Ando AQ-1425

Optical Spectrum Analyzer

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AS-61429

INSTRUCTION MANUAL

FOR

TYPE AQ-1425 OPTICAL SPECTRUM ANALYZER

ANDO ELECTRIC CO., LTD.

Tokyo, Japan

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SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual describes the procedures for operation and maintenance of Type AQ-1425 Optical Spectrum Analyzer.

1.2 GENERAL

The AQ-1425 is a general-purpose wavelength characteristics measuring instrument that measures the spectrum of a light source such as a laser diode (LD) and light-emitting diode (LED), and the loss-wavelength or transmission characteristics of an optical fiber cable and filter. This apparatus has a wide wavelength range of 400 to 1600 nm, high light sensitivity, high wavelength accuracy of ±1 nm, and high sweep rate, and is therefore ideal for a wide variety of applications.

In addition to center wavelength, sweep width, resolution, and reference level setting and other basic setting functions, this apparatus incorporates various functions such as averaging, data memory, loss-wavelength and transmission loss characteristics calculation capabilities, marker, peak search, half-value width search, and labeling.

This apparatus has two distinguished features.

One is upgraded man-machine interface capabilities. As an example, HELP function gives the operator as needed the operating procedure to be followed and a detailed description of errors. Although the data memory can be used for loss-wavelength

and transmission loss measurements, the apparatus is provided with a mode designed specifically for these measurements. This special mode permits even an unskilled operator to operate the apparatus under the guidance of CRT.

The other feature is automatic function setup. After this apparatus is connected by optical fiber to the light source, it automatically selects the optimum center wavelength, sweep width, and reference level, thus simplifying the operating procedure. Further, this apparatus can be used in conjunction with a video plotter for recording, and is provided as a standard with GP-IB interface that enables automatic measurements.

1.3 SPECIFICATIONS

The specifications for this apparatus are listed in Table 1-1.

1.4 OPTIONS

The options for this apparatus are listed in Table 1-2.

1.5 COMPOSITION

The AQ-1425 is provided with standard accessories listed in Table 1-3.

Table 1-1 Specifications

Wavelength range	:	400 to 1600 nm
Level measuring range	:	-60 to +10 dBm/resolution (at 600 to 1000 nm)
		-55 to +10 dBm/resolution (at 400 to 1600 nm)
		Automatic calibration of wavelength sensitivity is provided.
Wavelength accuracy	:	±1 nm (at 400 to 1600 nm)
Wavelength sweep width	:	0.0 to 122 nm/DIV (NOTE 1)
Resolution	:	0.1 to 10 nm, programmable
Functions	:	Data fetch (loss-wavelength characteristics measurements)
		Averaging
		Wavelength calibration (calibration light source optionally available)
		Auto offset
		Data/measurement condition memory (non-volatile)
CRT	:	Type ; Electromagnetic deflection
		Dimensions; 7 inches
		Number of dots ; 624 x 464
Optical input connector	:	FC type (standard), D4 type (NEC standard), OF2 type (FUJITSU standard), W/E type, diamond type, etc.
Video output	:	Approx. 1 Vp-p, composite video signal, 75 Ω load, BNC connector
Analog output	:	0-5V (for all ranges), load; 1K or more, BNC connector 0-1.1V (when HIGH SENSITIVITY is on)
GP-IB	:	Supplied as a standard
Power requirements	:	100, 115 to 120, 220, 230 to 240 VAC, 50/60 Hz, Approx. 160 VA
Dimensions and weight	:	Approx. 266(H) x 426(W) x 450(D)mm, 37kg

[NOTE1]: The 0.0 nm sweep is used for monitoring level variation with time at a specific wavelength.
This feature is effective in making optical axis alignment.

Table 1-2 List of Options

Type AQ-4302 He-Ne laser (For automatic calibration)	
Source wavelength	: 632.8 nm
Optical output level	: -8 dBm or more -15 dBm or more (SM)
Type AQ-4303 light source (For wavelength-loss characteristics measurement)	
Source wavelength	: 400 to 1800 nm
Optical output level	: -45 dBm or more (When measured with 850 nm and 1300 nm CW light with a bandwidth of 10 nm)
Output	: CW or 270 Hz chopped light
Plotter	: All data including those appearing on the CRT display can be printed as hard copy.

Table 1-3 Standard Accessories

Item	Qty	Remarks
Power cord	1	About 3 m (installed)
Fuse	1	* A (installed) NOTE
Instruction manual	1	

NOTE: The ampere is maked on the supply voltage rating indication above the rear panel AC LINE connector.

SECTION 2

PREPARATION FOR USE

2.1 INTRODUCTION

This section contains the procedure for unpacking, acceptance inspection, and repacking of the apparatus.

2.2 UNPACKING AND ACCEPTANCE INSPECTION

This apparatus has been factory inspected, mechanically and electrically, prior to shipment to insure that it gives satisfactory performance. When your order is received, promptly unpack it and check its contents for damage in transit. When unpacking the apparatus, save the wooden box, corrugated cardboard box, cushions, and other packing materials where possible so that they may be reused when the apparatus is to be packed again for shipment.

2.2.1 Mechanical Inspection

Visually inspect the apparatus and its components exposed to view, such as switches and connectors, for damage or deformation sustained in transit, and also check the types and quantity of the accessories and spare parts against the packing list.

2.2.2 Performance Test

If the apparatus is found by the mechanical inspection to be in good order externally, then test it to check its performance for compliance with the specifications given in Table 1-1.

2.3 DAMAGE OR FAULT

If the apparatus is found damaged or faulty in the acceptance inspection, immediately report the damage or fault to your local dealer.

2.4 REPACKING

When repacking the apparatus, use the packing material, if saved for later use. If they have not been saved, repack the apparatus in the following manner.

(1) Wrap the apparatus in strong paper or vinyl sheeting. Protect all protrusions with cushions against damage.

(2) Place the wrapped apparatus in a wooden or cardboard box which is larger by about 5 to 10 cm than the apparatus on all sides.

(3) Fill all open spaces between the apparatus and the box with polyurethane foam or any other suitable cushioning material. The apparatus may rattle and be damaged in transit, if cushioning is insufficient.

(4) Cover the box and brace it up with steel bands. If a corrugated cardboard box is used, seal it with adhesive tape.

(5) Indicate the contents and shipping marks in a legible and durable way.

SECTION 3

OPERATION

3.1 INTRODUCTION

This section contains the procedures for operating the AQ-1425.

3.2 CONTROLS, INDICATORS, AND CONNECTORS

The names of the panel controls, indicators, and connectors are shown in Figs. 3-1 and 3-2, and their functions are described in Tables 3-1, 3-2, and 3-3.

The encircled numbers in the figures correspond to those in the remarks column of the tables.

As these controls, indicators, and connectors will be referred to by the names shown in this section throughout this manual, the operator should familiarize himself with their names and functions before attempting to operate the apparatus.

The bracket [ ] indicates a marking provided on the panel of the apparatus.

