[Softkey Menu Display]	[Softkey Function]
GRAPH CLR	Clears the waveform data on the screen.
S. IMPOSE	Turns the super impose mode display on or off.
DUAL	Turns the dual screen display mode on or off.
3D	Sets ON/OFF and display conditions of the three-dimensional display mode.
3D ON/OFF	Controls ON/OFF in the three-dimensional display mode.
INC ANGLE	Increases the display angle by 1 step (15°). (Maximum : +75°)
DEC ANGLE	Decreases the display angle by 1 step (15°). (Maximum : -75°)
CSR NEXT	Moves the cursor to the next measured data.
DELETE	Deletes the preceding measured data.
more	Displays the next soft key menu.
CLEAR	Clears all preceding three-dimensional display data from memory.
INC N	Increases the number of displayable data by 1. (Maximum : 16)
DEC N	Decreases the number of displayable data by 1. (Minimun : 1)
N LOCK	Sets whether sweep operation should stop or not when measurement of the maixmum number of displayable data is completed.
ROLL	Controls ON/OFF in ROLL display mode.
RECALL	Recalls and displays preceding three-dimensional data.
prev menu	Returns the soft key menu to the previous menu.
prev menu	Returns the soft key menu to the previous menu.

[Softkey Menu Display] (Cont'd)	[Softkey Function]
GRID	Turns the grid inside the data display frame on or off.
SAVE	Saves the measurements, panel setting in the internal memory. Use sofkeys and numeric keys.

[Softkey Menu Display]	[Softkey Function]
SAV REF	Saves data in the reference memory.
SAV MEAS1	Saves data in the data memory 1.
SAV MEAS2	Saves data in the data memory 2.
SAV MEAS3	Saves data in the data memory 3.
SAV PANEL	Saves panel setting conditions in the memory 1 to 9. Immediately after pressing this key, press one of the numeric keys (1 to 9) and then the ENTER key.

RECALL

Recalls the measurements, panel settings saved in the internal memory. Use softkeys and numeric keys.

[Softkey Menu Display]	[Softkey Function]
RCL REF	Recalls data saved in the reference memory.
RCL MEAS1	Recalls data saved in the data memory 1.
RCL MEAS2	Recalls data saved in the data memory 2.
RCL MEAS3	Recalls data saved in the data memory 3.
RCL PANEL	Recalls panel setting conditions saved in the memory 1 to 9. Immediately after pressing this key, press one of the numeric keys (1 to 9) and then the ENTER key.

NORMALIZE LOSS/TRANS

Normalizes the measurements to the reference memory or the maximum spectrum value in the memory and displays the result.

[Softkey Menu Display]	[Softkey Function]
Pk. NORM	Normalizes the measurements to the maximum spectrum value and displays the result.
REF NORM	Executes the measurement memory 1 and reference memory data operation and displays the result.
LOSS	Executes LOSS characteristic (N=REF/MEAS) operation.
TRANS	Executes transparent characteristic (N=MEAS/REF) operation.
SAV REF	Saves data in the reference memory.
FUNC MENU	Determines whether to change the softkey menu or not, when one of the FUNCTION section keys is pressed.

SPECTRAL WIDTH Calculates the pulse duration in one of the three methods, and displays the result.

[Softkey Menu Display]	[Softkey Function]
Pk. -XdB	Calculates the pulse duration in XdB method and displays the result.
RMS	Calculates the pulse duration in RMS method and displays the result.
ENVELOPE	Calculates the pulse duration in ENVELOPE method and displays the result.
paraneter	Sets the parameter necessary to calculate the pulse duration.
XdB	Sets X, the difference between the peak and the descending level.
YdB	Sets Y, the peak count threshould level.
K	Sets K, the coefficient to the calculated pulse duration.
prev menu	Goes back to the menu before the softkey menu.
FUNC MENU	Determines whether to change the softkey menu or not, when one of the FUNCTION section keys are pressed.

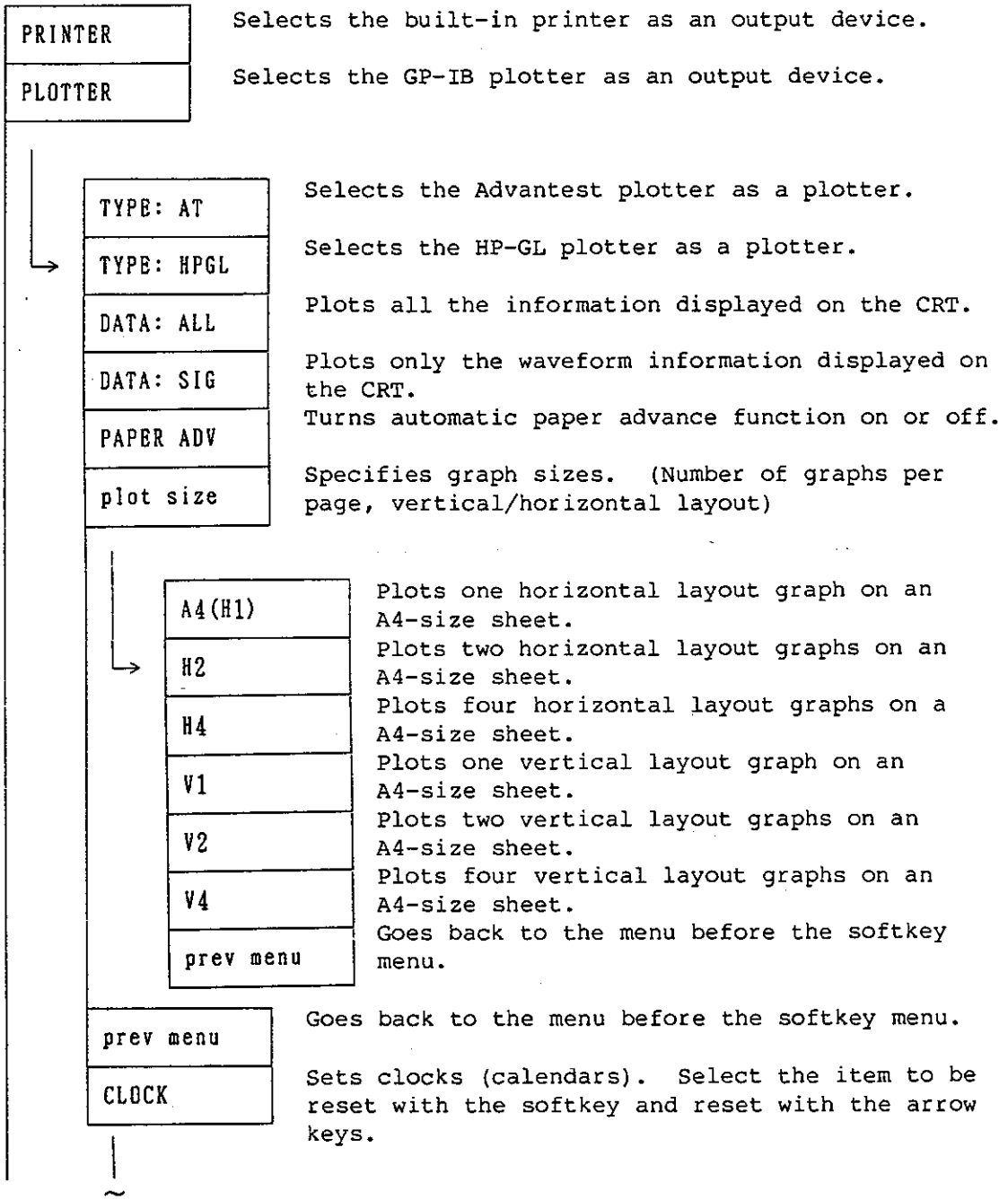
ADVANCE Use this key to analyze high level waveforms.

[Softkey Menu Display]	[Softkey Function]
SPECTRUM	Specifies the ordinary spectrum analysis function.
CURVE FIT	Curve fits the measured spectrum waveform with the specified functional waveform and displays the result.
FUNC MENU	Determines whether to change the softkey menu or not, when one of the FUNCTION section keys are pressed.

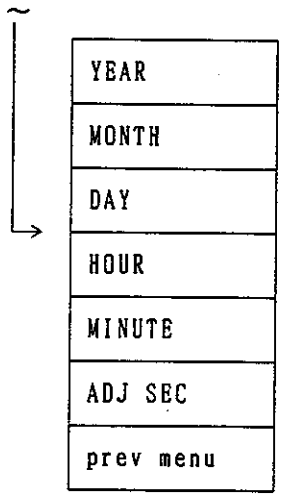
5.2.5 PLOT OUT Section

The PLOT OUT section contains keys that are used to output measured data and set clocks (calendars).

DEVICE Specifies the output device or sets clocks.



(continued on next page)



- Resets the year.
- Resets the month.
- Resets the day.
- Resets the hour.
- Resets the minutes.
- Resets the seconds.
- Goes back to the menu before the softkey menu.

COPY

Starts outputting data.

FEED

Feeds printer paper.

5.2.6 GP-IB Section

The GP-IB section contains keys that are used to set GP-IB addresses and switch to local operation.

LOCAL

ADDRESS

Sets GP-IB addresses, when the REMOTE lamp is lit; switches to local operation, when the REMOTE lamp is not lit.

[Softkey Menu Display]	[Softkey Function]
HEADER	Sets whether to add the header or not to the output data.
ONLY	Switches between the talk only mode (effective at plotter output) and addressable mode (in which address settings from the external controller are accepted).
ADR UP	Increases address.
ADR DOWN	Decreases address.

5.2.7 Other

CAL

Calibrates wavelength or level.

[Softkey Menu Display]	[Softkey Function]
λ	For inputting wavelength calibration data.
LEVEL	For inputting level calibration data.
EXECUTE	For executing calibration.
CAL VALID	For making the calibrated data effective.

MEMO

6. GP-IB INTERFACE

This chapter describes command names (programming names of the keys), data arrangements, and reference programs.

6.1 General

Equipped with the GP-IB interface, the Q8381 optical spectrum analyzer can be remotely controlled by a general-purpose interface bus (GP-IB) that conforms to IEEE Standard 488-1978.

Functions of the GP-IB interface are as follows:

(1) Setting

① Panel Setting : Has the same function as the manual panel setting (including label setting).

② Data Send Mode Setting: Sets various data send formats and read commands, turns the header on or off, and selects delimiters.

(2) Reading

① Reads the panel setting state.

② Reads the following data: Cursor data, wavelength data, and level data.

(3) Service Request

This function is enabled when a setting error or operation end is detected. It also masks specific service request factors.

The GP-IB is an interface system that can connect measuring equipment, controllers, and peripheral devices by simple cabling (bus line).

The GP-IB is ont only more flexible and easier to use than the conventional interface systems, but it also electrically, mechanically and functionally compatible with products manufactured by other companies. A single bus cable can configure all types of automatic measuring systems from basic to high-end.

In the GP-IB system, addresses of the devices on the other end of the bus cables must be set in advance. Each system component acts as one or more of the following: controller, talker, listener. During system operations only one talker can send data on the bus cable but multiple listeners receive the data.

The controller sets addresses of the listener and talker, transmits data from the talker to the listener, and also switches itself from the talker to the listener, and vice versa.

Eight bit-parallel and byte-serial data lines are used to synchronously and bi-directionally transfer data between devices. Both high-speed and low-speed devices can be connected to the GP-IB system because of the synchronous feature.

Data (messages) includes measurement data, measuring conditions (programs), and commands, all represented in ASCII code.

In addition to the eight data lines mentioned earlier, the GP-IB has three handshake lines for controlling synchronous data transmissions between devices and five control lines for controlling data flow on the bus.

- Handshake lines handle the following signals:

DAV (Data Valid)	:	Indicates whether the data is valid or not.
NRFD (Not Ready For Data)	:	Indicates whether it is ready to transmit data.
NDAC (Not Data Accepted)	:	Indicates whether data reception has completed or not.

- Control lines handle the following signals:

ATN (Attention)	:	Indicates whether the data line signal is an address, command, or other.
IFC (Interface Clear)	:	Clears the interface.
EOI (End of Identify)	:	Used at the end of data transfer.
SRQ (Service Request)	:	Used by a device to request the controller service.
REN (Remote Enable)	:	Used when remote controlling a remote programmable device.

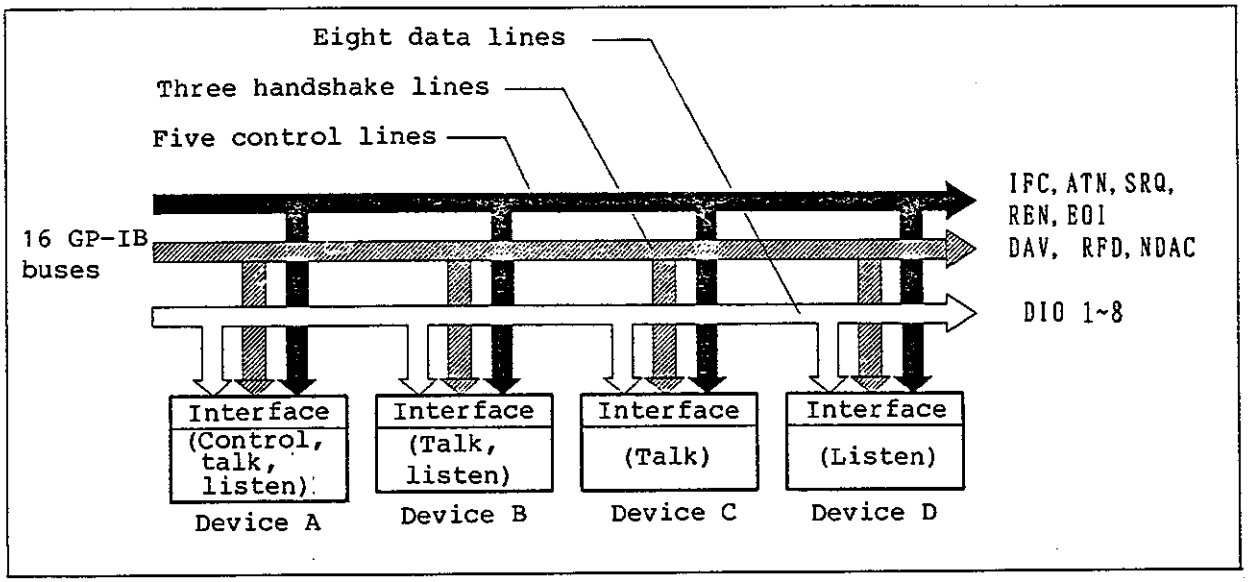


Figure 6 - 1 GP-IB Outline

6.2 Specifications

6.2.1 GP-IB Specifications

Standard : IEEE488-1978

Code used : ASCII (Packed format: binary code)

Logic level : Logical 0 (high) is +2.4V or more.
Logical 1 (low) is +0.4V or less.

Driver : Open collector

Signal line end : 16 bus lines are terminated as shown in Figure 6-2.