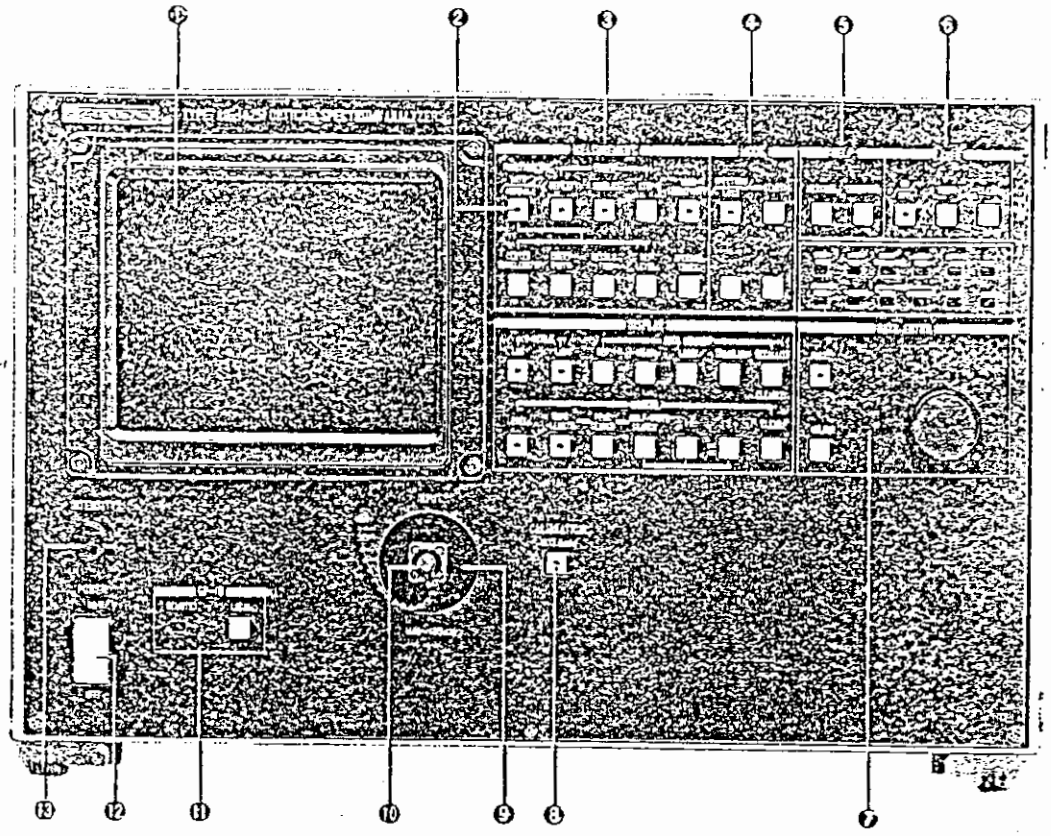


Fig. 3-1 Front Panel

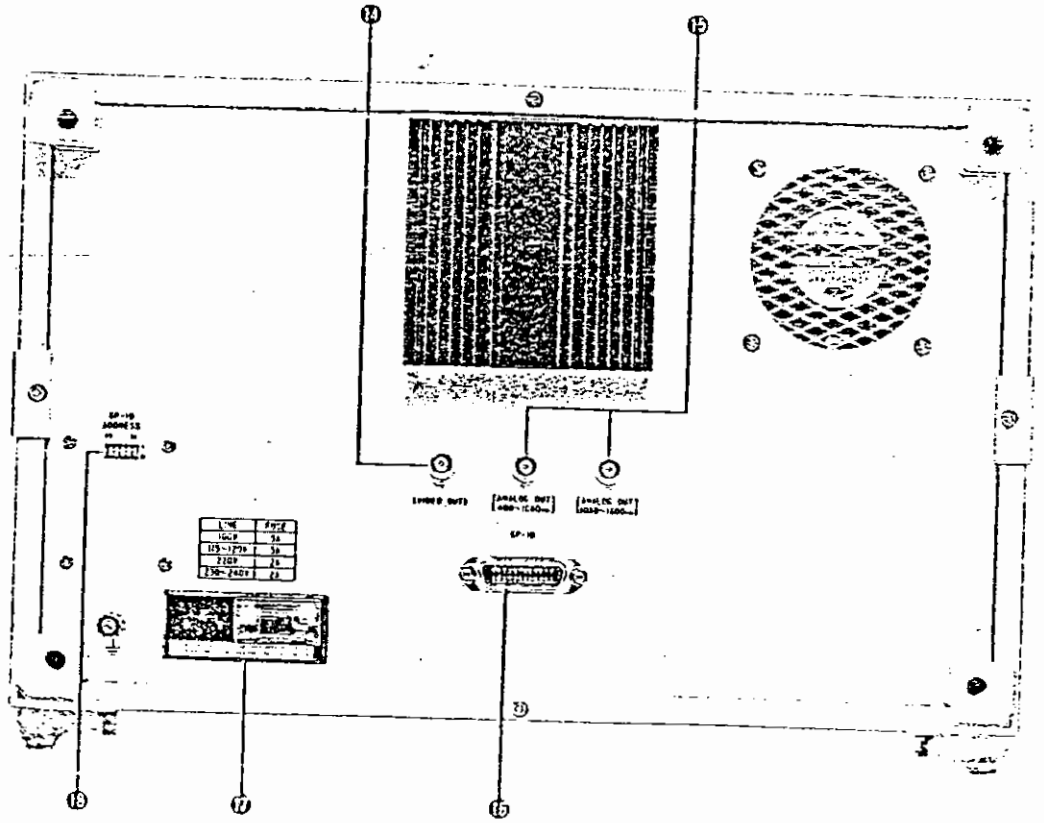


Fig. 3-2 Rear Panel

<Front Panel>

(1) CRT display

This display shows measured waveforms, measurement conditions, and measured values.

(2) AUTO/MANUAL selector key

The AUTO position automatically selects the center wavelength, sweep width, resolution, and reference level best suited for the input to be measured. The MANUAL position allows any desired setting to be selected for measurement.

(3) Measurement keys

(4) Mode selector keys

These keys are used to select either spectrum or loss-wavelength characteristics measurement.

(5) HELP function keys

These switches are used to obtain the instructions for operating procedures or display the current settings.

(6) Label keys

The MEASUREMENT, MODE, and DISPLAY keys can be used as alphanumeric keys for data recording.

(7) Data entry keys and knob

These are used to change measurement conditions.

(8) Calibration key

With a He-Ne laser beam input, this key is used for automatic wavelength calibration.

(9) Input connector

⑩ Dust-block cap

⑪ GP-IB mode key

When GP-IB mode is selected, the REMOTE lamp is on.

⑫ Power switch

⑬ Intensity control

<Rear Panel>

⑭ Video output for monitor or plotter

⑮ Analog output

These terminals are used for external measurement wavelength level monitoring.

⑯ GP-IB connector

⑰ AC power connector

An AC power cord connector and a fuse unit.

⑱ GP-IB interface address setting key.

Table 3-1 Description of Panel keys

Marking		Function	Remarks
MEASUREMENT			(3)
FUNCTION	AUTO/MANUAL	Selection between automatic and manual function measurements	
SWEEP	REPEAT	Repetitive sweep	
	SINGLE	Single sweep The lamp lights during sweep operation.	
	STOP	Sweep is suspended. A second press selects manual sweep.	
HIGH SENSITIVITY		High-sensitivity measurement key The sweep rate is extremely low.	
CENTER WAVELENGTH		Center wavelength setup	NOTE 1
SWEEP WIDTH		Sweep width setup	
RESOLUTION		Resolution setup	
REF LEVEL		Reference level setup	NOTE 2
AVERAGE TIMES		Average time setup	
MODE			(4)
SPECTRUM/LOSS		Selection between spectrum and loss measurement modes	
START		Measurement startup in loss mode	
↓		The parameter table setup cursor is moved downward.	
↑		The parameter table setup cursor is moved upward.	

Table 3-2 Description of Panel keys

Marking		Function	Remarks
DISPLAY			(1)
Y-SCALE	LOG	LOG is selected as the vertical display scale.	
	LIN	LIN is selected as the vertical display scale.	
DATA MEMORY	REF	Waveform memory	
	MEAS	Waveform memory	
	LOSS	REF-MEAS (dB) is scaled and displayed.	
	TRANS.M	MEAS-REF (dB) or MEAS/REF is scaled and displayed.	
	RECALL(1) CLEAR (2)	This key is used to recall memory. A second press on this switch clears the waveform.	
MARKER	LEVEL	Level marker selection	
	WAVE LENGTH	Wavelength marker selection	
	PEAK SEARCH	The peak power is searched and a wavelength marker is placed at the corresponding position.	
	HALF WIDTH SEARCH	The half of the peak value is searched and wavelength markers 1 and 2 are placed at the corresponding position.	
	1	Marker 1 is set at the current marker position.	
	2	Marker 2 is set at the current marker position.	
	CLEAR	The marker is cleared.	