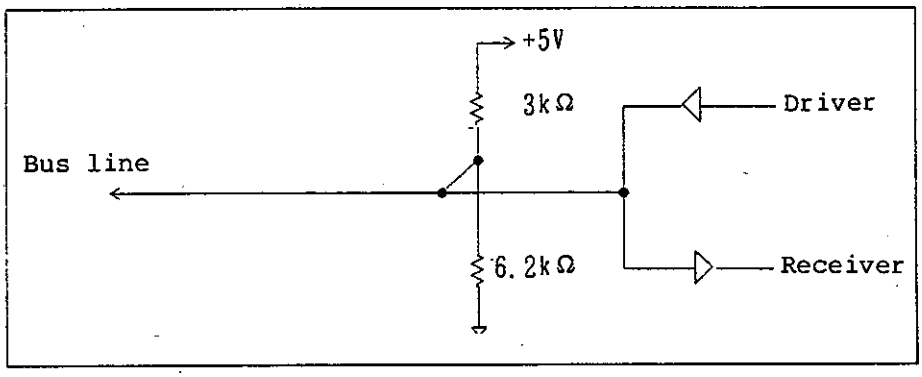


Figure 6 - 2 Signal Line End

Driver : Three-state
"low" output voltage: +0.4V or less, 48mA
"high" output voltage: +2.4V or more, -5.2mA

Receiver : +0.6V or less: low
+2.0V or more: high

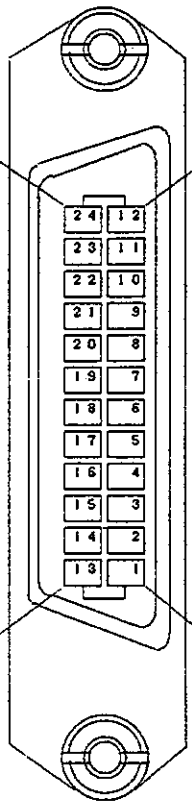
Bus cable length: The total bus cable length should not exceed 20m and should be shorter than 2m x (the number of devices connected to the bus).

Address setting : 31 talk/listen addresses can be set by the LOCAL ADDRESS switches on the front panel.

Connector : 24-pin GP-IB connector
57-20240-D35A (or the equivalent manufactured by Anphenol Co., Ltd.)

24-pin GP-IB Connector

Signal name	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
DIO8	16
DIO7	15
DIO6	14
DIO5	13



Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO4
3	DIO3
2	DIO2
1	DIO1

Figure 6 - 3 GP-IB Connector Pin Arrangement

6.2.2 Interface Functions

Table 6-1 lists GP-IB interface functions.

Table 6 - 1 Interface Functions

Code	Function and explanation
SH1	Source handshake function
AH1	Acceptor handshake function
T5	Basic talker, serial polling, talker-only*, listener-specified talker cancellation functions
L4	Basic listener, talker-specified listener cancellation functions
SR1	Service request function
RL1	Remote function
PP0	Parallel polling function, not provided.
DC1	Device clear function, provided.
DT1	Device trigger function, provided.
C0	Controller function, not provided.
E2	Three state bus driver is used.

* The talker-only function is effective against the plotter.

6.3 Handling GP-IB

6.3.1 Connecting System Components

The GP-IB system, which consists of a number of devices, must be set up with the following points in mind.

(1) Before connecting, check for the ready state and functions of each system component according to the main unit, controller, and peripheral instruction manuals.

(2) The length of connection cables to measuring equipment or bus cables to controllers must be as short as possible. Each bus cable length must be within the specified range. The total bus cable length should not exceed 20m and should be shorter than 2m x (the number of devices connected to the bus). ADVANTEST standard bus cables are as follows:

Table 6 - 2 Standard Bus Cables (Option)

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

(3) When connecting bus cables, do not link up three or more connectors together. Fasten the connectors tightly with screws.

The bus cable connector is of the piggyback type; each connector has both male and female connectors so that two piggyback connectors can be linked.

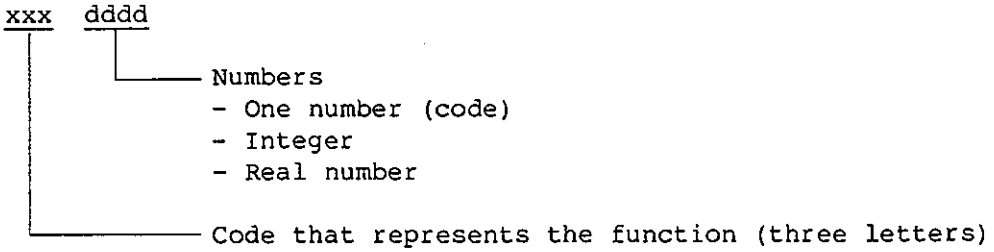
(4) Check the power supply, grounding, and setting conditions of the system components before turning on the power.

Be sure to turn on the power of all the system components. Otherwise, the system operation is not assured.

6.3.2 Program Code (Listener Format)

This section shows the program codes used by the external controller when setting the main unit conditions. Each program code consists of three alphabetic letters, that represent the function, and numbers, that set the value.

- Basic program code format



To enter the condition setting, and "?" to the function code. (After "xxx?" is sent, the main unit is set as a talker to enter the data.) This setting is effective only if the setting READ column is marked o.

* Both capitals and small letters are acceptable as function codes and units.

- FUNCTION (1/2)

Item		Program code		Contents	Setting READ
		Function	Setting		
CENTER	CENTER	CEN	Number + unit	Unit UM: µm NM: nm	o
	PEAK	PKC	-	peak to center	x
	CURSOR	CUC	-	cursor to center	x
SPAN	SPAN	SPA	Number + unit	Unit UM: µm NM: nm NMD: nm/DIV	o
	START	STA	Number + unit	Unit UM: µm NM: nm	o
	STOP	STO	Number + unit	Unit UM: µm NM: nm	o
	Δλ ⟶ SWEEP	PSW	0, 1	0: OFF 1: ON	o
	Δλ ⟶ SPAN	LSP	-		x
	FULL	FSP	-	FULL SPAN	x

- FUNCTION (2/2)

Item		Program code		Contents	Setting READ
		Function	Setting		
REF LEVEL	REF LEVEL	REF	Number + unit	Unit DBM: dBm MW: mW UW: µW NW: nW	o
	PEAK	PKL	-	peak to ref level	x
	CURSOR	CUL	-	cursor to ref level	x
	AUTO	RAU	0, 1	0: OFF 1: ON	o
LEVEL SCALE	LIN/LOG	LIN	0, 1	0: OFF (LOG) 1: ON (LIN)	o
	LEVEL SCALE	LEV	0 to 5	0: 10dB/D 1: 5dB/D 2: 2dB/D 3: 1dB/D 4: 0.5dB/D 5: 0.2dB/D	o
AUTO		AUT	0 to 3	0: OFF (STOP) 1: FULL SPAN 2: 0.6 to 1.0µm 3: 0.9 to 1.75µm	x
AVG		AVG	1 to 1024	Integer	o
SWEEP MODE		SWE	0 to 3	0: RAPID 1: NORMAL 2: ADAPTIVE 3: HIGH SENS	o
RESOLUTION		RES	0 to 5	0: 0.1nm 1: 0.2nm 2: 0.5nm 3: 1.0nm 4: 2.0nm 5: 5.01nm	o

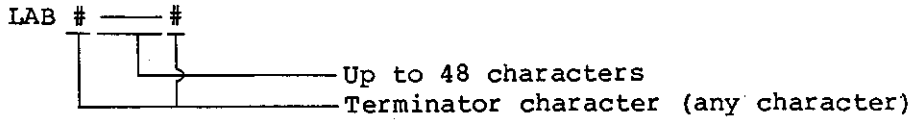
- CURSOR

Item		Program code		Contents	Setting READ
		Function	Setting		
CURSOR ON/OFF		CUR	0, 1	0: CURSOR OFF 1: CURSOR ON	o
λ1	ON/OFF	XAC	0, 1	0: X1 OFF 1: X1 ON	o
	SET X1	XAS	Number + unit	Unit UM: μm NM: nm	
λ2	ON/OFF	XBC	0, 1	0: X2 OFF 1: X2 ON	o
	SET X2	XBS	Number + unit	Unit UM: μm NM: nm	
L1	ON/OFF	YAC	0, 1	0: Y1 OFF 1: Y1 ON	o
	SET Y1	YAS	Number + unit	Unit DBM: dBm MW: mW UW: μW NW: nW	
L2	ON/OFF	YBC	0, 1	0: Y2 OFF 1: Y2 ON	o
	SET Y2	YBS	Number + unit	Unit DBM: dBm MW: mW UW: μW NW: nW	
CURSOR DATA		CUD	0 to 3	0: NORMAL 1: ΔMODE 2: 2ND PEAK 3: POWER	o

- LABEL

Item	Program code		Contents	Setting READ
	Function	Setting		
LABEL	LAB*	See * below.		o

* Set the LAB code in the following format.



- MEASURE

Item	Program code		Contents	Setting READ
	Function	Setting		
MEASURE	MEA	0, 1, 2	0: STOP 1: SINGLE 2: REPEAT	o

- DISPLAY (1 of 2)

Item		Program code		Contents	Setting READ
		Function	Setting		
CONTROL	GRAPH CLR	GCL	——		x
	SUPER IMPOSE	SIM	0, 1	0: OFF 1: ON	o
	DUAL	DUA	0, 1	0: OFF 1: ON	o
	GRID	GRI	0, 1	0: OFF 1: ON	o
	3D	TDM	0, 1	0: OFF 1: ON	o
	3D ANGLE	TAN	-75 to +75 (15 step)	-75° to +75°:display angle	o
	3D CUESOR NO	TCN	1 to 16	1 to 16 : data number	o
	3D DELETE	TDL	——		x
	3D CLEAR	TCL	——		x
	3D MAX NO	TMX	1 to 16	1 to 16 : maximum number of displayable data	o
	3D N LOCK	TNL	0, 1	0: N-LOCK OFF 1: N-LOCK ON	o
	3D ROLL	TRO	0, 1	0: ROLL OFF 1: ROLL ON	o

- DISPLAY (2 of 2)

Item		Program code		Contents	Setting READ
		Function	Setting		
	3D RECALL	TRC	—		x
SAVE	SAVE DATA	SAV	0 to 3	0: REF 1: MEAS1 2: MEAS2 3: MEAS3	x
	SAVE PANEL	SVP	1 to 9	1 to 9: PANEL 1-9	x
RECALL	RECALL DATA	RCL	0 to 3	0: REF 1: MEAS1 2: MEAS2 3: MEAS3	x
	RECALL PANEL	RCP	1 to 9	1 to 9: PANEL 1-9	x
NORMAL-IZE	PEAK NORM.	PNR	0, 1	0: OFF 1: ON	o
	REF NORM.	RNR	0, 1	0: OFF 1: ON	o
	LOSS	LOS	0, 1	0: OFF 1: ON	o
	TRANS	TRA	0, 1	0: OFF 1: ON	o
SPECTRAL WIDTH	SPEC. WIDTH	SPW	0, 1	0: OFF 1: ON	o
	WIDTH TYPE	WTY	0, 1, 2	0: PK-XdB 1: RMS 2: ENVELOPE	o
	XdB para.	WPX	Number		o
	YdB para.	WPY	Number		o
	K para.	WPK	Number		o
ADVANCE	SPECTRUM	SPE	0, 1	0: OFF 1: ON	o
	CURVE FIT	CFT	0, 1	0: OFF 1: ON	o
	INPUT	PIS	0, 1	0: THROOGH 1: PRESELECTOR	
	SYNC	SYN	0, 1	0: SYNCHRONIZE STOPS 1: SYNCHRONIZE STARTS	

- PLOT OUT

Item		Program code		Contents	Setting READ
		Function	Setting		
DEVICE	DEVICE TYPE	DEV	0, 1	0: PRINTER 1: PLOTTER	o
	PLOTTER TYPE	PTY	0, 1	0: ADVANTEST 1: HPGL	o
	PLOT DATA	PDT	0, 1	0: ALL 1: SIGNAL only	o
	PAPER ADV.	PPA	0, 1	0: OFF 1: ON	o
	PLOT SIZE	PSZ	0 to 5	0: A4 (H1) 1: H2 2: H4 3: V1 4: V2 5: V4	o
	BUZZER(BEEP)	BUZ	0, 1	0: OFF 1: ON	o
	WARNING	WAR	0, 1	0: OFF 1: ON	o
COPY & FEED	COPY	COP	-	Starts outputting to the printer or plotter.	x
	FEED	FEE	-	Feeds paper approximately 5mm.	x
CLOCK		CLO*	See * below.	Sets date and time.	o

* Set the CLO code in the following format:

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

Terminator character ("#" or "!")

YY: Year (2-digit number)
MM: Month (01 to 12)
DD: Day (01 to 31)
hh: hour (00 to 23)
mm: minutes (00 to 59)
ss: seconds (00 to 59)

- CODE FOR OTHER KEYS

Item		Program code		Contents	Setting READ
		Function	Setting		
INSTR PRESET		IPR	-	Resets to preset initial measuring conditions.	x
CAL	λ	CLM	Number + unit	Unit UM: µm NM: nm	x
	LEVEL	CLV	Number + unit	Unit DBM: dBm MW: mW UW: µW	x
	CAL	CAL	1 to 3	1: Calibrates 2: Calibrates level λ 3: Calibrates λ and level	x
	VALID	CVA	0, 1	0: Make calibrated data valid 1: Make calibrated data invalid	

- DATA OUTPUT CONTROL, etc. (1 of 2)

Item	Program code		Contents	Setting READ
	Function	Setting		
Controls SRQ signal	SRQ	0, 1	0: Mode in which SRQ is not sent. 1: Mode in which SRQ is sent.	o
Masks status bytes	MSK	0 to 255	Sets 1 to the bit of the status byte to be masked. (Initial value is 0.) Example: To mask bit 0 and bit 1 "MSK3"	o
Clears status bytes	CSB	-		x
Controls header data outputs	HED	0, 1	0: HEADER OFF 1: HEADER ON	o
Specifies block delimiters	DEL	0, 1, 2	0: CR, LF (EOI) 1: LF 2: (EOI)	o
Specifies string delimiters	SDL	0, 1, 2	0: ',' (comma) 1: ' ' (space) 2: CR, LF	o

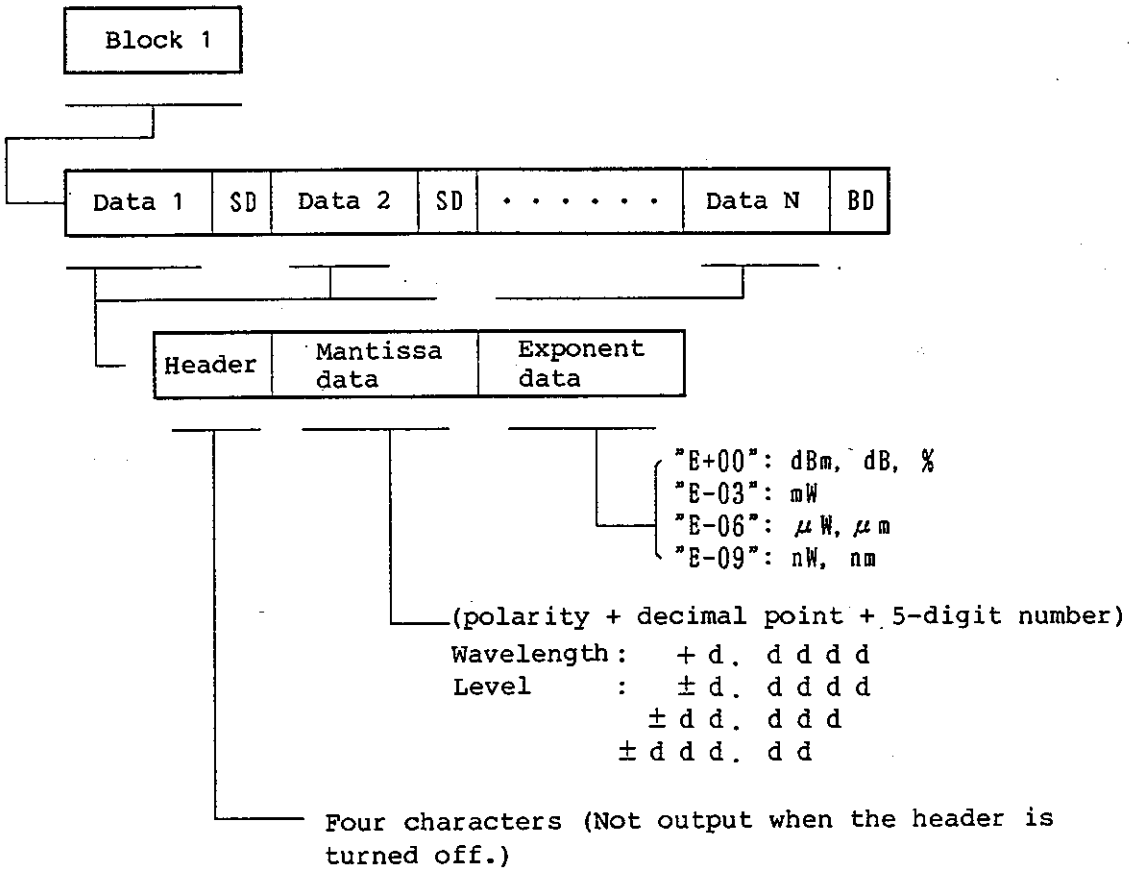
- DATA OUTPUT CONTROL, etc. (2 of 2)