Table 3-3 Description of Panel keys

Marking	Function	Remarks
HELP		
MESSAGE	This switch is used to obtain a detailed description of operating procedures and errors.	NOTE 3
CONDITION	The current function settings are displayed in tabular form.	NOTE 3
LABEL		
ON/OFF	This key is used for labeling. While the lamp is on, the key switch blue markings are effective.	NOTE 3
SHIFT	After this key is pressed, the blue marking on the right side is effective.	
CLEAR	The label area is cleared.	
DATA ENTRY		
FAST	Fast rotary knob feed	
HOLD	This key makes the rotary knob inoperative.	
(Rotary knob)	This knob is used for function setup.	
CALIBRATION (632.8 nm)	Automatic wavelength calibration (Option AQ-4302 is required.)	
GP-IB		
LOCAL	REMOTE mode is cleared when GP-IB is in use. Inoperative during LLO operation.	

NOTE 1: When a wavelength marker has been set, successive two presses on this key select the marker value as the center wavelength.

NOTE 2: When the vertical scale is set to LOG and a level marker is preset, successive two presses on this key select the level marker value as the reference level.

NOTE 3: This key is effective only when no measurement is in progress.

3.3 PREPARATION

Before plugging the power cord into the power outlet, make the following checks.

(1) Turn off the [POWER] switch (12).

(2) Make sure that the power outlet voltage coincides with the supply voltage for this apparatus.

3.4 OPERATING PROCEDURES

3.4.1 Initial Setup

(1) Turn on the [POWER] switch.

(2) The CRT display then looks like the right figure, initial conditions are automatically set, and auto offset is performed. Immediately after the initial condition setup is completed, the display changes.

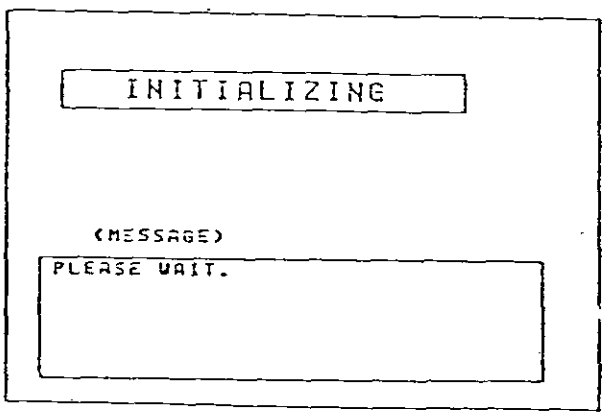


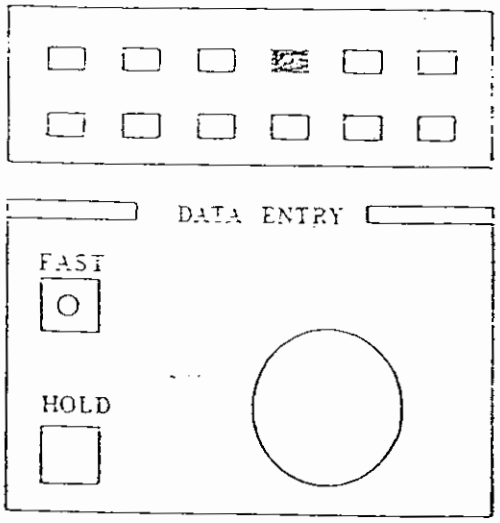
Fig. 3-3 CRT Display at Initial Setup

3.4.2 FUNCTION Setup

Press the desired FUNCTION and MARKER key. Then the corresponding lamps above the marking [DATA ENTRY] come on.

The current setting is displayed at the top right of the CRT screen. Change the setting by turning the [DATA ENTRY] rotary knob.

If the [CONDITION] key is pressed, the setting can be changed while monitoring the table appearing on the CRT.



3.4.3 Description of Display on CRT

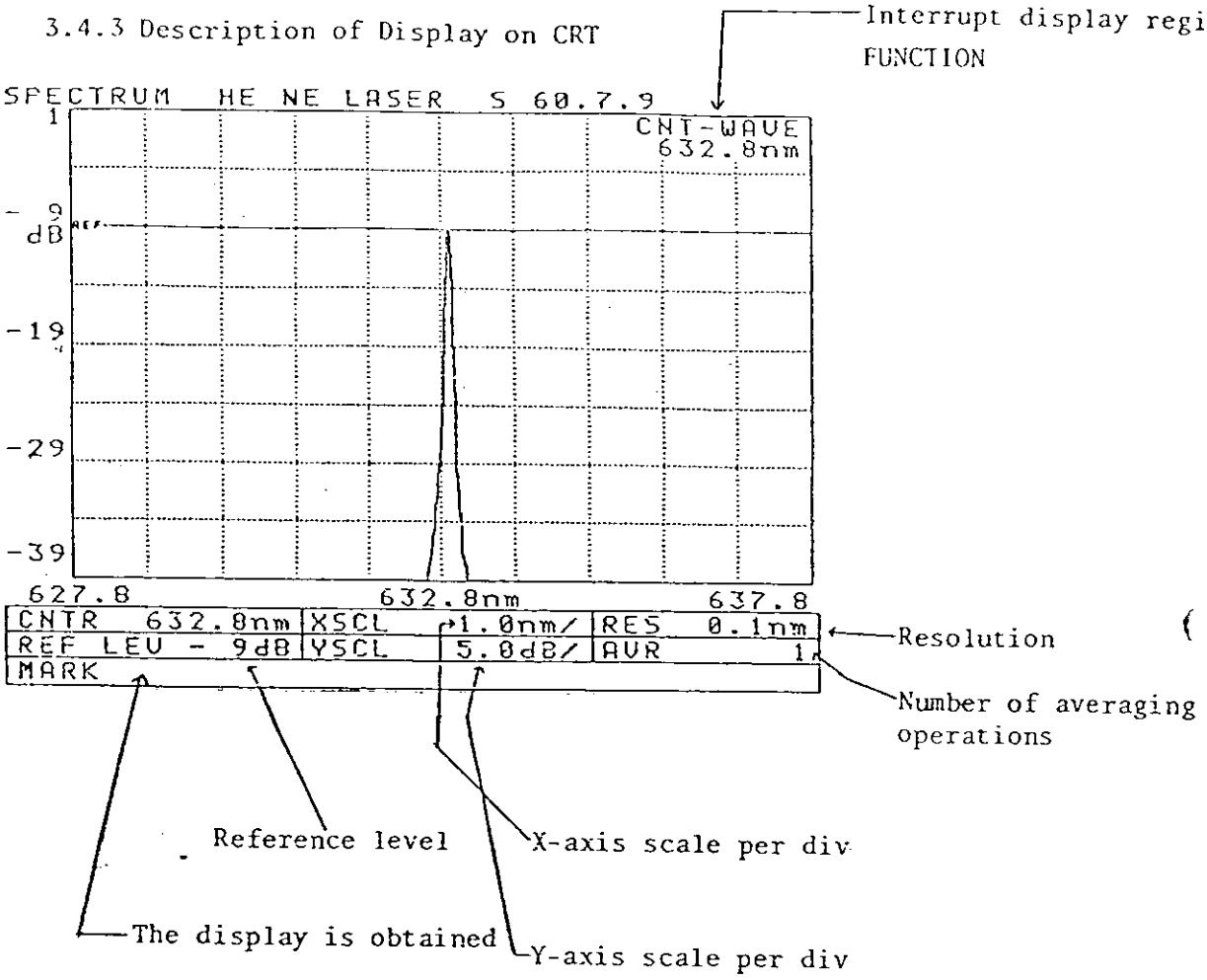


Fig. 3-4 CRT Display Example

3.4.4 Selected Parameter Display

(1) Pressing the [HELP] [CONDITON] switch displays the parameters currently selected. The parameter value at the right of the cursor can be changed by use of the [DATA ENTRY] dial.

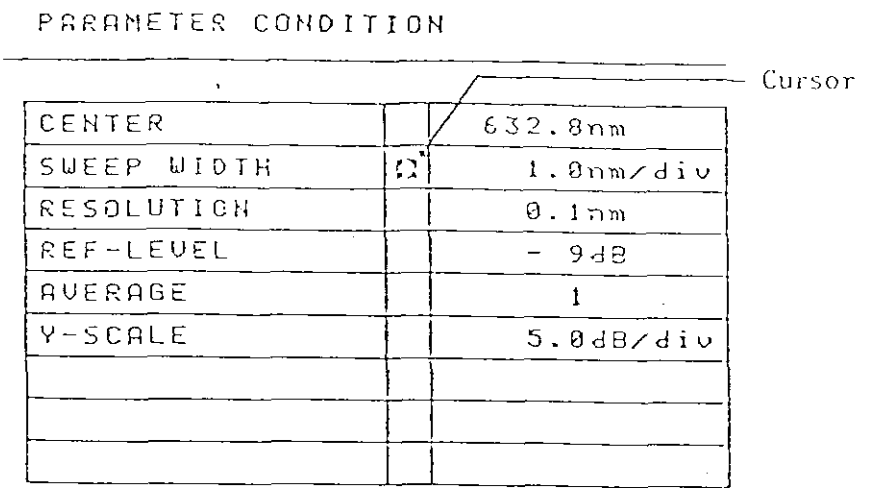


Fig. 3-5 CONDITION Display Example

3.4.5 Automatic Measurement in AUTO FUNCTION Mode

(1) Connect the [INPUT] connector to the sample to be tested.

(2) Press the [FUNCTION][AUTO/MANUAL] key. Then the key lamp lights.

(3) The apparatus automatically selects the optimum center wavelength, sweep width, reference level, and resolution according to the input signal spectrum and repeatedly performs sweep operation.

(4) In [AUTO FUNCTION] mode, unless the peak level is -40 dBm or more for short wavelength and -30 dB or more for long wavelength, the display shows ATN to indicate that [AUTO FUNCTION] is misapplied. In this case, change the measurement mode from [AUTO FUNCTION] to [MANUAL].

3.4.6 Spectrum Measurement in MANUAL Mode

(1) Press the [FUNCTION][AUTO/MANUAL] key to turn off the lamp.

(2) Press the [SPECTRUM/LOSS] key. Then the switch lamp lights.

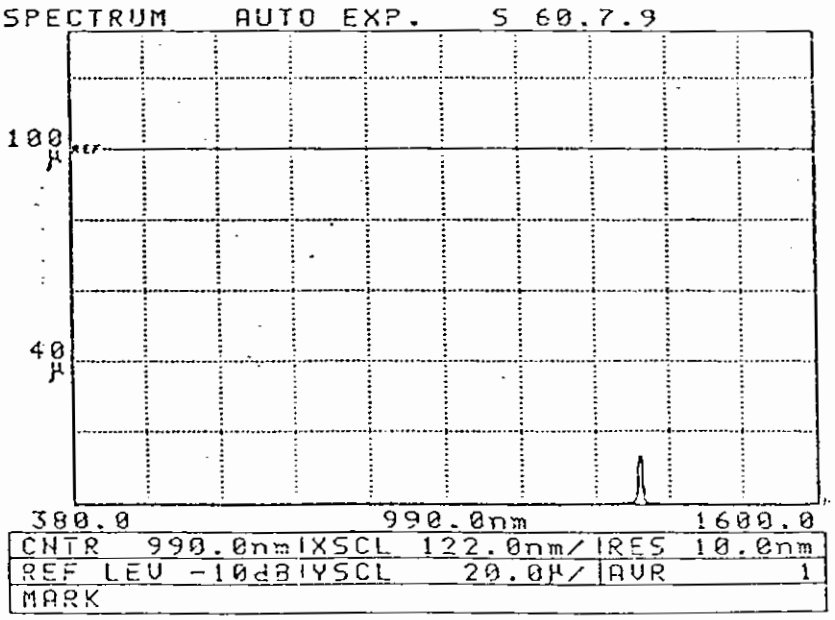
(3) Set the desired measurement conditions using the procedure described in section 3.4.2.

(4) For repetitive measurement, press the [SWEEP][REPEAT] key. For single measurement, press the [SWEEP][SINGLE] key.

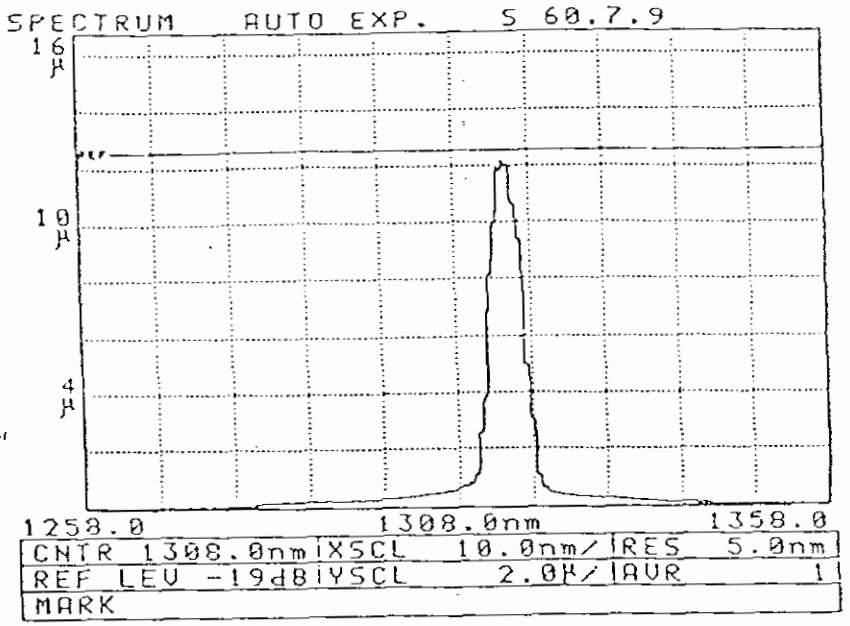
(5) To stop the repetitive measurement, press the [SWEEP][STOP] key.

(6) Successive two presses on the [SWEEP][STOP] key cause the apparatus to enter MANUAL SWEEP mode. Manual sweep can be performed by turning the [DATA ENTRY] dial clockwise.

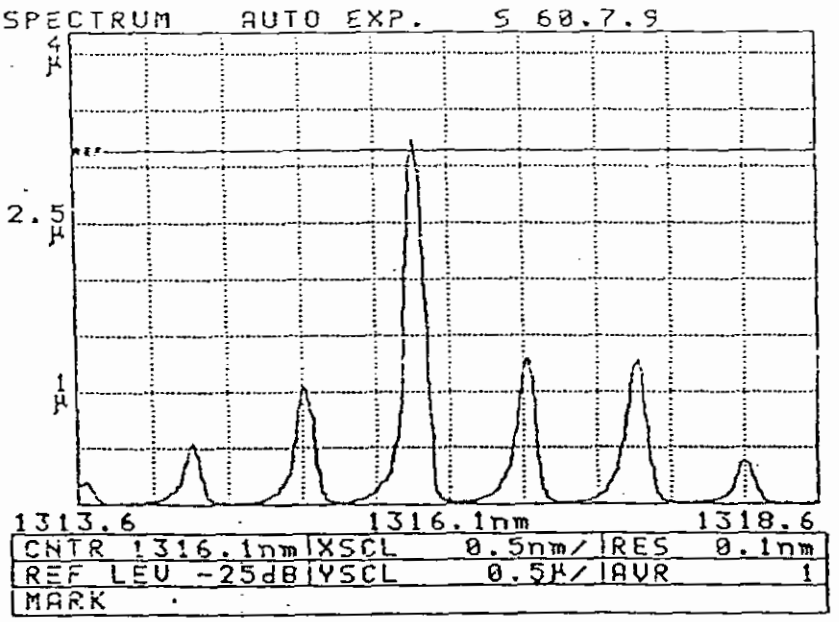
[AUTO FUNCTION] Measurement Example



[First sweep]



[Second sweep]



[Sweep after convergence]

NOTE

In measurement by [AUTO FUNCTION], optimum convergence may not be obtained and the measurement parameter may change for each sweep because of input signal variations (wavelength or level). In such a case, [AUTO FUNCTION] should be cleared and the measurement should be made in [MANUAL] mode.

3.4.7 Peak-value Wavelength Search by PEAK SEARCH Function

(1) The measurement is made in either [SWEEP][SINGLE] or [SWEEP][REPEAT] mode.

(2) After the measurement is completed, press the [PEAK SEARCH] key.

(3) Then the peak value is automatically searched and a wavelength marker is placed at the corresponding position.

(4) A press on the [MARKER][CLEAR] key causes the marker to disappear.