Item	Program code Function	Setting	Contents	Setting READ
Specifies data output formats (effective for sweep data output)	FMT	0 to 2	0: ASCII 1: BINARY (16 bit) 2: BINARY (64 bit floating)	o
Switches to data output screen	OVS	0, 1	0: upper (upper screen) 1: lower (lower screen) (Effective at dual-screen display)	o
Requests peak search data output	OPK	-		x
Requests waveform data output	OSD	0, 1	0: Outputs y-axis data 1: Outputs x-axis data	x
Requests cursor data output	OCD	-	Data to be output differs depending on the type of cursor read modes.	x
Requests half width data output	OSW	-	Outputs calculated half width data	x
Requests curve fit	OCF	-		x
Three-dimensional display data output	OTD	1 to 16	1 to 16 : data number	x
Starts sweeping	E	-	Used to start sweeping that is identical to the "MEA 1" code function.	x
Resets to initial conditions	C	-	Resets to the same conditions as when the power is turned on.	x

6.3.3 Talker Format

(1) Sweep Data

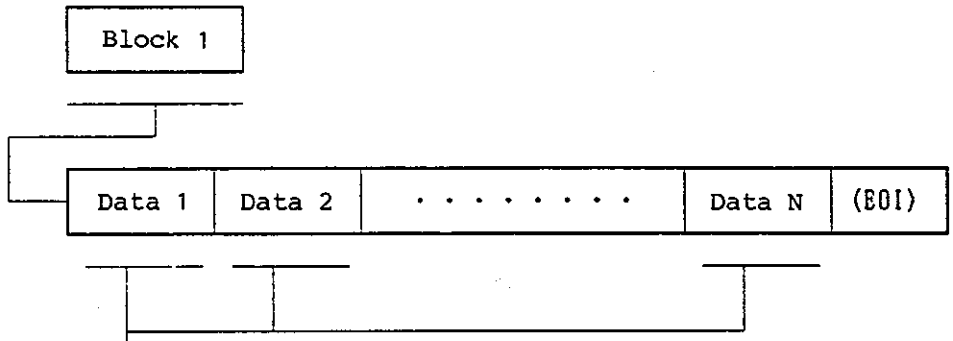
① ASCII Format



Header	Data type
LMUM	Wavelength [μm]
LVLG	Log scale level data [dBm]
LVLI	Linear scale level data
LVRU	Relative value level data
LVPC	% level data

SD: String delimiter (one of the following: ",", " ", CR, LF)
Specify with the program code "SDLn".
BD: Block delimiter (one of the following : CR, LF (EOI), LF (EOI))
Specify with the program code "DELn".

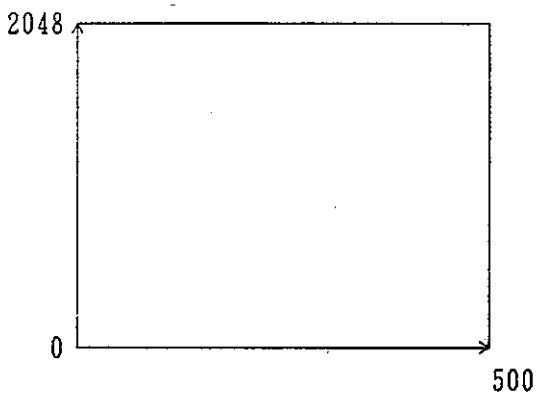
② Binary Format



Outputs in one of the three formats depending on how the format specification code "FMTn" is set.

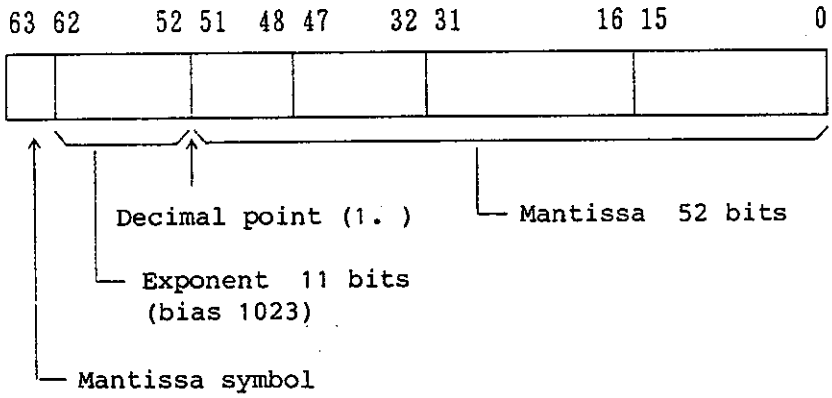
- "FMT1" ... 16 bits (integer)

  Outputs X-axis data in the 0 to 500 range and Y-axis data in the 0 to 2048 range, assuming that every CRT data is a linear scale.



- "FMT2" ... 64 bits (floating point)

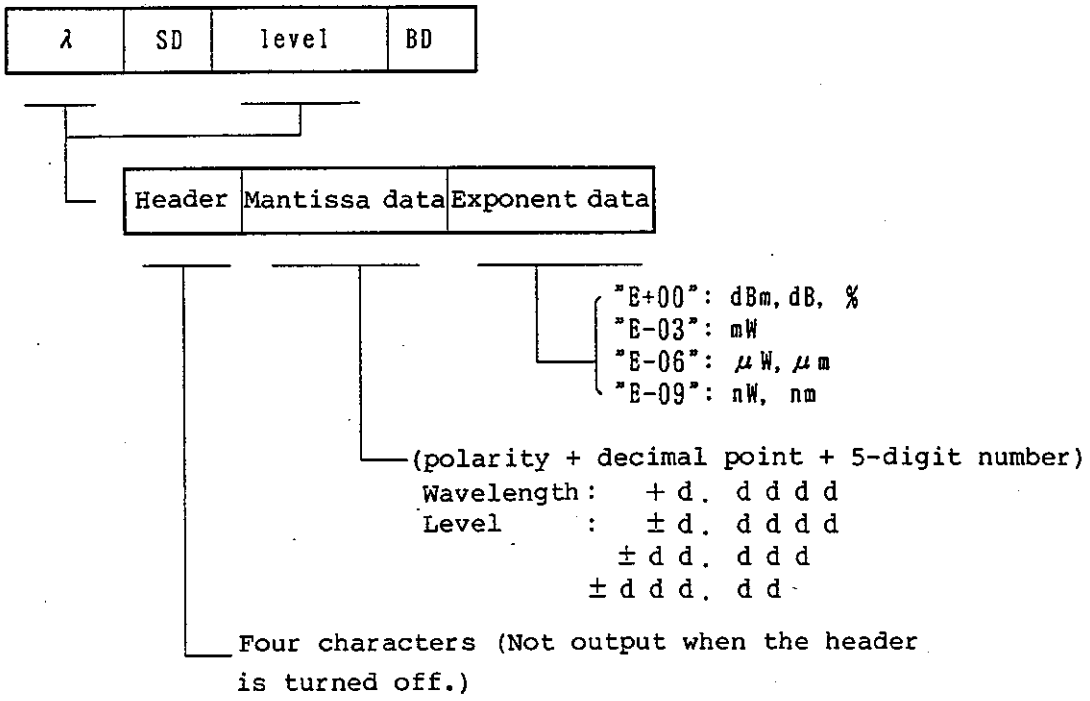
  Outputs data in the following floating point format.



  Numbers are represented in the following expression.

  -1 (Mantissa symbol) x 2 (Exponent - 1023) x 1. + Mantissa

(2) Peak Search Data

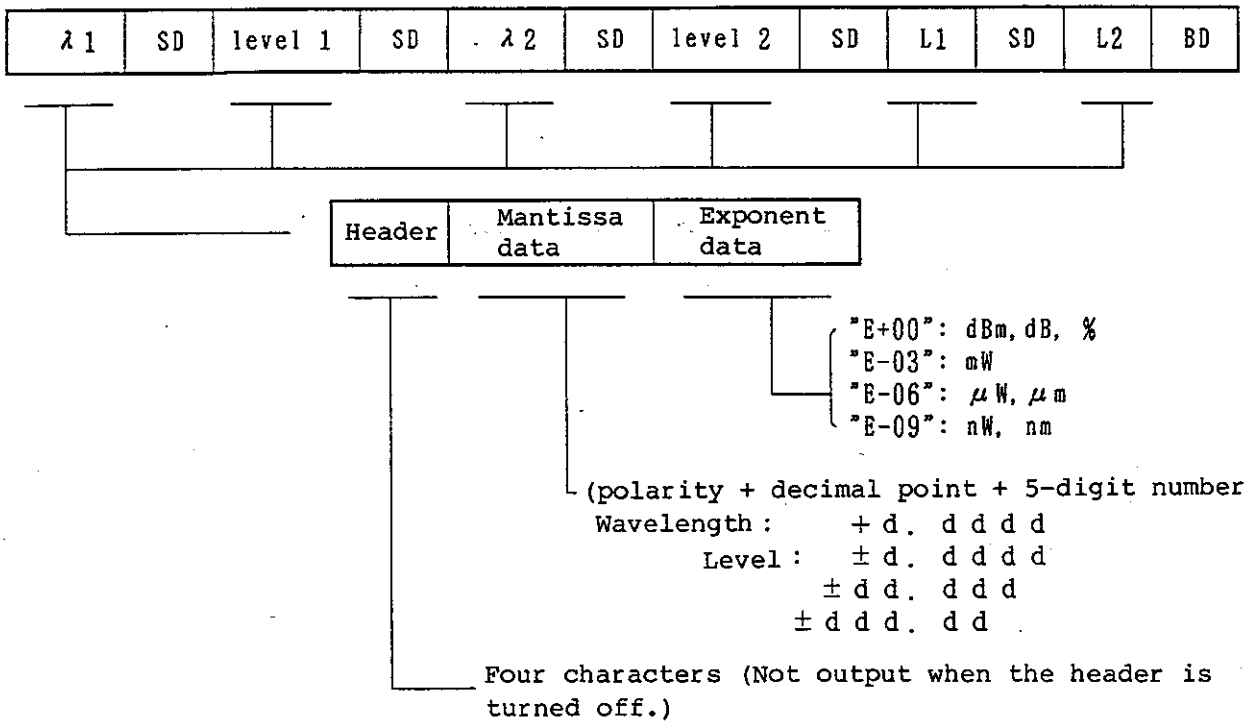


Header	Data type
LMPK	Peak wavelength
LVPK	Peak level

(3) Cursor Data

Cursor data is output in one of the four formats depending on how the cursor read format specification code "CUDn" is set.

① "CUD0" ... NORMAL



Header	Data type
LMXA	X cursor 1 wavelength (λ1)
LVXA	X cursor 1 level (level 1)
LMXB	X cursor 2 wavelength (λ2)
LVXB	X cursor 2 level (level 2)
LVYA	Y cursor 1 level (L1)
LVYB	Y cursor 2 level (L2)

SD: String delimiter (one of the following: ",", " ", CR, LF)
Specify with the program code "SDLn".
BD: Block delimiter (one of the following : CR, LF (EOI), LF (EOI))
Specify with the program code "DELn".

*1 "+0.0000E+00" data is not output if the corresponding cursor is off.

*2 Same format is used for the mantissa and the exponent.

② "CUD1" ... ΔMODE

λ1	SD	level 1	SD	Δλ	SD	Δlevel	SD	L 1	SD	ΔL	BD

Header data: Four characters (Not output if the header is turned off.)

Header	Data type
LMXA	X cursor 1 wavelength (λ1)
LVXA	X cursor 1 level (level 1)
LMDX	Wavelength difference between X cursor 1 and 2 (Δλ)
LVDX	Level difference between X cursor 1 and 2 (Δlevel)
LVYA	Y cursor 1 level (L1)
LVYB	Level difference between Y cursor 1 and 2 (ΔL)

③ "CUD2" ... 2ND PEAK

λ1	SD	level 1	SD	Δλ	SD	Δlevel	BD

Header data: Four characters (Not output if the header is turned off.)

Header	Data type
LMPK	Peak wavelength (λ1)
LVPK	Peak level (level 1)
LMDP	Wavelength difference between peak and 2nd peak (Δλ)
LVDP	Level difference between peak and 2nd peak (Δlevel)

④ "CUD3" ... POWER

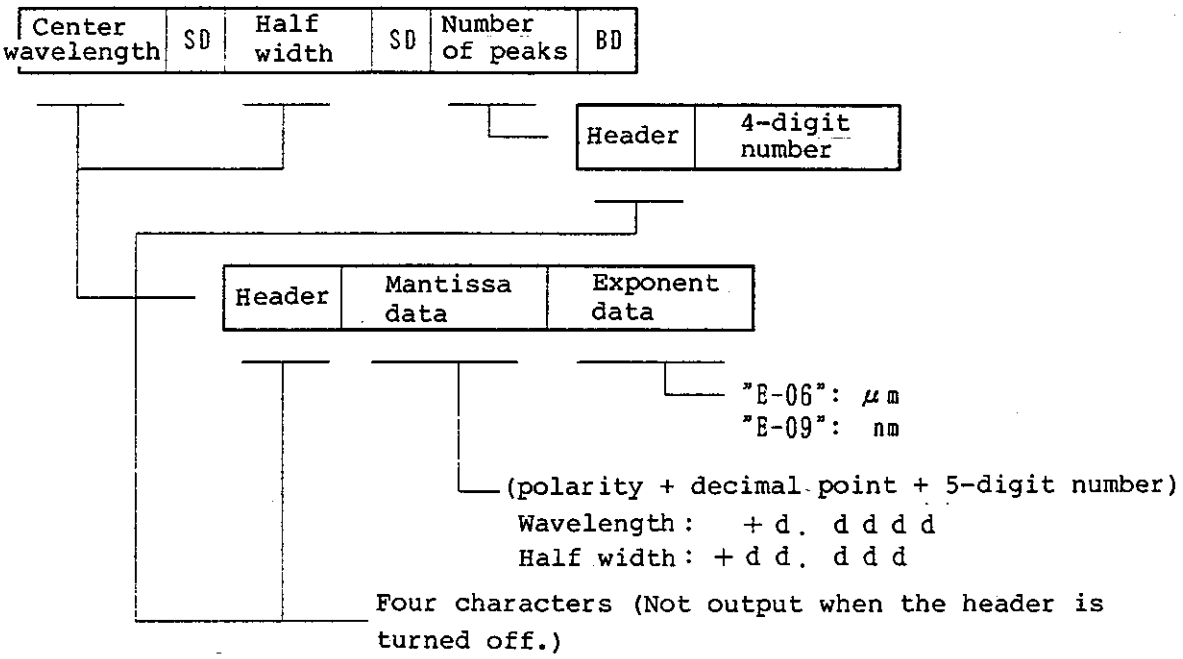
λ1	SD	λ2	SD	ΣL	BD

Header data: Four characters (Not output if the header is turned off.)

Header	Data type
LMXA	X cursor 1 wavelength (λ1)
LMXB	X cursor 2 wavelength (λ2)
LVPW	Sum of levels between X cursor 1 and 2 (ΣL)

(4) Half Width Data

The half width data is output in the following format for all three calculation methods.

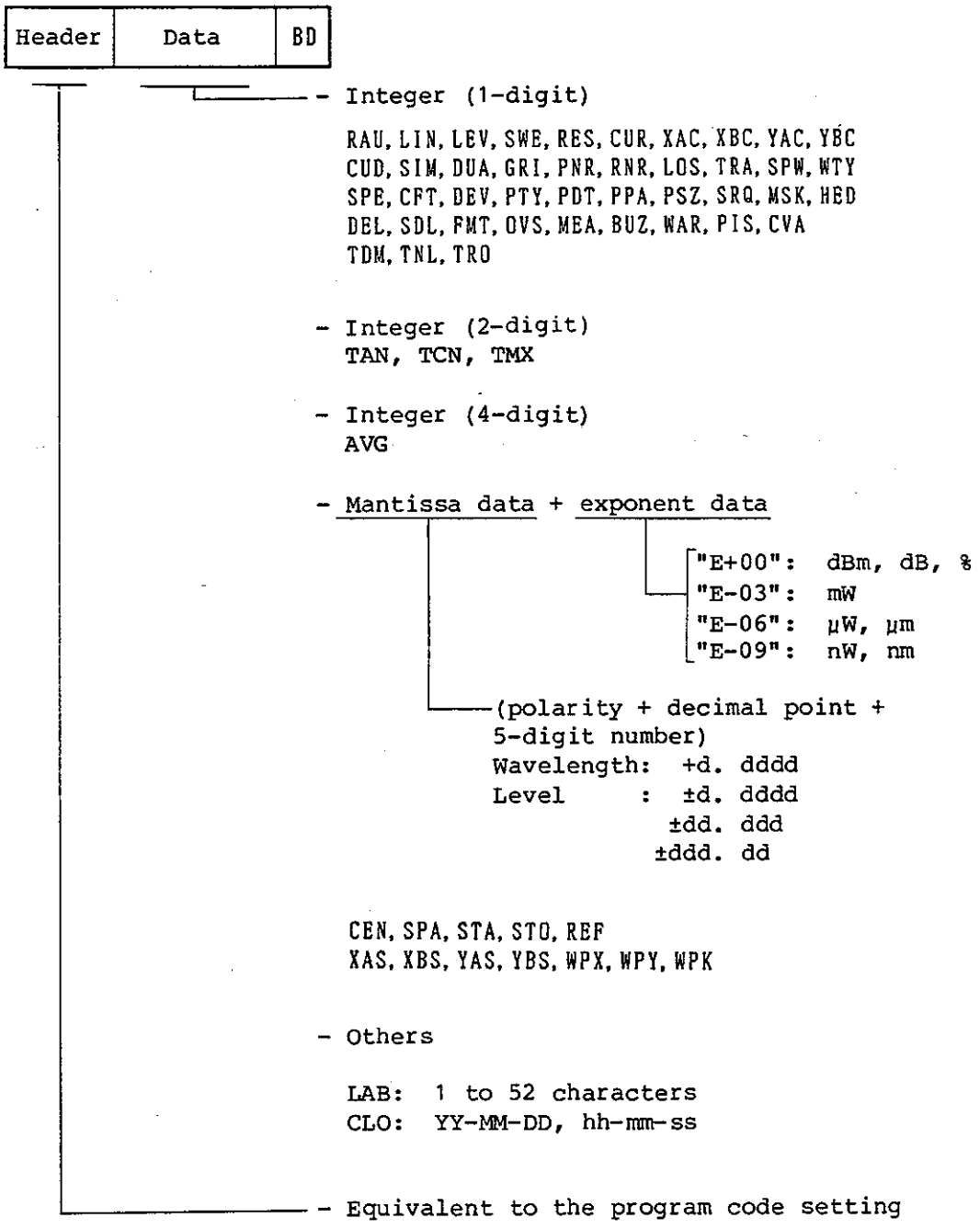


Header	Data type
LMCN	Center wavelength
LMHW	Half width
NOSP	Number of peaks

SD: String delimiter (one of the following: ",", " ", CR, LF)
Specify with the program code "SDLn".
BD: Block delimiter (one of the following : CR, LF (EOI), LF (EOI))
Specify with the program code "DELn".

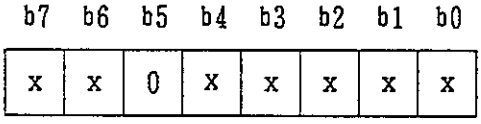
(5) Setting Conditions

Current setting conditions can be entered by substituting "?" for the setting data, if the program code is enabled READ setting. The basic output format of setting conditions are as follows.



6.3.4 Service Request

The main unit, if in "SRQ1" mode, requests the controller service from the various operating states. After requesting a service, it sends status bytes to the controller executing serial polling. (Status bytes are also sent in "SRQ0" mode.) Status byte bits can be masked by the program code "MSKnnn". (All bits are cleared by turnig the power on or by the program code "CSB".)



b0: sweep end
Indicates that there is sweep data to be output. Set to "1" at the end of sweeping. Reset to "0" at the beginning of sweeping or at the end of sweep data output.

b1: syntax error
Set to "1" when the program code contains a grammatical or setting error. Resets to "0" when the next program code is set.

b2: calculation end
Set to "1" at the end of half width calculation or curve fit calculation. Reset to "0" at the beginning of sweeping or at the end of sweep data output.

b3: copy end
Set to "1" at the end of printer or plotter output. Reset to "0" at the beginning of sweeping or when "COP" is received.

b4: sync end
Bit 4 is set to "1" at the end of the synchronization with Q8381 during the use of the Q83811 pre-selector. Reset to "0" when the next program code is set.

b6: RQS
Indicates that the service is being requested. Set to "1" when one of the b0 to b3, b7 bits is set. Reset to "0" when all b0 to b3, b7 bits are reset.

b7: self-test error
Sets to "1" when an error is detected during powering up self-test.

6.3.5 Device Trigger Function

The "GET" (Group Execute Trigger) command performs sweep & measure once in the same manner as when the program code "MEA1" or "E" is received.

6.3.6 Device Clear Function

The "SDC" (Selected Device Clear) command or the "DCL" (Device Clear) command resets to initial conditions at powering up in the same manner as when the program code "C" is received.

Initial conditions are as follows:

- Measuring condition (FUNCTION section): previous state
- Status byte : cleared
- SRQ signal transmission : "SRQ0" mode (in which SRQ signals are not sent.)
- Cursor : all the cursors are off.
- Block delimiter : "DEL0"
  String delimiter : "SDL0"
- Status byte mask : "MSK0" (no mask)
- Normalization, half width: off

6.3.7 Programming Examples

The following are programming examples using the HP's 9000 series 300. (In these examples, the main unit GP-IB address is set to "7".)

(1) Programming Example 1

Setting center wavelength, span, and reading peak wavelength, level

HP-9000 Series 300

```
10    !****************************************
20    !     Q8381 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=707                        ! define Q8381 GP-IB address (7)
120   ON INTR 7 GOSUB Srq            ! define SRQ interrupt routine
130   CLEAR Spa                      ! initialize Q8381
140   OUTPUT Spa;"CEN 1.55um"        ! 'CENTER' set to 1.55um
150   OUTPUT Spa;"SPA 20nm"          ! 'SPAN' set to 20nm
160   OUTPUT Spa;"REF 0dBm"          ! 'REF LEVEL' set to 0dBm
170   OUTPUT Spa;"RES 0"             ! 'RESOLUTION' set to code-0(0.1nm)
180   OUTPUT Spa;"MSK 254"           ! enable 'sweep end' bit
190   OUTPUT Spa;"SRQ 1"             ! enable SRQ signal
200   OUTPUT Spa;"MEA 1"             ! start sweep measure
210   Sweep_end=0                    ! clear measure end flag
220   ENABLE INTR 7;2                ! enable SRQ interrupt
230   IF Sweep_end=0 THEN 230        ! wait measurement end
240   OUTPUT Spa;"OPK"               ! request peak data output
250   ENTER Spa;Peak_lambda,Peak_level       ! read peak lambda,level
260   STOP
270   !
280 Srq:S=SPOLL(Spa)                 ! read status byte of Q8381
290   Sweep_end=1                    ! set sweep end flag
300   RETURN
310   !
320   END
```

- Explanation of Programming Example 1

HP-9000 Series 300

Line No.	Explanation
10 to 70	Notes
80 to 90	Variable definitions
110	Sets Q8381 GP-IB address (7) to variables
120	Defines interrupt processing routine caused by SRQ signals
130	Sets to initial state at powering up
140	Sets the center wavelength to 1.55µm
150	Sets the span to 20nm
160	Sets the reference level to 0dBm
170	Sets resolution to 0.1nm
180	Makes the status byte sweep-end (b0) bit effective
190	Sets to mode in which SRQ signals are sent
200	Starts single sweep and measure
210	Clears the flag which indicates the end of sweeping
220	Permits the SRQ signals to generate an interrupt
230	Waits for the end of sweeping
240	Requests peak data output
250	Reads peak wavelength and peak level data into variables
280	<interrupt processing routine> Executes serial polling and reads status bytes.
290	Sets a flag to indicate the end of sweeping
300	Returns to the main routine

(2) Programming Example 2

Setting measuring conditions, and reading spectrum data (ASCII format)

HP-9000 Series 300

```
10    !****************************************
20    !     Q8381 Optical Spectrum Analyzer
30    !     == sample program 2 ==
40    !     (set-up measurement condition
50    !      and read spectrum data)
60    !****************************************
70    !
80    INTEGER Spa
90    REAL Level(1:501)
100   !
110   Spa=707                        ! define Q8381 GP-IBaddress (7)
120   ON INTR 7 GOSUB srq            ! define SRQ interrupt routine
130   CLEAR Spa                      ! initialize Q8381
140   OUTPUT Spa;"STA 800nm"         ! 'START lambda' set to 800nm
150   OUTPUT Spa;"STO 900nm"         ! 'STOP lambda' set to 900nm
160   OUTPUT Spa;"REF 0.1mW"         ! 'REF LEVEL' set to 0.1mW (select LINEAR)
170   OUTPUT Spa;"RES 3"             ! 'RESOLUTION' set to code-3(1.0nm)
180   OUTPUT Spa;"SWE 1"             ! 'SWEEP MODE' set to code-1(NORMAL)
190   OUTPUT Spa;"AVG 10"            ! 'AVERAGE' set to 10
200   OUTPUT Spa;"MSK 254"           ! enable 'sweep end' bit only
210   OUTPUT Spa;"SRQ 1"             ! enable SRQ signal
220   OUTPUT Spa;"MEA 1"             ! start sweep measure
230   Sweep_end=0                    ! clear measure end flag
240   ENABLE INTR 7;2                ! enable SRQ interrupt
250   IF Sweep_end=0 THEN 250        ! wait measurement end
260   OUTPUT Spa;"FMT 0,HED 0"       ! select ASCII format and header OFF
270   OUTOUT Spa;"OSD0"              ! request sweep data output(level)
280   ENTER Spa;Level(*)             ! read level data
290   !***  spectrum data transaction write here  ***
300   STOP
310   !
320 Srq:S=SPOLL(Spa)                 ! read status byte of Q8381
330   Sweep_end=1                    ! set sweep end flag
340   RETURN
350   !
360   END
```

- Explanation of Programming Example 2

HP-9000 Series 300

Line No.	Explanation
10 to 70	Notes
80 to 90	Variable definitions
110	Sets Q8381 GP-IB address (7) to variables
120	Defines interrupt processing routine caused by SRQ signals
130	Sets the initial state at powering up
140	Sets the start wavelength to 800nm
150	Sets the stop wavelength to 900nm
160	Sets the reference level to 0.1mW (mW unit setting automatically turns on the LINEAR scale)
170	Sets resolution to 1nm
180	Sets the sweep mode to normal
190	Sets the number of averaging to ten
200	Makes the status byte sweep-end (b0) bit effective
210	Sets to mode in which SRQ signals are sent
220	Starts single sweep and measure
230	Clears the flag which indicates the end of sweeping
240	Permits the SRQ signals to generate an interrupt
250	Waits for the end of sweeping
260	Sets the data output format in ASCII and turns off the header
270	Requests sweep data output (level data)
280	Enters level data into array variables at once
290	(Usually, data processing program is written after this line number.)
320	<interrupt processing routine> Executes serial polling and reads status bytes.
330	Sets a flag to indicate the end of sweeping
340	Returns to the main routine

(3) Programming Example 3

Setting measuring conditions and reading spectrum data (binary format)
High-speed transfer

HP-9000 Series 300

```
10    !****************************************
20    !     Q8381 Optical Spectrum Analyzer
30    !     == sample program 3 ==
40    !     (set-up measurement condition
50    !      and read spectrum data with
60    !      64bit floating format)
70    !****************************************
80    !
90    INTEGER Spa
100   REAL Spectrum(1:501) BUFFER
110   !
120   Spa=707                          ! define Q8381 GP-IB address (7)
130   ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
140   CLEAR Spa                        ! initialize Q8381
150   !
160   OUTPUT Spa;"CEN 1.3um"           ! 'CENTER' set to 1.3um
170   OUTPUT Spa;"SPA 10nm"            ! 'SPAN' set to 10nm
180   OUTPUT Spa;"REF -10dBm"          ! 'REF LEVEL' set to -10dBm
190   OUTPUT Spa;"RES 0"               ! 'RESOLUTION' set to code-0(0.1nm)
200   OUTPUT Spa;"SWE 2"               ! 'SWEEP MODE' set to code-2(ADAPTIVE)
210   OUTPUT Spa;"MSK 254"             ! enable 'sweep end' bit only
220   OUTPUT Spa;"SRQ 1"               ! enable SRQ signal
230   TRIGGER Spa                      ! start sweep measure
240   Sweep_end=0                      ! clear measure end flag
250   ENABLE INTR 7;2                  ! enable SRQ interrupt
260   IF Sweep_end=0 THEN 260          ! wait measurement end
270   OUTPUT Spa;"FMT 2"               ! select 64bit floating format
280                                    ! block delimitter (EOI)
290   OUTPUT Spa;"OSDO"                ! request sweep data output(level)
300   ASSIGN @Buf TO BUFFER Spectrum(*)   ! assign path-name for variable
310   ASSIGN @Spa TO Spa               ! assign path-name for Q8381
320   TRANSFER @Spa TO @Buf;WAIT       ! Q8381 level data xfer to Spectrum(*)
330   !***  spectrum data transaction write here  ***
340   STOP
350   !
360 Srq:S=SPOLL(Spa)                   ! read statys byte of Q8381
370   Sweep_end=1                      ! set sweep end flag
380   RETURN
390   !
400   END
```