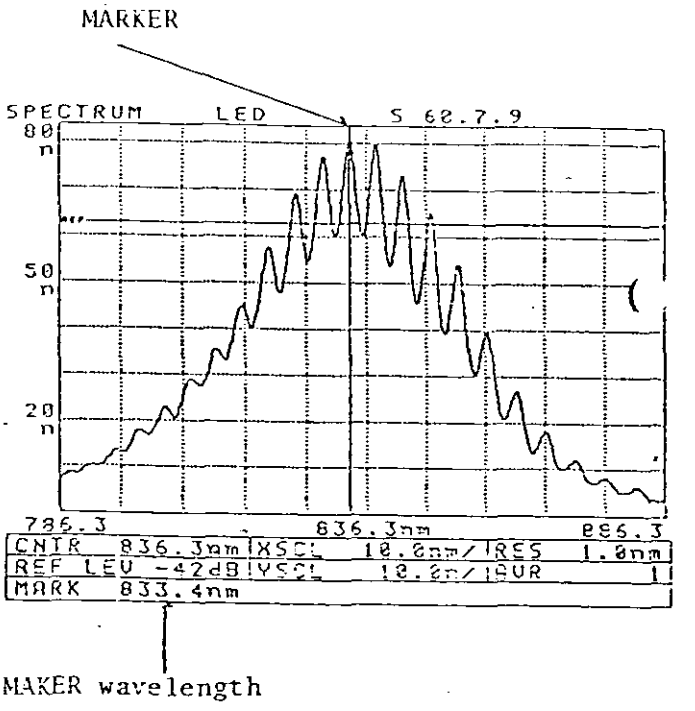


Fig. 3-6 PEAK SEARCH Example

3.4.8 Automatic Half-value Width Measurement by HALF WIDTH SEARCH Function

(1) The measurement is made in either [SWEEP][SINGLE] or [SWEEP][REPEAT] mode.

(2) After the measurement is completed, press the [HALF WIDTH SEARCH] key.

(3) When the search operation is completed, the display shows two marker lines and their wavelengths, and the marker-to-marker wavelength difference. This difference is the half-value width.

(4) A press on the [MARKER] [CLEAR] key causes the markers to disappear.

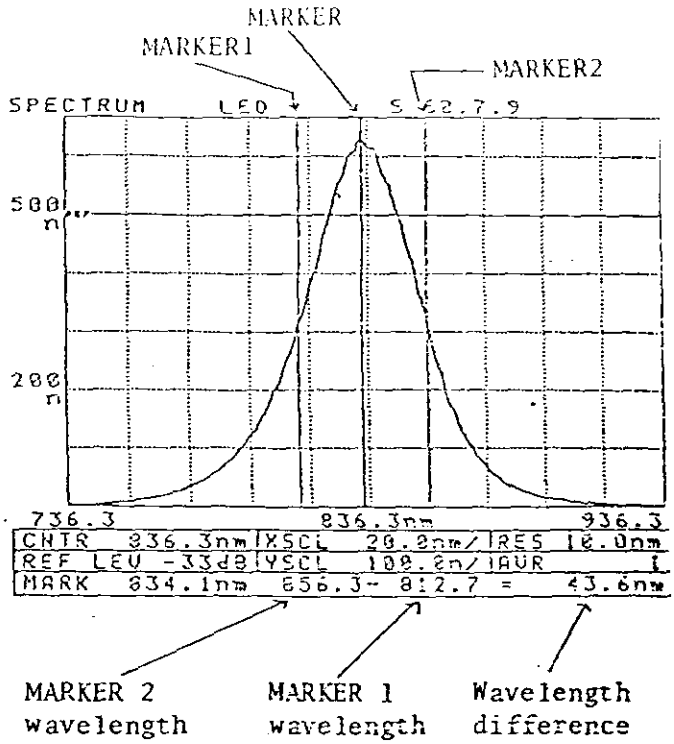


Fig. 3-7 HALF-VALUE WIDTH MEASUREMENT Example

3.4.9 Wavelength Difference Measurement by MARKER Function

(1) Press the [MARKER] [WAVELENGTH] key. Then a vertical marker line appears on the CRT display.

(2) Move the marker to a desired position by using the [DATA ENTRY] dial.

(3) Press the [MARKER][1] key. Then MARKER 1 in step (2) is stored and its wavelength is shown in the MARK column.

(4) Move the marker to another desired position in the same manner as with step (2) and press the [MARKER] [2] key. Then MARKER 2 is stored, its wavelength is shown in the MARKER column, and the marker wavelength difference is displayed.

(5) A press on the [MARKER] [CLEAR] key causes the marker to disappear.

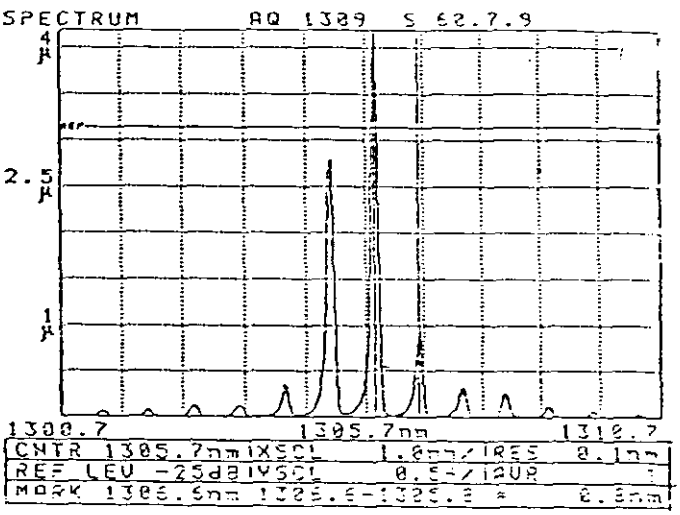


Fig. 3-8 Example of Wavelength Difference Measurement by MARKER Function

3.4.10 Level Difference Measurement by MARKER Function

(1) Press the [Y-SCALE][LOG] key to select dB scale as the Y-scale.

(2) Press the [MARKER][LEVEL] key. Then a horizontal marker line appears on the CRT display.

(3) Move the marker to a desired position by using the [DATA ENTRY] dial.

(4) Press the [MARKER][1] key. Then MARKER 1 in step (3) is stored and its level is shown in the MARK column.

(5) Move the marker to another desired position in the same manner as with step (3), and press the [MARKER] [2] key. Then MARKER 2 is stored, its level is shown in the MARK column, and the marker level difference is displayed.

(6) A press on the [MARKER] [CLEAR] key causes the marker to disappear.

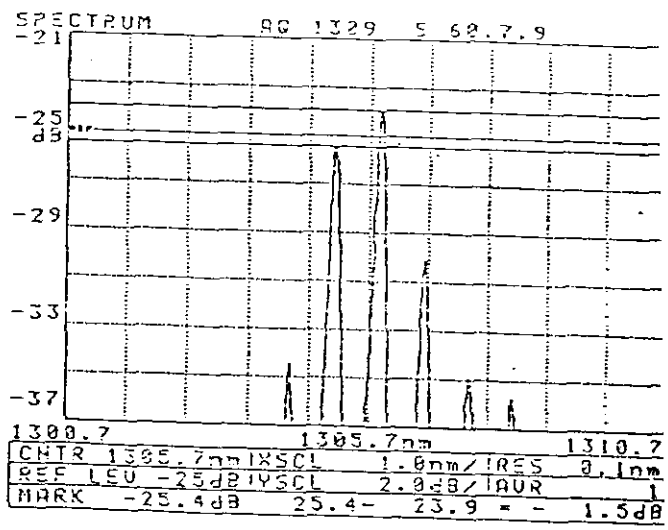


Fig. 3-9 Example of Level Difference Measurement by Level Marker

3.4.11 Center Wavelength Measurement Using MARKER

Although center wavelength is normally set by use of the [DATA ENTRY] dial, it can also be set by using the wavelength marker as described below.

(1) Set the wavelength marker to the desired position using [PEAK SEARCH] and other keys.

(2) Press [CENTER WAVELENGTH] two times in succession. Then the marker value is set as the center wavelength.

3.4.12 REF LEVEL Setting by MARKER

Although REF LEVEL is normally set by use of the [DATA ENTRY] dial, it can also be set by using the level marker as described below.