- Explanation of Programming Example 3

HP-9000 Series 300

Line No.	Explanation
10 to 80	Notes
90	Defines Q8381 GP-IB address variables
100	Defines spectrum data storage variables as "BUFFER"
120	Sets Q8381 GP-IB address (7) to variables
130	Defines interrupt processing routine caused by SRQ signals
140	Sets to same initial state as at powering up
160	Measuring condition setting center wavelength ... 1.3µm
170	span ... 10nm
180	reference level ... -10dBm
190	resolution ... 0.1nm
200	sweep mode ... "ADAPTIVE"
210	Makes the status byte sweep-end (b0) bit effective
220	Sets to mode in which SRQ signals are sent
230	Starts single sweep and measure
240	Clears the flag that indicates the end of sweeping
250	Permits the SRQ signals to generate an interrupt
260	Waits for the end of sweeping
270	Sets data output format to binary (64 bit floating point) (Block delimiter is always at EOI when binary format is in use.)
290	Requests peak data output
300 to 310	Defines I/O route name in the data read array variables and Q8381 and enables buffer transfer mode
320	Starts buffer transfer and waits for it to end
330	(Usually, data processing program is written after this line number.)
360	<interrupt processing routine> Executes serial polling and reads status bytes.
370	Sets a flag to indicates the end of sweeping
380	Returns to the main routine

(4) Programming Example 4

Setting measuring conditions, and reading peak, half width calculation, data

HP-9000 Series 300

```
10    !****************************************
20    !     Q8381 Optical Spectrum Analyzer
30    !     == sample program 4 ==
40    !     (set-up measurement condition
50    !      and calculate spectral width
60    !      ,2ND peak)
70    !****************************************
80    !
90    INTEGER Spa
100   REAL S_width,L_center,N_sp
110   REAL Lm1,Lv1,D_1m,D_1v
120   !
130   Spa=707                          ! define Q8381 GP-IB address (7)
140   ON INTR 7 GOSUB Srq              ! define SRQ interrupt routine
150   CLEAR Spa                        ! initialize Q8381
160   !
170   OUTPUT Spa;"CEN 1.3um"           ! 'CENTER' set to 1.3um
180   OUTPUT Spa;"SPA 10nm"            ! 'SPAN' set to 10nm
190   OUTPUT Spa;"REF -10dBm"          ! 'REF LEVEL' set to -10dBm
200   OUTPUT Spa;"RES 0"               ! 'RESOLUTION' set to code-0(0.1nm)
210   OUTPUT Spa;"SWE 2 "              ! 'SWEEP MODE' set to code-2(ADAPTIVE)
220   OUTPUT Spa;"MSK 254"             ! enable 'sweep end'
230   OUTPUT Spa;"SRQ 1                ! enable SRQ signal
240   TRIGGER Spa"                     ! start sweep measure
250   Sweep_end=0"                     ! clear measure end flag
260   ENABLE INTR 7;2                  ! enable SRQ interrupt
270   IF Sweep_end=0 THEN 270          ! wait measurement end
280   OUTPUT Spa;"CUD 2,CUR 1"         ! select 2ND peak and cursor ON(calculate)
290   OUTPUT Spa;"OCD"                 ! request cursor data output
300   ENTER Spa;lm1,Lv1,D_1m,D_1v      ! read lambda1, level1, d-lambda, d-level
310   OUTPUT Spa;"WTY 0,WPX 3"         ! width type-0(Pk-XdB), X=3dB
320   OUTPUT Spa;"SPW 1"               ! width ON(execute width calculation)
330   OUTPUT Spa;"OSW"                 ! request width data output
340   ENTER Spa;L_center,S_width,N_sp  ! read center,width,no of peak
350   STOP
360   !
370 Srq:S=SPOLL(Spa)                   ! read status byte of Q8381
380   Sweep_end=1                      ! set sweep end flag
390   RETURN
400   !
410   END
```

- Explanation of Programming Example 4

HP-9000 Series 300

Line No.	Explanation
10 to 80	Notes
90 to 110	Variable definitions
130	Sets Q8381 GP-IB address (7) to variables
140	Defines interrupt processing routine caused by SRQ signals
150	Sets to same initial state as at powering up
170	Measuring condition setting (Same as programming example 3)
180	center wavelength ... 1.3µm
190	span ... 10nm
200	reference level ... -10dBm
210	resolution ... 0.1nm
220	sweep mode ... "ADAPTIVE"
230	Makes the status byte sweep-end (b0) bit effective Sets to mode in which SRQ signals are sent.
240	Starts single sweep and measure
250	Clears the flag that indicates the end of sweeping
260	Permits the SRQ signals to generate an interrupt
270	Waits for the end of sweeping
280	Sets the cursor data display mode to "2nd PEAK" and turns the cursor on (then executes 2nd PEAK calculation)
290	Requests cursor data output
300	Reads cursor data (λ1, level1, $\Delta\lambda$, Δlevel)
310	Sets half width calculation method to 0 (Pk-XdB) and sets parameter XdB to 3dB
320	Executes half width calculation
330	Requests half width data output
340	Reads center wavelength, half width, number of peaks
370	<interrupt processing routine> Executes serial polling and reads status bytes.
380	Sets a flag to indicate the end of sweeping
390	Returns to the main routine

7. Q83811 OPTICAL PRESELECTOR

This section describes the operation procedure of the Q83811 optical preselector, which is usefull for measuring the side mode ratio of DFB-LD, for example.
Q8382 is composed of Q8381 and Q83811 preselector.

7.1 Introduction

Q83811 is an optional optical preselctor which improves the dynamic range of spectrum analysis when it is used with the Q8381 optical spectrum analyzer. Using Q83811, a dynamic range of more than 50dB (level difference) at ±0.5nm away from a peak wavelength and more than 60dB at ±1.0nm can be obtained.
Figure 7-1 shows the block diagram of the whole system when Q8381 and Q83811 are connected.

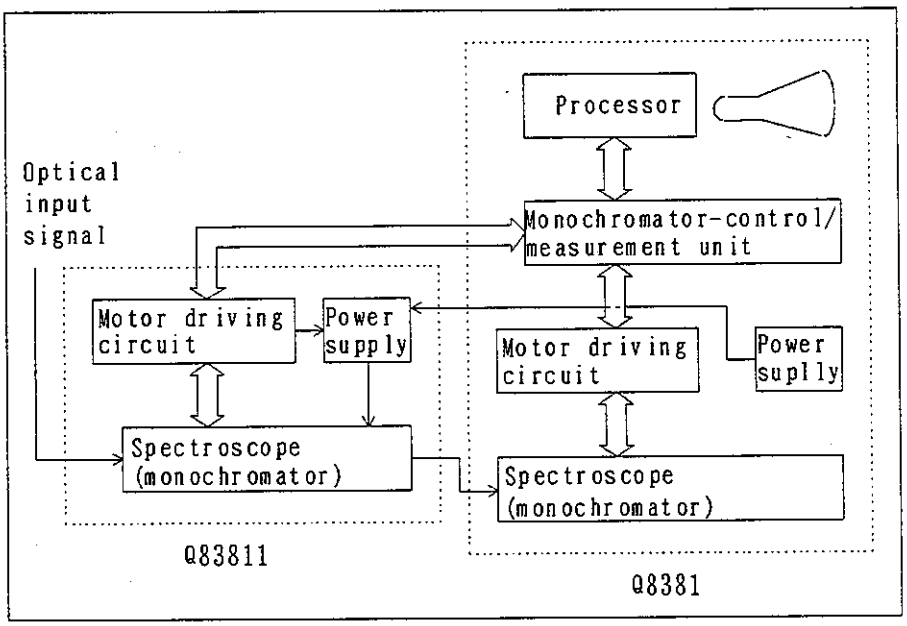


Figure 7 - 1 Block Diagram of the Analyzer System Consisting of Q8381 and Q83811

7.2 Front and Rear Panels

This section describes the functions of the front and rear panels of Q83811.

(1) Front Panel

① POWER Lamp

This lamp lightens up when the power is turned on.

② INPUT Connector

This is the input connector for optical signals. The cable for inputting optical signals to be measured is connected with this connector.

③ OUTPUT Connector

This is the output connector for optical signals. Optical signals selected by the preselector or input optical signals as they are output from this terminal.
This connector and the input connector of Q8381 are connected by the fiber cable included in the package.

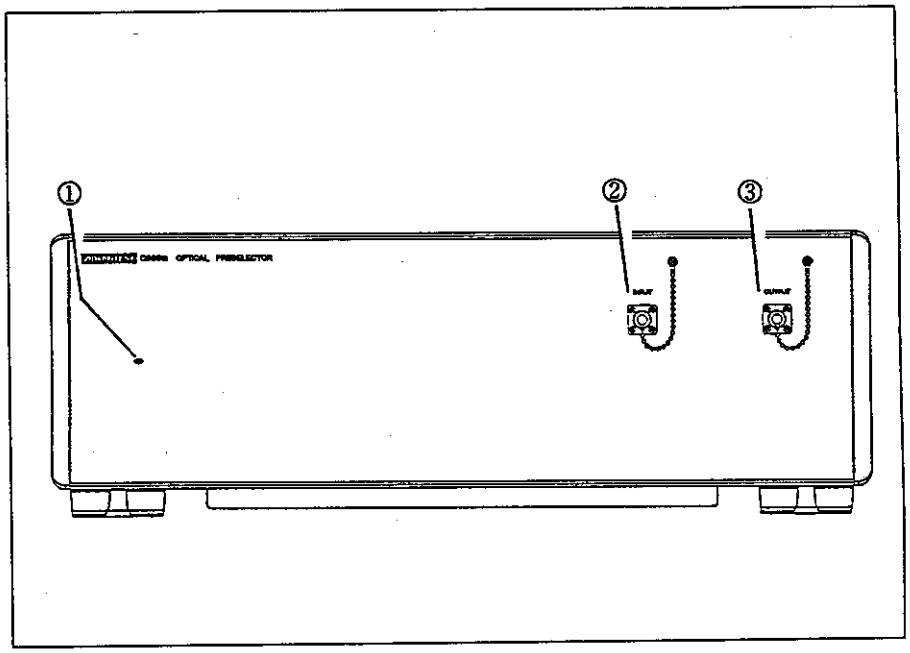


Figure 7 - 2 . Front Panel

(2) Rear Panel

① AC INPUT Connector

This is the connector for power supply. This connector and the AC OUT connector of Q8381 are connected by the power supply cable included in the package.

② CONTROL Conncetor

This is the connector for inputting or outputting signals for controlling this preselector. This connector and the PRESELECTOR connector of Q8381 are connected by the interface cable included in the package.

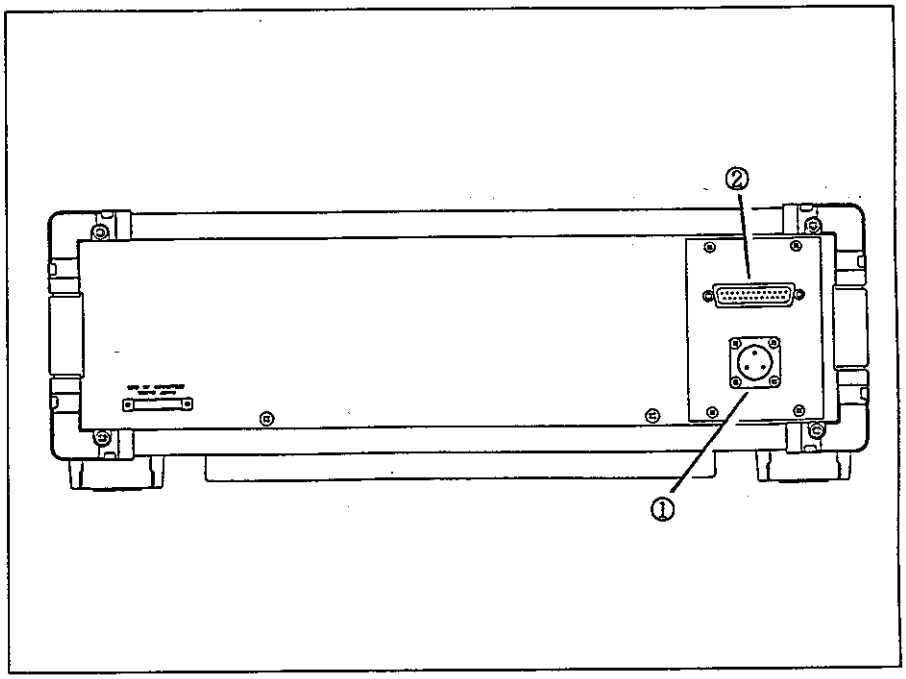
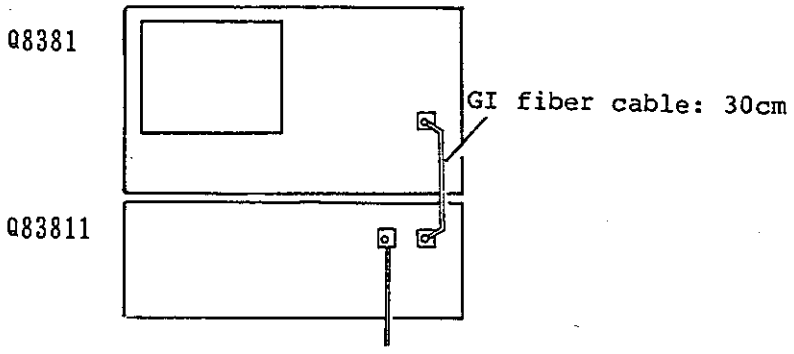


Figure 7 - 3 Rear Panel

7.3 Cable Connection

Figure 7-4 shows the connection of Q8381 and Q83811. The two equipments are connected by the three cables included in the package of Q83811.

(a) The INPUT connector of Q8381 and the OUTPUT connector of Q83811 are connected by the fiber cable (GI fiber cable: 30cm).



(b) The power supply cable (3-pin) and the interface cable (25-pin) are connected to the rear panel of Q83811.

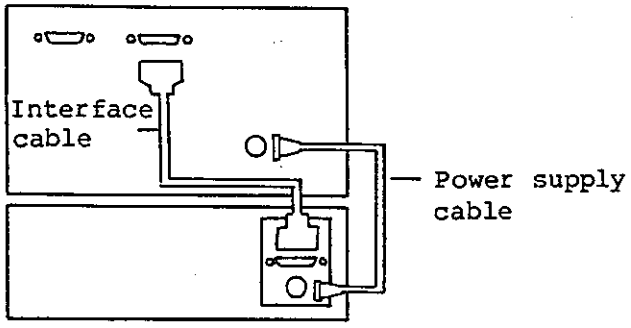


Figure 7 - 4 Connection of Q8381 and Q83811

Note

Before connecting or disconnecting the power supply cable or the interface cable to or from the rear panel, make sure that the power of Q8381 is turned off.

7.4 Operation

This optical preselector is controlled by Q8381, and therefore its operation is done using panel keys of Q8381.
To operate the preselector, press the ADVANCE key. Then the following softkey menu is displayed.

Softkey menu

[ADVANCE]

SPECTRUM			CURVE FIT	INPUT	SYNC	PREV MENU

7.4.1 Input Mode Switching

This preselector has an optical switch so that it can output, without reconnecting the fiber cable, either input signals processed by the preselector (PRESELECTOR) or those bypassing the preselector (THROUGH). This switching can be done by INPUT key is pressed, the input mode is switched between "THROUGH" and "PRESELCTOR". The mode is "THROUGH" if "INPUT" is displayed in the ordinary way, and "PRESELECTOR" if it is displayed with its color being inverted.