(1) Set [Y-SCALE] to [LOG].

(2) Set the level marker to the desired position by pressing [MARKER] [LEVEL].

(3) Press [REF LEVEL] two times in succession. Then the marker value is set as REF LEVEL.

3.4.13 Data Deduction by DATA MEMORY Function

(1) Press the [SWEEP] [SINGLE] switch, and measure the reference spectrum.

(2) Press the [DATA MEMORY] [REF] switch to store the waveform in step (1) as the reference value.

(3) Press the [SWEEP] [SINGLE]switch, and measure the comparison spectrum.

(4) Press the [DATA MEMORY] [MEAS] switch to store the waveform in step (3) as the comparison value.

(5) Press the [DATA MEMORY] [LOSS] switch. Then the difference between the reference and comparison levels (REF-MEAS) is shown on the CRT display after automatic scaling.

(6) Press the [DATA MEMORY] [TRANS.M] switch. Then the level difference with reversed polarity is shown on the CRT display.

(7) Press the [DATA MEMORY] [RECALL[1]] [REF] switch. Then the reference value is called and displayed on the CRT again. Successive two presses on the [RECALL[1]] switch clear the waveform.

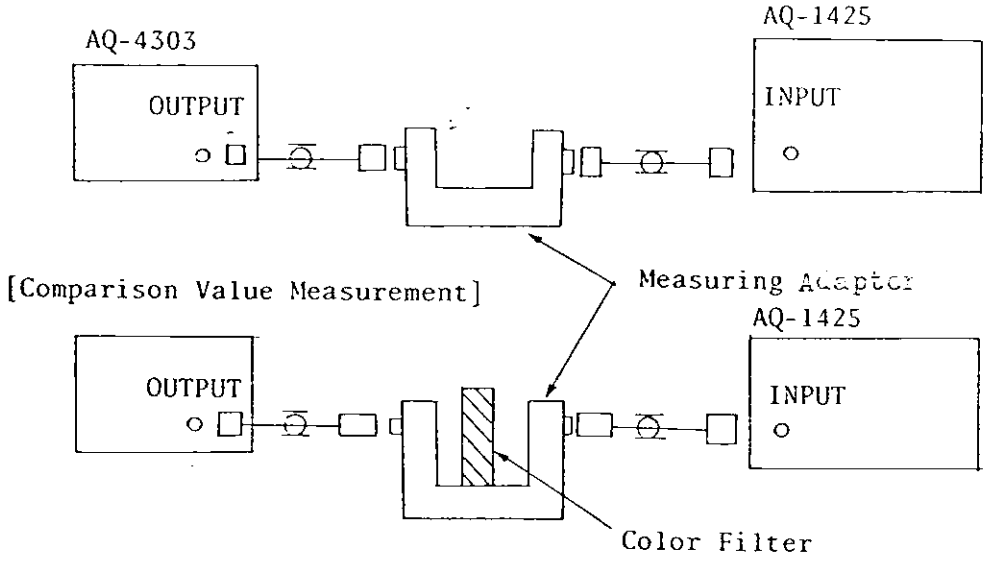
(8) Similarly, a press on the [DATA MEMORY] [RECALL[1] [MEAS] switch calls the reference value.

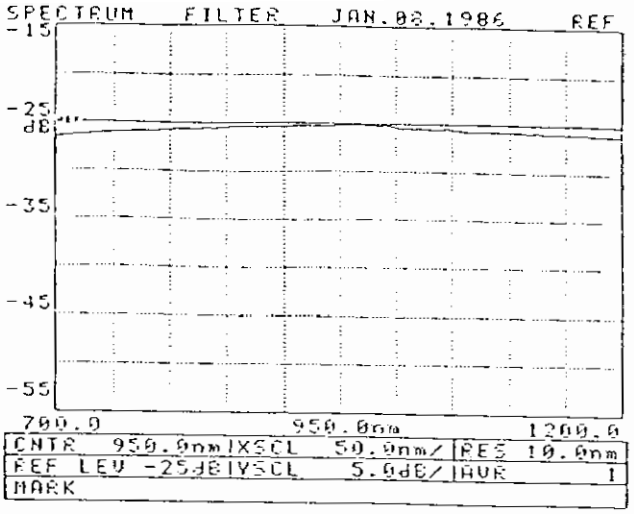
(9) [DATA MEMORY] [REF] and [MEAS] parameters, if coincide with each other, can be displayed at the same time.

(10) Data Memory Application examples

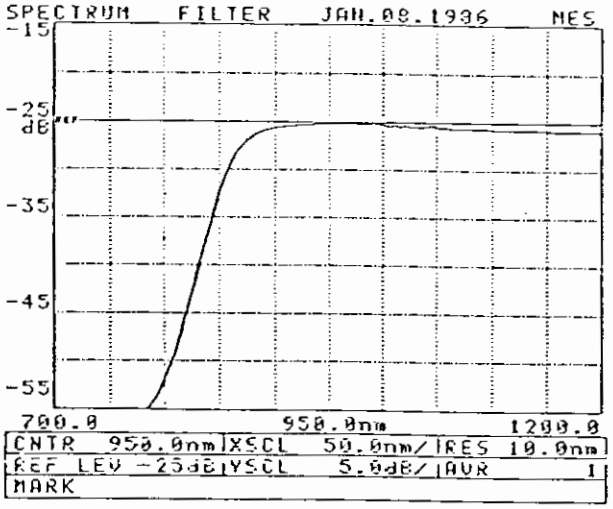
Shown below are examples of color filter transmittance characteristics measurement using the following measuring systems.

[Reference Measurement]

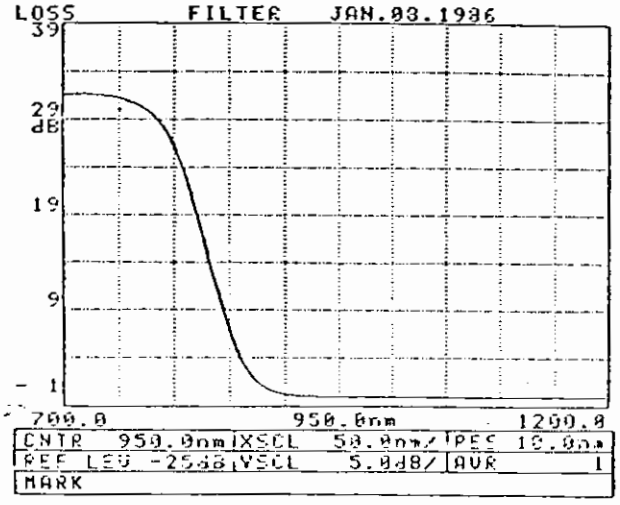




[Reference Measurement]



[Comparison Value Measurement]



[Filter Characteristics]

Fig. 3-10 Data Memory Application Examples

(11) Since [DATA MEMORY][REF] is a nonvolatile memory, its content is retained even after power is turned off. Accordingly, important data should preferable be saved in the [REF] memory. It should be noted, however, that the memory content is cleared when the LOSS mode is selected because the [REF]/[MEA] memory doubles as the LOSS mode reference/DUT measurement memory described in Section 3.4.14.

3.4.14 Wavelength Characteristics Measurement in LOSS Mode

(1) Press the [SPECTRUM/LOSS] switch to turn OFF the lamp.

Then the display will look like this:

TRANS OR LOSS MEASUREMENT MODE

START WAVELENGTH		700 nm
STOP WAVELENGTH		900 nm
INTERVAL WAVELENGTH		2 nm
RESOLUTION	⊏⊐	10.0 nm
AVERAGE TIME		10
Y-SCALE		AUTO
DEDUCTION MODE		REF-MES

(MESSAGE)

SELECT PARAMETERS WITH ↓ AND ↑
KEYS AND CHANGE VALUE WITH
DATA ENTRY.

(2) Set the AQ-4303 White Light Source (option) to a wavelength of 600 to 1000 nm (NOTE 1).

(3) Connect the apparatus to the Type AQ-4303 white light source (option) by a short fiber.

(4) Connect the specimen (test fiber or filter) between the apparatus and the AQ-4303 white light source (option).