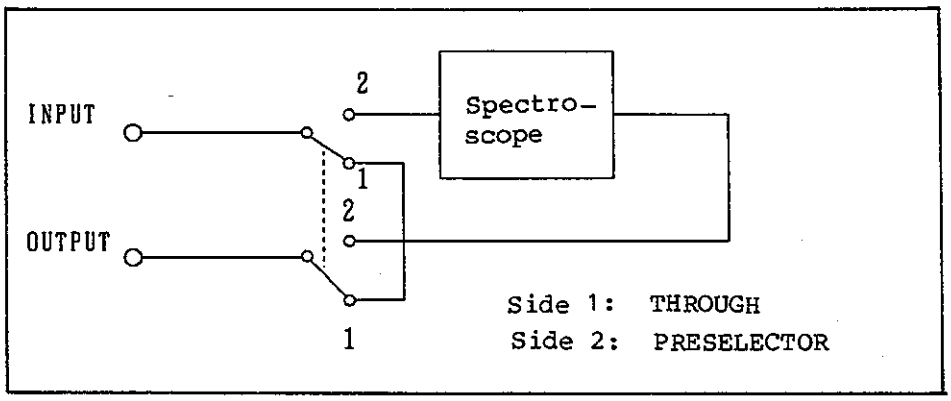


Figure 7 - 5 Circuit for Input Mode Switching

7.4.2 Synchronization with Q8381

The wavelength range of this preselector for measurement is 0.6μm to 1.75μm. Since the stray light level (the dynamic range) in the vicinity of a peak is lowered (increased) by monochromizing the input signal first with the preselector and then with Q8381, Q8381 and the driving system of the diffraction grating of the preselctor must be synchronized.
To synchronize the two instruments, the SYNC key in the above softkey menu is used. (One synchronization operation synchronizes the instruments in a range of 50nm.)
The following is the synchronization procedure:

(1) Set the conditions for measurement, such as the wavelength range and the level of measurement according to the optical signal to be measured.

(2) Set the input mode of the preselector for "THROUGH", and perform a measurement to make sure that peaks to be masured are located within the range of the central wavelength ±50nm. (The levels of the peaks must be more than -30dBm.)

(3) Press the SYNC key to activate synchronization. (During activation, the color of the word "SYNC" is inverted, and returns to normal with a buzzer when activation is done.)
If measurement is being performed, pressing the SYNC key cannot activate synchronization. Press the key after stopping the measurement operation. Activation operation can be stopped by pressing the SYNC key again.

* Activation operation takes 30 to 90 seconds.

(4) To obtain a spectrum through the preselector, select the PRESELECTOR mode by pressing the INPUT key, and then perform measurement.

* Synchronization must be reactivated if the wavelength to be measured is largely changed (more than 20nm).

7.5 Notes for Operation

(1) Setting of the Resolving Power

If the preselctor is used, changing the resolving power does not change the width of peaks, but changes the width of their shoulders.

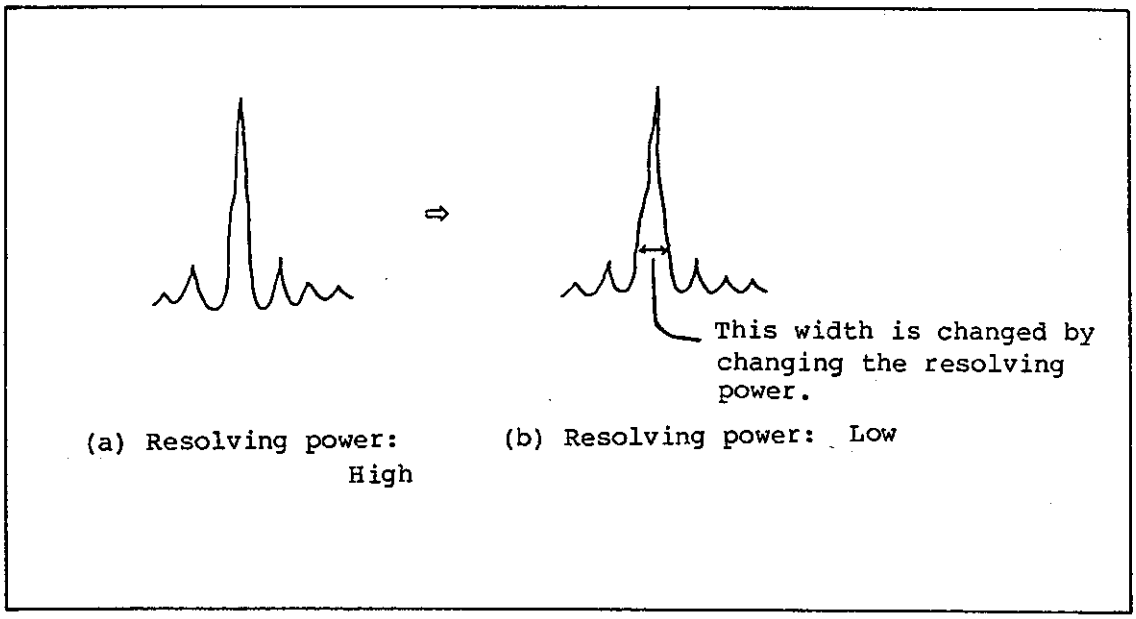


Figure 7 - 6 Spectrum Change due to a Change in the Resolving Power

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8. PERFORMANCE

(Q8381)

Wavelength	Measurement range	0.6 to 1.75μm
	Resolution	0.1, 0.2, 0.5, 1.0, 2.0, 5.0nm
	Accuracy	±1.0nm (10 to 40°C) ±0.5nm (23°C)
	Sweep range	0.1 to 115nm/DIV or 0
Level	Measuring range	-80 to +10dBm (1.1 to 1.6 μm +23°C) -70 to +10dBm (0.7 to 1.6μm) -60 to +10dBm (0.6 to 1.75μm)
	Accuracy *1	±1.5dB (1.31, 1.55μm resolution 0.2 to 5 nm)
	Polarization dependence	$0.5dB_{p-p}$
	Linearity *2	±1.0dB/40dB ±0.5dB/10dB
	Scale	0.2, 0.5, 1.0, 2.0, 5.0, 10.0dB/DIV or linear
	Dynamic range *3	40dB/±1nm 50dB/±5nm
Processing function	Sweep time *4	Up to 1 second (SPAN up to 50nm, RAPID mode, LOG display) Up to 4 seconds (SPAN up to 500nm, RAPID mode, LOG display) Up to 8 seconds (SPAN up to 1.15μm, RAPID mode, LOG display)
	Memory function	Three screens (battery backup)
	Display	Bisect (overexposure, upper/lower-half) Cursor function
	Calculation	Automatic optimum measuring condition setting Half width measuring Peak search Peak center Averaging Normalization
Input/ output	Input connector	FC model
	Data output	GP-IB interface loaded Direct plotter output *5 Built-in printer (printing speed 8 seconds or less)
	Others	Pre-selector control (option)

(Q8381)

General specifications	Operating environment	Temperature +10 to +40°C, relative humidity 85% or less (No condensation)
	Storage environment	Temperature -20 to +60°C, relative humidity 90% or less (No condensation)
	Power source	90 to 250VAC, 48 to 66Hz, 180VA or less
	Dimensions	Approximately 424(W) x 221(H) x 450(D)mm
	Weight	29kg or less

(Q8382 (combination of Q8381 with Q83811))

Wavelength	Measurement range	0.6 to 1.75μm
	Sweep range	50nm max. (range for one synchronization)
Level	Dynamic range *6	50dB/±0.5nm 60dB/±1.0nm
	Insertion loss *7	Up to 15dB (0.9μm to 1.6μm, preselector used) Up to 20dB (0.8μm to 1.65μm, preselector used) Up to 8dB (1.1μm to 1.6μm, THROUGH mode) Up to 12dB (0.8μm to 1.65μm, THROUGH mode)
Operation	Synchronization of analyzer and preselector	Automatic (by pressing a key)
	Input mode switching (THROUGH/PRESELECTOR)	Can be controlled externally (switching mechanism built in)
	Sweep time *8	Up to 2.5sec (SPAN up to 50nm, RAPID mode, LOG display)
General specifications (Q83811 preselector	Input/output connector	FC model
	Power source	Supplied from Q8381
	Control	Controlled at Q8381
	Dimensions	Approximately 424(W) x 132(H) x 450(D)mm
	Weight	19kg or less

Note 1: Dynamic range, insersion loss, and sweep range are guaranteed at temperature of 15°C to 30°C.

Note 2: Specifications other than the ones given above, level accuracy and polarization dependence are the same as those of Q8381.

*1: Measured at wavelengths 1310nm and 1550nm (resolving power: 0.2 to 5nm), -30dBm input including the polarization dependence, temperature of +23°C.
*2: -10dBm standard.
*3: Measured at wavelengths 1152nm and 1523nm (resolving power: 0.1nm) using the SM fiber cable.
*4: Range of measurement: More than -30dBm.
Number of averaging : 1
*5: Connectable plotters: R9833, TR9832 (ADVANTEST)
7475A, 7440A, 7470A (HP)
*6: Measured at wavelengths 633nm, 1152nm and 1523nm (resolving power: 0.1nm).
*7: GI-50/125μm fiber cables used for input/output.
*8: Range of measurement: More than -30dBm.
Number of averaging : 1

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APPENDIX

A.1 Optical Terms

Automatic Power-Control (APC)

Application of electric power so as to make light output constant. When a laser diode is driven by a constant-current source, its light output decreases or its oscillation stops with increase in temperature, and its light output increases with decrease in temperature. When the temperature decreases, the light output may exceed the maximum rating. An APC circuit is designed to receive the monitor light of the laser diode at a photo diode and to feed it back to the driving circuit in order to protect the laser diode and to obtain a stable light output at the same time.

Avalanche Photodiode

A light-sensitive element which is often used in optical-fiber cable communications. When a high reverse bias voltage (100 to 200 V) is applied to the p-n junction of semiconductors, carriers are generated one after another as they move slightly, and the current increasingly accelerates by the avalanche effect. This diode uses this avalanche effect.

Back-Scattered Light

When light travels through an optical fiber, Rayleigh scattering occurs at all points along the fiber. This scattering occurs both in the forward and backward directions. However, light which is scattered in the backward direction and returns to the incident end is called back-scattered light. For Rayleigh scattered light, the weakly reflected light which returns to the incident end in the wave guiding mode of the optical fiber is also called back-scattered light.

Baseband Transmission Characteristics

When pulse light is incident onto one end of an optical fiber, the width of the output pulse at the other end is greater than that of the incident pulse. This phenomenon is called dispersion. It illustrates the increase of transmission loss in time domain. When converting this dispersion phenomenon into that in the frequency domain, it is determined that the transmission loss in the high-frequency range increases. These transmission characteristics in the frequency domain are called the baseband transmission characteristics. It is an important optical fiber performance factor.

Beam Divergence Angle

An angle at which radiation intensity becomes one half of that of the optical axis (where the radiation intensity is maximum). In the case of a laser diode, an angle between a junction and a horizontal direction is θ, and an angle between a junction and a vertical direction is θ.

Breakpoint Detection

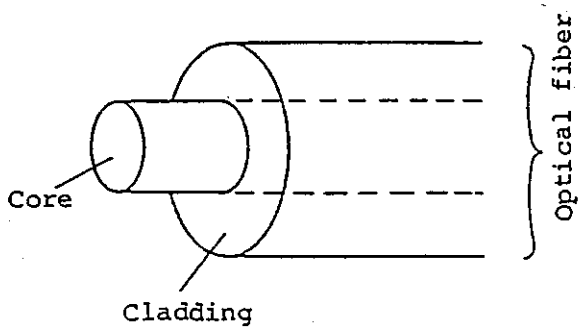
Detection of the part of the core of an optical fiber at which a break occurred. When light is directed into a broken optical fiber, it is scattered at the breakpoint and leaks to the outside of the core. The breakpoint in an optical fiber can be found by detecting such leaked light.

Chopped Light

The intensity of the light modulated by a rectangular wave. That is, the light is intermittently output at certain repetitive periods.

Cladding

A part of the structure of an optical fiber. An optical fiber consists of a core at the center and cladding surrounding the core. It is generally made of quartz glass or plastic. The cladding has a refractive indix which is about 1% lower than that of the core so as to confine the light in the core with stability.



Coated Fiber

A core and a cladding of an optical fiber covered with a primary coating (of silicone resin) and a secondary coating (of a nylon protective layer).

Coherence

1. The relationship with respect to time between two or more waves.

2. When the wavelength, phase, and wave front of light coincide completely, such light is said to have coherence. There are two kinds of coherence; temporal coherence and spatial coherence. Temporal coherence is the uniformity of wavelength and the continuity of phase. Spatial coherence means the ability to focus the light to a point by the use of a lens. As typically expressed by laser light, light having coherence and a specific phase relationship with the same wavelength is called the coherent light.

Coherent

Light is an electromagnetic wave having a very short wavelength. Visible light, however, is greatly different from the electromagnetic waves used in radio and TV broadcasting. That is, the electromagnetic waves for radio and TV broadcasting are waves having completely coinciding in frequency, phase, and wave front, while, light from an electric lamp, for example, has no such completely coinciding frequency, phase, and wave front. Therefore, it can be regarded as a kind of noise. Light having completely coinciding frequency, phase, and wave front is called coherent light. The light from a laser diode used in optical communication is not completely coherent but highly coherent light. [OPE]

Core

The central part of an optical fiber, which is surrounded by cladding. The light travels through the core. It is made of quartz and its refractive indix is greater than that of the cladding by about 1%. There are two kinds of optical fibers, distinguished according to the thickness of the core; multi-mode fiber of about 50 to 100 m in diameter and single-mode fiber of about 10 m in diameter. In addition, optical fiber is classified into a GI type and an SI type according to the difference in the distribution of the refractive index of the core.

Core and Cladding

The center and the surrounding part of an optical fiber are called a core and cladding respectively. Since the refractive index of the cladding is lower than that of the core, light directed into the core travels through the core in a confined state by repeating the total reflection at the boundary surface between the core and the cladding. Generally, the diameters of the core and the clad are expressed by the form of 50/125 μm.

This expression means that the core diameter is 50 μm and the cladding diameter is 125 μm. As described above, the center of the optical fiber is called the core, and the surrounding part with a slightly lower refractive index is called the cladding. Because of this structure, the light is confined in the core and travels through the core by repeating the total reflection at the boundary surface between the core and the cladding.

CW Light

Light with constant intensity and without modulation. It is also called DC light.

Dark Current

The output current of a light-sensitive element without incident light.

Direct Modulation

The use of a modulated signal as a driving current to turn on a light source. When a photo modulator is used for this purpose, such a method is called external modulation. [OPE]

Directivity

Cases when the light output or the light receiving sensitivity is greater in the specific direction.

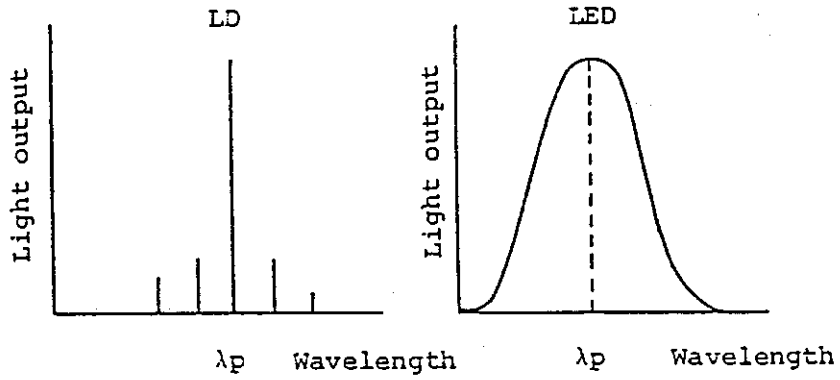
Double Heterojunction

A heterojunction means a junction between crystals having a different atomic composition. In the case of double heterojunction used in a laser diode, cladding layers having wide energy gaps are placed on both sides of an activated layer to confine the carrier in order to increase the density of the minority carrier. It is used to form an optical waveguiding path.

Emission Peak Wavelength

A wavelength at which the energy density of a luminescent spectrum of light emitting elements becomes maximum.

Symbol: λp



Excess Noise Factor

The coefficient of the shot noise multipled in an avalanche photodiode. It is defined as $F = M^x$.

The shot noise current iN increases with fluctuations in the multiplication process, according to the following equation:

$$\langle iN^2 \rangle = 2qIPoM^{2+x}B$$

M: multiplication factor
B: signal bandwidth
x: excess noise index
q: charge of electron

Exciter

A device to excite an optical fiber to be tested, in the stationary mode, in light loss measurement or transmission characteristics measurement, etc. For this purpose, the following methods are used:

Using a dummy optical fiber of several hundred meters in length; controlling the incident mode power distribution by using microbending of an optical fiber, controlling the mode distribution by sequentially connecting graded type optical fiber, step type optical fiber, and so on. (GSG type or SGS type exciting optical fiber cord, and so on are available.)

Fiber Identification

Individual distinction of the many fibers in an optical fiber cable. Particularly, light is directed at one end of an optical fiber and the transmitted light is detected at the other end.

Fresnel Reflection

The reflection when light passes through a boundary face between materials of different light refractive indexes. When a light pulse is directed into an optical fiber, a portion of the pulse is reflected from the media boundary face such as that of optical fiber and air, for example, at the end of the optical fiber or at a breakpoint in the optical fiber. Such reflection is called Fresnel reflection. In the case of an ideal break face (a mirror-like break at right angles to the axis of an optical fiber), about 4% reflection (-14 dB) occurs.

Fundamental Mode

An electromagnetic distribution of the 0th order. It is also called a single transverse mode.

Graded-Index Fiber

A kind of a multi-mode fiber having a core with a refractive index distribution in radial form. Therefore, the light through the center of the core travels slower and light through the peripheral part travels faster, so that the light propagation time becomes constant regardless of the path of the light. As a result, it is possible to decrease the spreading of the emitted pulse with time. (In other words, the mode dispersion is less.) Therefore this fiber has a much wider transmission bandwidth compared with that of a step-index fiber (several hundreds MHz-km).

Infrared Rays

Light having a wavelength which is longer than that of visible light.

Near infrared rays	:	0.78 to 3 μm in wavelength
Middle infrared rays	:	3 to 30 μm in wavelength
Far infrared rays	:	30 μm to 1 mm in wavelength
Microwave	:	Over 1 mm in wavelength

Laser

Solid lasers, gas lasers, liquid lasers, and so on are available. A semiconductor laser is used as the light source used in optical fiber communication because of its compactness and the capability of direct modulation, compared with other lasers. The laser has excellent coherence, and has high speed response, compared with LEDs, which means that laser is an important light source. The abbreviation for semiconductor laser is LD.

Laser Diode

One of the semiconductor light emitting elements. Laser is the abbreviation of light amplification by stimulated emission of radiation. That is, the laser diode is an oscillator which emits light according to this principle. The laser diode has various merits such as a high light output, capability of high speed direct modulation, high connection efficiency to optical fibers, and so on. In the past, however, the LED had been principally used because of its light emission stability. Recently, the problem of laser emission stability has been solved. Therefore, the laser diode is now used as the light emission source for high speed, long distance communications.

Leak Light

When an optical fiber is bent or when pressure is applied to an optical fiber, the path of the light propagating through a core is bent and can be seen externally. This light is called leak light.

Light Sensor

In optical fiber communication, a photo diode (PD) utilizing the photovoltaic effect or the photoconductive effect is used. There are two kinds of PDs; p-n junction type and a pin type. A PD which uses the avalanche effect by applying a reverse bias voltage to the p-n junction is called an avalanche photodiode (APD). Measuring instruments principally use these light sensors. A thermopile, utilizing the thermosensitive effect, is used as the detector in a standard power meter, because its sensitivity is constant regardless of the wavelength.

Light-Emitting Diode

One type of semiconductor light-emitting element. It uses light which is emitted by re-combination of the carrier injected at the p-n junction of semiconductors, similar to a laser diode. The LED differs from a laser diode in that its light is emitted naturally. (In the case of the laser diode, the light is emitted by induction.) The features of the LED include long life and stability, moderated price, and excellent linearity. However, the LED has such disadvantages as low incident power for optical fiber and the impossibility of high-speed modulation. Therefore, the LED is a suitable light emitting element for a system handling small capacities for over relatively short distances, analog systems, and so on.

Long Wavelength Region

Of the wavelength of light used in optical fiber communications, in this region the wavelength is in the range 1.0 to 1.5 μm. This long wavelength region is used for long-distance communications because of its low transmission loss.

Longitudinal Mode

A status in which emission spectrum having very small half value widths are not continuously present, or else individual luminescent spectra. The difference in wavelength from the adjacent mode is called a longitudinal mode interval. When the number of modes is one, it is called a single longitudinal mode.

Luminous Flux

Luminous flux is expressed in units of lm (lumen) by the equation given below.

$$F = Km \int_{380}^{780} V(\lambda) d$$

Km : Maximum luminous efficacy, 680 m/W
$V(\lambda)$: Relative spectral luminous efficacy (the value which is determined by the International Commission on Illumination (CIE))

1.00004 for the yellow-green spectrum (λ = 555 nm)

$P(\lambda)$: Spectral distribution

Luminous Intensity

Luminous intensity is expressed in (Cd) candella by the equation given below.

$$i = \frac{dF}{d\omega}$$

F: Luminous flux
ω: Solid angle

The radiant intensity is the luminous intensity in the energy unit.

Monitor Current

The output of a monitor diode, when the light emitted from the chip back of a laser diode is received by a monitor diode.

Monitor Output

The light which is emitted toward the chip back of a laser diode.

Multi-Mode Fiber

For an optical fiber in which multiple light guiding modes exist, many modes (each mode having a different light propagation angle to the central axis of an optical fiber) are transmitted through a core at the same time. There are various kinds of multi-mode fibers according to the difference in the refractive index distribution. These include a step type optical fiber and graded type optical fiber. These optical fibers have a core of relatively large size (50 to 100 μm). They also allow easy connection compared with single mode fiber. However, because many modes propagate through the multi-mode fiber, the transmission rate differs according to the mode and so the transmission bandwidth becomes somewhat narrower. (Mode dispersion)

Numerical Aperture

The degree of extension of light at the end of an optical fiber, which has a cylindrical core having a refractive index of n1 and which is surrounded by clad having a refractive index of n2 (n1 > n2), due to a similarity in the lens system. Of the light falling on a plane, which includes the axis of the core of the optical fiber and which crosses the axis (the meridian light), if some light, which attains critical angle with respect to the axis, crosses the axis of the core outside the optical fiber at angle θ, the NA of the optical fiber can be expressed by the equation given below.

$$NA = n\sin\theta = \sqrt{n_1^2 - n_2^2}$$

n: Refractive index of the media in which the optical fiber is placed

Optical Fiber

A light guiding path through which light can travel, in spite of bends in the path, by setting the refractive index of the outside to a lower level in comparison with that of the inside. It consists of two kinds of quartz glass (a core and a cladding) having different refractive indexes arranged in the radial direction in the form of a glass fiber of about 0.12 mm in diameter. It has such excellent characteristics as wide bandwidth, low loss, and non-induction.

Optical Fiber Connector

A detachable connector to connect optical fibers to each other or to connect an optical fiber with a device. Generally, two optical fibers are simply abutted against each other. That is, the end of one optical fiber is directly abutted against that of the other one by means of a connector the center of which is sufficiently aligned with those of the optical fibers. The optical fiber connector is different from an electrical connector in mechanical accuracy and connection loss. That is, the former has a higher mechanical accuracy and a connection loss of about 0.5 to 1 dB. Special care should be taken when handling this connector to protect it from dust.

Optical Output

Light power coupled to the inside of the specified optical fiber cord.

Optical Rotary Power

A phenomenon of the rotation of a plane of polarization when linearly polarized light passes through material.

OTDR Method

An abbreviation of optical time domain reflectometer method. A system to detect a defective point or a loss characteristic of optical cable by using a light pulse as a signal, transmitted through the optical cable to be tested, and detecting the Fresnel reflection at a breakpoint or the Rayleigh scattered light of the optical fiber circle. Fiber optic time domain reflectometer (FOTDR).

Output Power from Fiber-End

The light output at the fiber end of a light emitting element equipped with fiber. It can be obtained by subtracting the connection loss of the fiber and the transmission loss of the fiber, from the light output of the light emitting element itself.

Pigtail Fiber

An optical fiber with one or both ends open.

Polarizer

An element to convert natural light into linearly polarized light.

Quantum Efficiency

- Light-emitting element (light emitting diode and laser diode)

  The ratio of the number of carriers caused by current application to the number of photons generated (internal quantum effect) or the number of photons emitted (external quantum effect). The quantum efficiency is expressed by the equation given below.

$$\eta = \frac{q\lambda}{hc} \cdot \frac{P}{I} = \frac{\lambda}{1.24} \cdot \frac{P}{I}$$

  h: Planck's constant
  c: Velocity of light in a vacuum
  q: Charge of electron
  λ: Wavelength (μm)
  P: Light output
  I: Current

  In the case of a laser diode, the term differential quantum efficiency is also used.

- Light receiving element (pin photodiode, APD)

  The ratio of the number of carriers generated to the number of incident photons. The quantum efficiency (η') is expressed by the equation given below. This equation is opposite to that for a light emitting element.

$$\eta' = \frac{hc}{q\lambda} \cdot \frac{I}{P} = \frac{1.24}{\lambda} \cdot \frac{I}{P}$$

  The quantum efficiency of an avalanche photodiode is expressed on the assumption that the multiplication factor is 1.

Radiant Flux

The amount of light energy which is emitted or propagated per unit time.

Rayleigh Scattering

Light scattering by a slight fluctuation of the refractive index of material when the light propagates through such material. The light scattering which is generated by the fluctuation of a refractive index which is shorter than the wavelength in an optical fiber.

Responsivity

A current output when a unit radiant flux is directed into a light-sensitive element. It is expressed by the equation given below.

$$R = \frac{I}{P} = 0.806 \times \eta \times \lambda \times M \ (A/W)$$

η : Quantum efficiency
λ : Wavelength

Short Wavelength Region

The wavelength used in optical fiber communications is about 0.8 to 1.5 μm, namely, in the so-called near-infrared domain. In this wavelength region, light having a wavelength of about 0.8 μm is called the short wavelength region. It has been used in optical fiber communications since early times, and the actual results of the development of practical systems have been most remarkable. Recently, the long wavelength region, the region of light having a wavelength longer than 1 μm, has been developed. [OPE]

Short-Term Stability

The stability of an optical output over a short time, when the ambient temperature is constant.

Single-Mode Fiber

When the diameter of a core is decreased to about 10 μm, and optical fiber having only one propagating mode is obtained. This optical fiber is called a single-mode fiber. One feature of this fiber is its very wide bandwidth (several GHz), because it is free from the mode dispersion of a multi mode fiber. However, connection of such fiber is difficult because of its small core diameter. It has other problems such as a greater connection loss when it is connected to a light source.

Specific Rotatory Power

A quantity to indicate the intensity of optical activity power of optically active substances.

Speckle Noise

The noise produced by the interference of coherent light scattered in an optical fiber in an irregular phase relationship.

Spectral Width, Full Width at Half Maximum

The distance between two wavelengths where the energy density of the light emitting spectrum becomes 1/2 of the maximum value of a light emitting element.

Spectrum

Normal light is made up of synthesized sine waves. A spectrum is the arrangement of each component on a wavelength axis. A white light source has a flat spectrum with the LD concentrated in a narrow range.

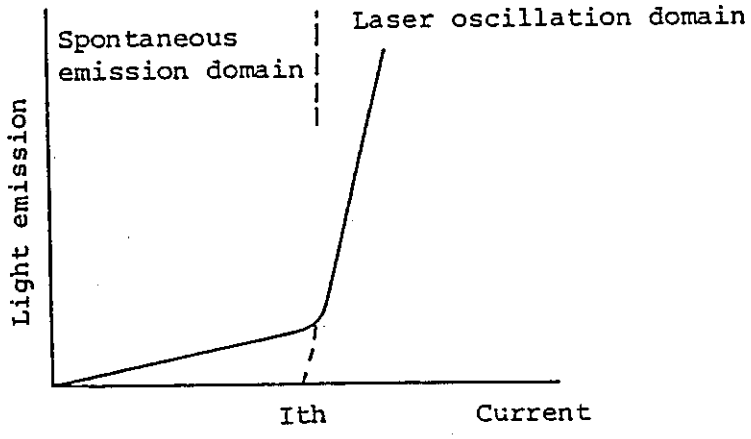
Splicing

A permanent connection between one optical fiber and another required in the installation of an optical fiber cable. Various splicing methods are now available. Generally, a fusing connection method is used in which one optical fiber is fused with another by the arc discharge method. This method is predominant because of its minimum connection loss and high stability.

Threshold Current

The minimum current which can start laser oscillation. Since the domain where spontaneous emission changes to a laser oscillation is not strictly defined in most cases, the intersection between the extended line of the current-light output characteristics in the laser oscillation and the zero value line of the light output is specified as the threshold current.

Symbol: Ith



Ultraviolet rays

Light having a wavelength shorter than that of visible light in the wavelength range of 300 to 380 nm.

Visible Light

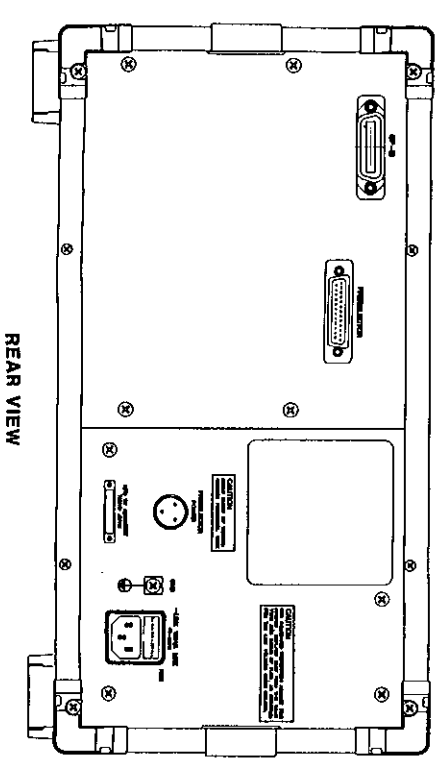
Light which can be seen by the human eye in the wavelength range of 380 to 780 nm.