(5) The display shows a measurement condition table. Set the desired conditions using the cursor and the [DATA ENTRY] dial.

(6) Press the [START] key to start measurement. Upon completion of the measurement, the apparatus stops operation. The CRT displays the measured waveform for the specimen.

(7) Connect the short fiber between the apparatus and the AQ-4304.

(8) A second press on the [START] key starts reference wavelength measurement. Upon completion of the measurement, the CRT displays the reference waveform and then level difference between the reference value and the measured value, (REF-MEAS) of (MEAS-REF). This waveform represents the loss-wavelength characteristics to be determined.

(9) To further measure other samples, repeat steps (2) through (7).

(10) When the measurement is to be suspended, press [MODE] [SPECTRUM/LOSS]to select the spectrum mode.

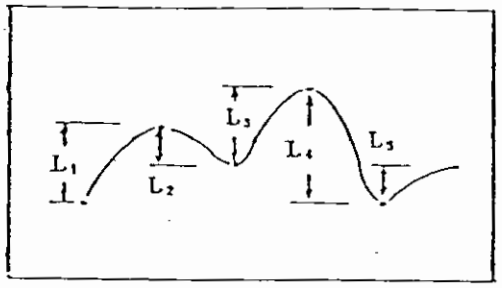
NOTE 1

This setting covers the measurement range of 600 to 1600 nm. The reason is that the AQ-4303 cuts light with a wavelength of 600 nm or less and not cut light with a wavelength of 1000 nm or more. With common spectroscopes, light with a certain wavelengh times an integer is allowed to pass, so that when a wavelength to be used is 1000 nm or more, a wavelength setting of 1000 to 1600 nm must be selected. With this apparatus, however, such operation need not be performed since it incorporates a filter that cuts high-order light for long wavelengths.

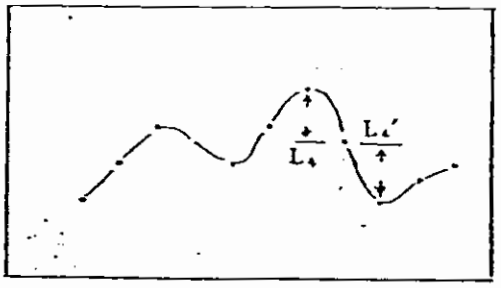
NOTE 2

This apparatus does not display correct values if the level difference between two adjacent measurement points is more than 30 dB.
In this case, select a shorter measurement wavelength interval to reduce the level difference to 30 dB or less.

Greater error when L1, L2, L3, L4, L5 > 30 dB



Normal measurement when L4, L4' < 30 dB

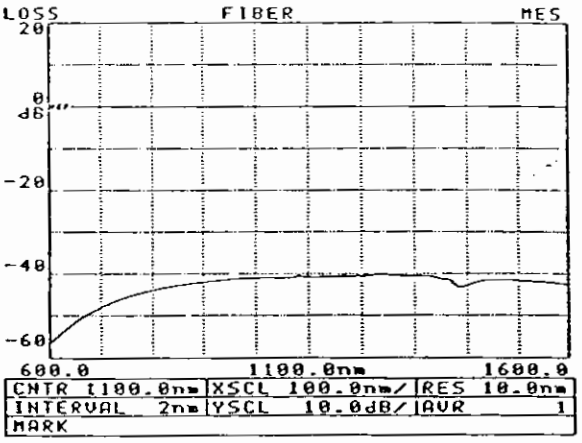


STOP WAVELENGTH		1600 nm
INTERVAL WAVELENGTH		2 nm
RESOLUTION		10.0 nm
AVERAGE TIME		1
Y-SCALE		AUTO
DEDUCTION MODE		REF-MES

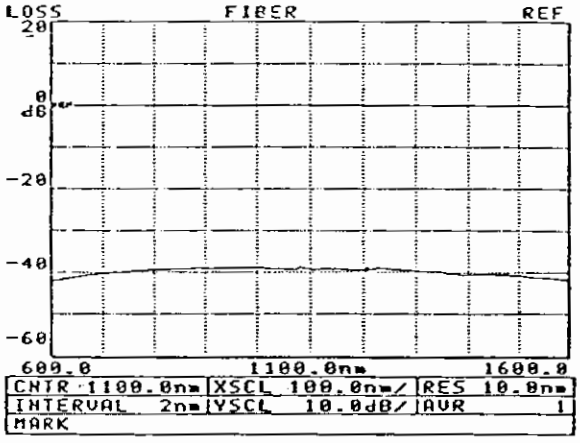
(MESSAGE)

SELECT PARAMETERS WITH ↓ AND ↑ KEYS AND CHANGE VALUE WITH DATA ENTRY.

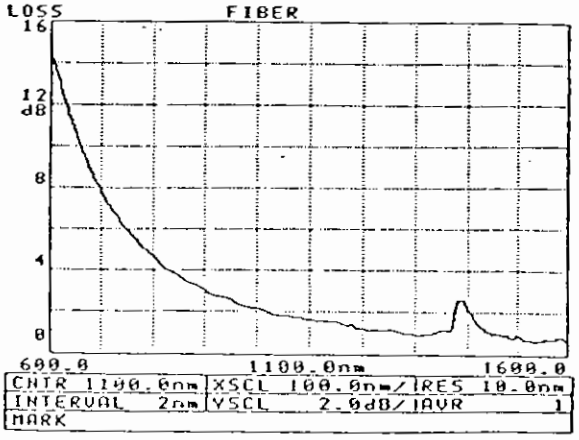
[Measurement condition table]



[1 km-long 50/125 μm GI Fiber]



[Short Fiber]



[LOSS CHARACTERISTICS]

Fig. 3-11 Example of Wavelength Measurement in LOSS Mode

3.4.15 Automatic Calibration by CALIBRATION Function

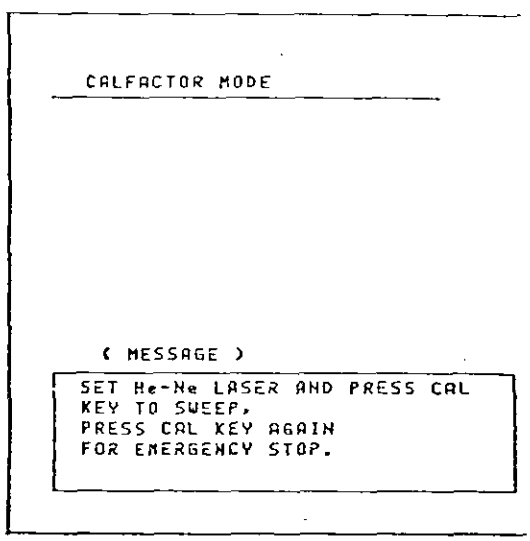
(1) Connect the apparatus to the Type AQ-4302 He-Ne laser (option) by a short fiber.

(2) Press the [CALIBRATION][(632.8nm)] switch. Then the switch lamp lights and the message shown at the right appears on the CRT display.

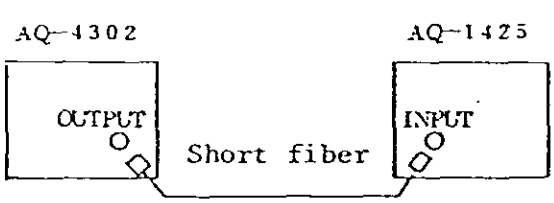
(3) Press the [CALIBRATION][(632.8nm)] switch again. Then the apparatus automatically performs calibration to 632.8 nm.
If the peak level is lower than -30 dBm, ATN. is shown in the interrup display area, which indicates that the level is insufficient for calibration.

(4) To stop calibration, press [CALIBRATION][(632.8nm)].

(5) The calibration range is ± 5 nm.
If the deviation is outside this range, the apparatus does not perform calibration. In this case ATN. is also displayed.



[Message]



Automatic calibration system

(6) Calibration can be made only when the SPECTRUM mode is selected and sweep is not being performed.

3.4.16 Comment Display by LABEL Function

(1) Press the [LABEL][ON/OFF] key to turn on the lamp.

(2) Move the cursor to the desired position within the label range using the [DATA ENTRY] dial.

(3) The blue marking at the left of each switch is displayed at the top of the CRT from left to right each time the key is pressed.