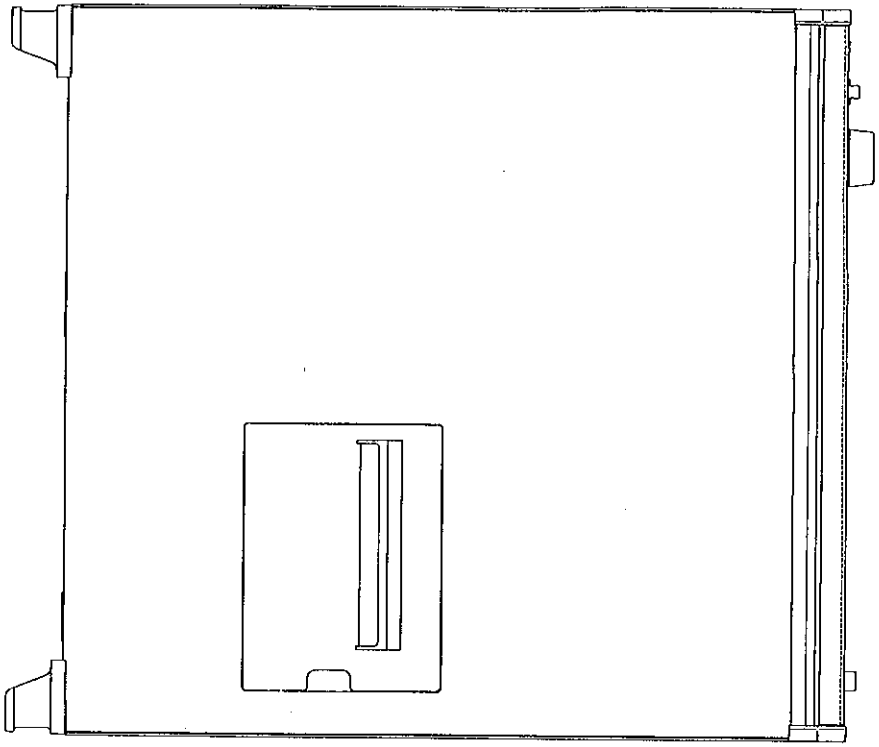
Wavelength

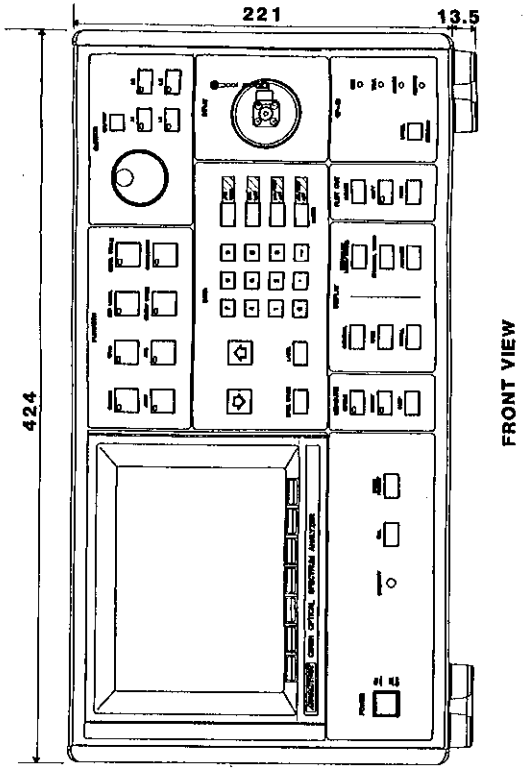
A wavelength is the center of the intensity distribution of a luminescent spectrum.

Wavelength Division Multiplexing

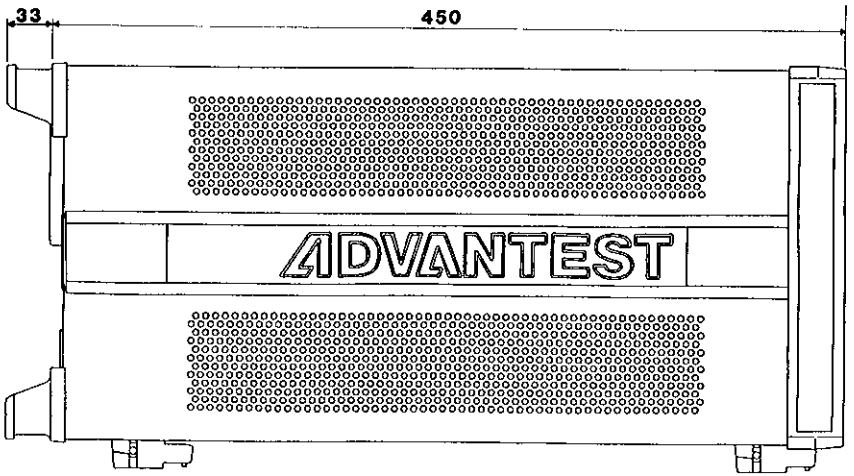
A communication system to transmit two or more kinds of signals through the one optical fiber at the same time. In this case, as a transmitter, light emitting diodes with various wavelengths and laser diodes are used. Both unidirectional systems and bidirectional systems are available.





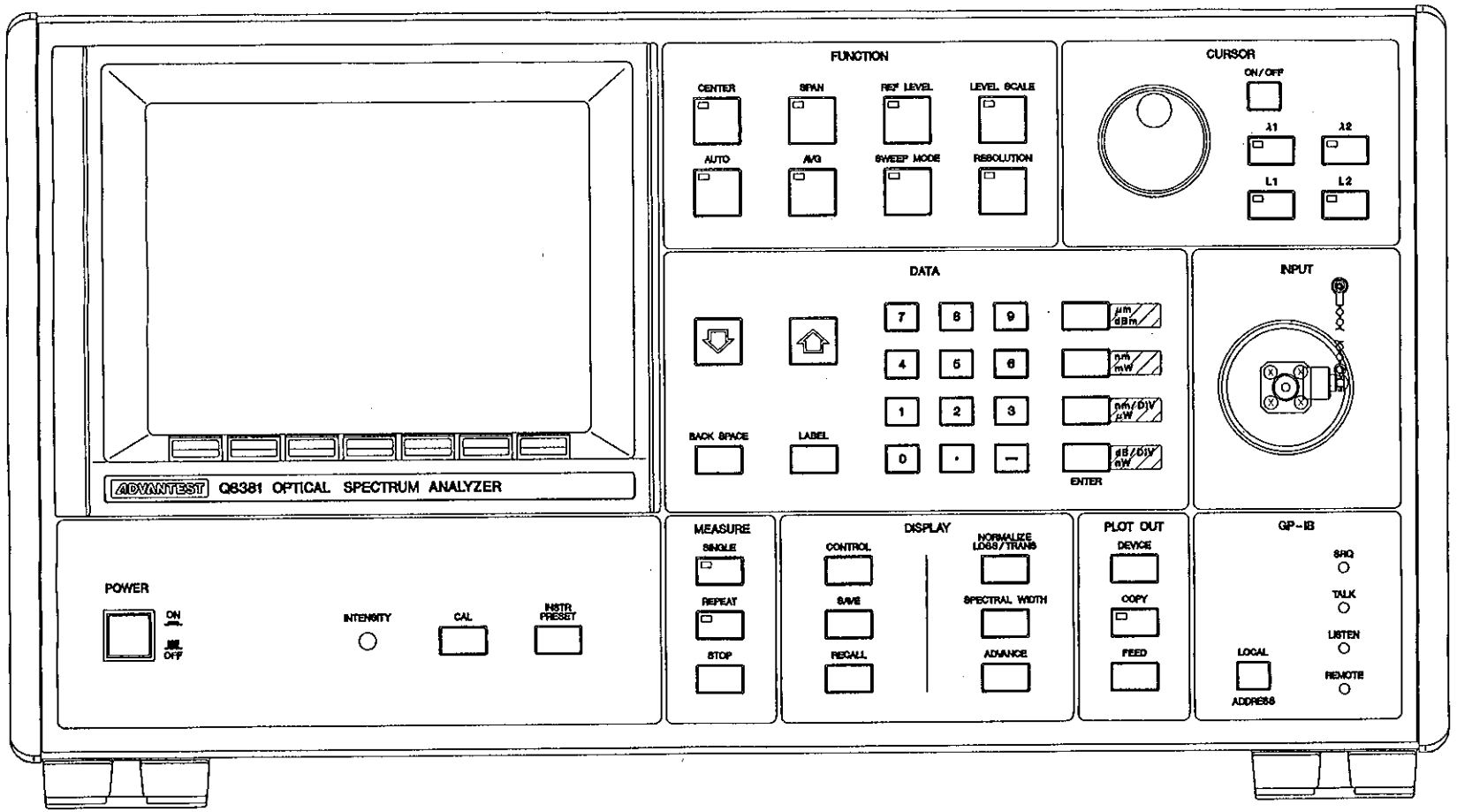


Unit : mm



Q8381
EXTERNAL VIEW

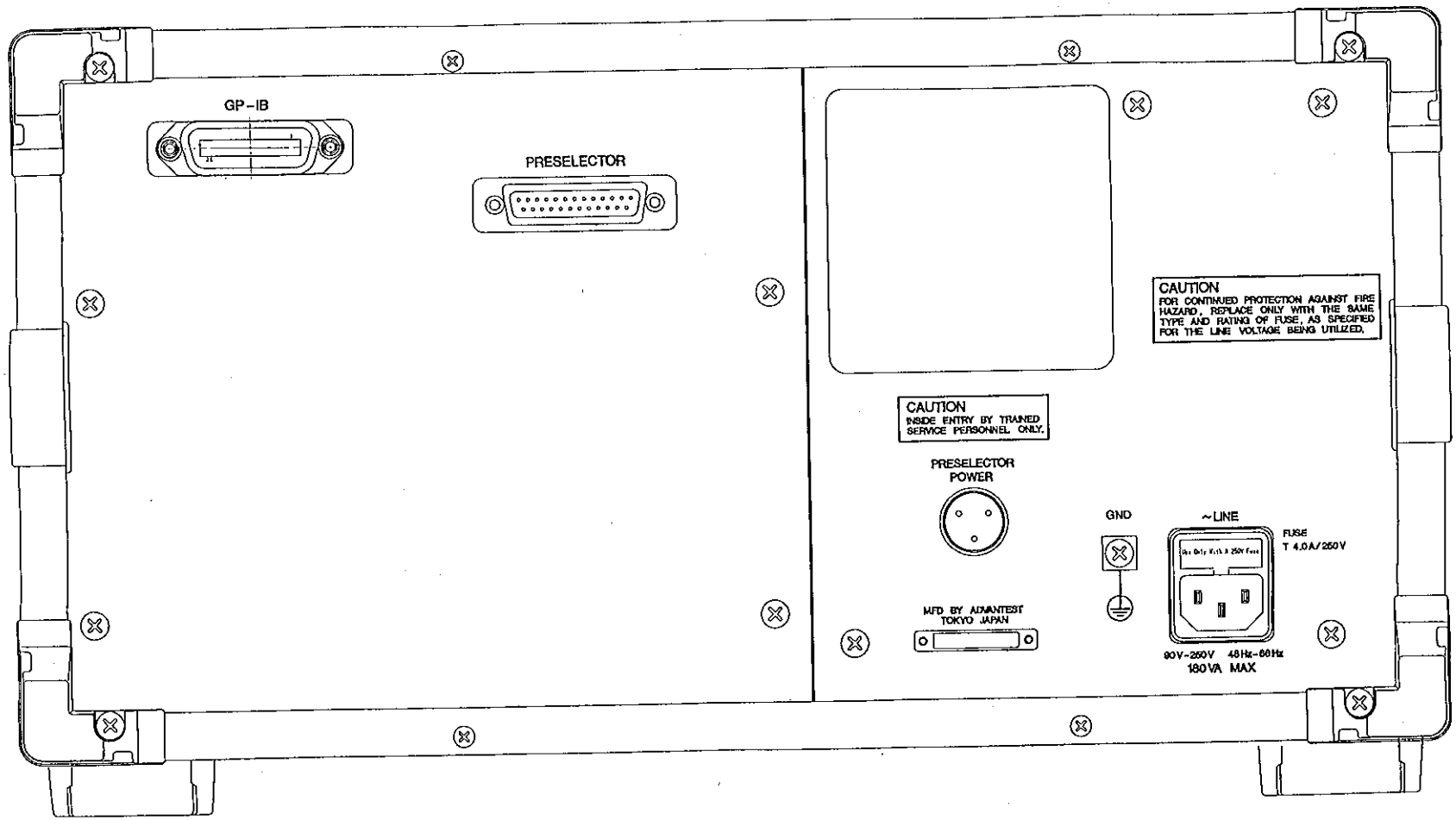
8381EXT1-903-B



8381EXT2-809-A

Q8381

FRONT VIEW



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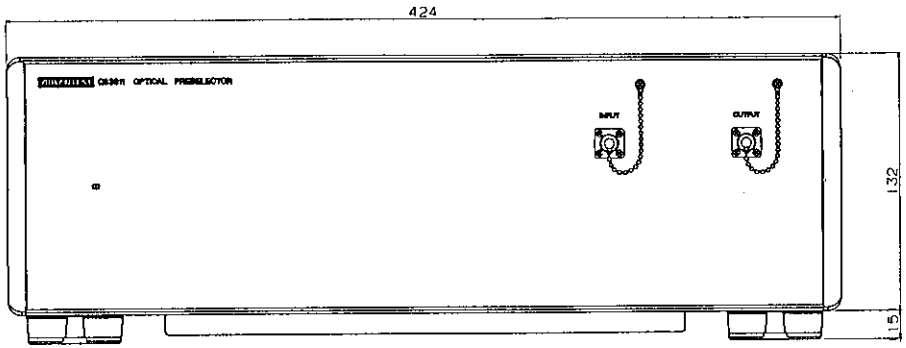
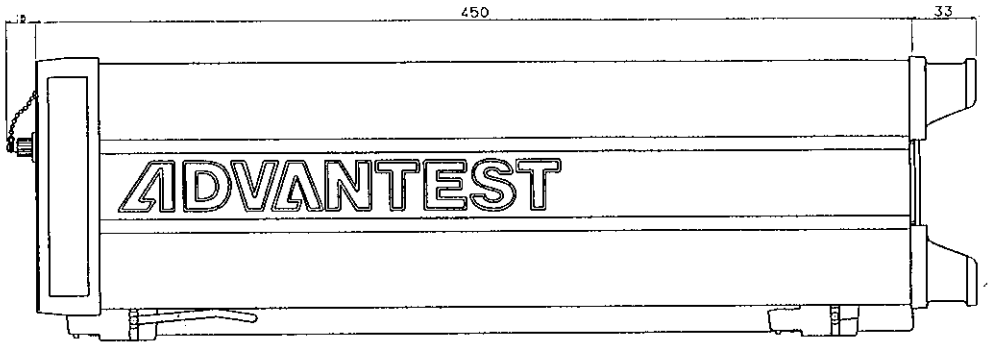
REAR VIEW

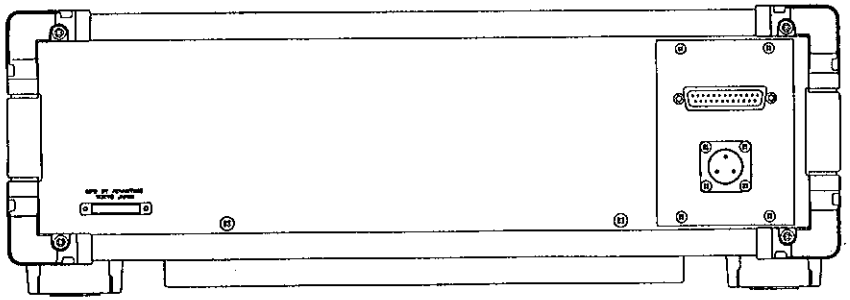
8381EXT3-903-B



FRONT VIEW



SIDE VIEW



REAR VIEW

Unit:mm

83811EXT1-904-A

Q83811
EXTERNAL VIEW

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PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

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1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

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.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (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);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (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.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

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CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

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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