(4) After the [LABEL][SHIFT] key is pressed, the right key marking becomes effective only once.

(5) To clear the label, press the [LABEL][CLEAR] key.

(6) After labeling is completed, press the [LABEL][ON/OFF] key. Then the lamp goes off and the apparatus returns to normal mode.

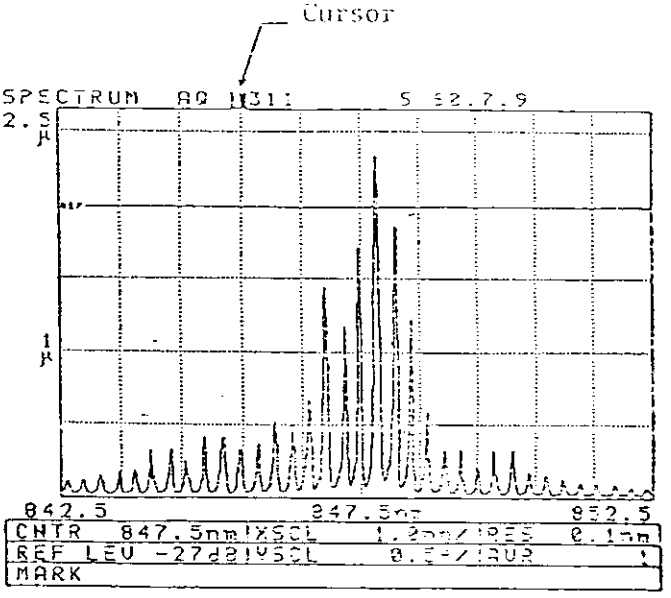


Fig. 3-12 Command Display by LABEL Function

3.4.17 Shutdown Procedure

(1) Set the [POWER] key to [OFF].

(2) Disconnect the cords from the [INPUT] and other connectors.

(3) Disconnect the power cord from the power outlet. Wind the power cord around the feet on the rear panel.

3.5 GP-IB CONTROL

This apparatus can be externally controlled through the GP-IB interface (IEEE Std. 488 compatible). Table 3-6 lists the interface capabilities of this apparatus. External control requires a controller. First, connect the controller to the apparatus by the GP-IB cord. Next, turn on the [POWER] switch (12) of the apparatus.

> CAUTION
>
> Before connecting the GP-IB cord to or removing it from the [GP-IB] connector (16), make sure that the [POWER] switch (12) is set at [OFF]. Ensure also that the bus handshaking has been completed.

3.5.1 Address Setup

(1) The addresses for this apparatus, both listen and talk, can be set by use of the rear panel [ADDRESS] switch (18).

(2) Set REN and ATN to "True" by the controller and send listen address to the apparatus. Then the [GP-IB][REMOTE] LED of this apparatus lights.

(3) Send talk address to the apparatus in the same manner as above. Then the apparatus is addressed as talker and transmits data. Available data include latest measurements, data stored in [DATA MEMORY][REF] or [MEAS], marker values, and current function information. The data should be specified beforehand using the function codes shown in Table 3-4. The format used for talker is shown in Table 3-5.

(4) The apparatus clears the address in the following cases.

When used as listener ..... IFC is "True".
Unlisten command
My talk address

When used as talker ..... IFC is "True".
Un talk command
My listen address
Other talk address

3.5.2 Function Setting

(1) After addressing the apparatus as listener by the controller, send the data in the data format shown in Table 3-4 to perform function and data setting.

Example

The center wavelength is set to 850 nm and sweep width to 10 nm/DIV.

CWL850, SW10 CR LF or EOI

(2) Device function codes can be sent one after another by using commas ",". However, if the number of characters other than blanks (including CR, LF, and other control codes) is more than 200, all the characters are ignored.

(3) Blanks may be inserted as desired since they are all ignored.

(4) Numbers are set correctly if the number of digits excluding the decimal point is 6 or less.

Ex. RES10 = RES010 = RES10. = RES10.000

(5) The delimiter is CR, LF or EOI.

3.5.3 Measurement Startup

(1) After addressing the apparatus as listener by the controller, send the data in the data format shown in Table 3-8. Then the apparatus starts measurement.

Example

Measurement by single sweep

SINGLE CR LF or EOI

3.5.4 Measurement Data Output

(1) If the apparatus is addressed as talker by the controller, the measurement data is output in the data format shown in Table 3-8 immediately after the measurement is completed.

Example

When the measurement is -12.34dB

DBΔ-12.34 CR LF. (Δ: Indicate a space.)

3.5.5 Other Remote Messages

Described below are other remote messages available for this apparatus.

(1) GO TO LOCAL

Upon receipt of this command, this apparatus goes from external control mode into local front panel control mode. At the same time, the [GP-IB][REMOTE] LED of this apparatus goes off. This can also be accomplished by setting REM to "False".

Further, the same operation as by GO TO LOCAL can be performed by using the [LOCAL] key (11) of this apparatus.

> CAUTION
>
> When the apparatus is to be used in remote mode after selecting local mode by use of the [LOCAL] switch (11), perform listener setting and the subsequent operations all over again.

(2) LOCAL LOCKOUT

When the apparatus is in remote mode, it can be set to local control mode by using the [LOCAL] key (11). However, after this command is accepted, the [LOCAL] key (11) is inoperative.

After this command is once accepted, this function is maintained until REM is set to "False". (Until then, the [LOCAL] key (11) remains inoperative.)

When a measurement is completed or when a command received contains an error, SRQ signal is transmitted. Then STATUS bytes are sent by controller serial polling. The content of the STATUS bytes is shown in Table 3-6.

3.5.7 DC Function

Upon receipt of CDL or SDC, this apparatus goes into the same status as it enters immediately after power is turned on.

3.5.8 DT Function

Upon receipt of GE, this apparatus performs the same operation as with function codes "SINGLE" in SPECTRUM mode and the same operation as with "START" or "S" in LOSS mode.

3.5.6 GP-IB Operating Precautions

(1) Before connecting the GP-IB cord to or disconnecting it from the [GP-IB] connector (16), make sure that the apparatus is turned off. Ensure also that the bus handshaking has been completed.

(2) After the system configuration is changed, perform interface clear and the subsequent operations all over again.

(3) When the apparatus is connected to GP-IB, it must be turned on or off after handshaking is completed, whether it is addressed as listener or talker. Otherwise, the entire system may malfunction due to noise or any other factor.

(4) The [GP-IB] connector (16) of this apparatus is a 24-pin connector conforming to the IEEE Std. 488 interface bus standard. The IEC-IB interface bus complies with the same bus standard but uses a 25-pin connector. The difference between these buses is shown in Fig. 3-3.

Table 3-4 Function Code

No.	Item	Description	Data format	Unit	Note
1.	Center wavelength setup	400.0 + sweep width/2 to 1600.0 - sweep width/2	CWL****.*	nm	NOTE 1
2.	Sweep width setup	0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 120,	SW ***.*	nm	NOTE 1
3.	Resolution setup	0.1, 0.2, 0.5, 1, 2, 5, 10	RES **.*	nm	
4.	Reference level setup	HIGH SENSITIVITY: Band / ON / OFF Short wavelength: 0-74 / 0-42 Long wavelength: 0-64 / 0-32	REF LVL-**	dB	
5.	Average time setup	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000	AVR ****		
6.	HIGH SENSITIVITY ON/OFF	ON position provides high S/N measurement by chopped light. OFF position provides high-speed measurement by CW light.	HIGH LOW		NOTE 1
7.	Y-SCALE LOG setup	0.5, 1, 2, 5, or 10 "10" is operative only when HIGH SENSITIVITY is ON.	SCL **.*	dB	NOTE 1
8.	Y-SCALE LIN setup		SCL LIN		NOTE 1
9.	Data memory	REF MEMORY MEAS MEMORY	REF MEAS		NOTE 1
10.	LOSS and TRANS.M turn-on		LOSS TRANS		
11.	Memory call	REF MEMORY MEAS MEMORY	RECALL REF RECALL MEAS		
12	Peak search	The peak value is searched and a wavelength marker is placed at the corresponding position.	PEAK SEARCH		
13.	Half-value width search	The half-value width position is searched and wavelength markers 1 and 2 are placed there.	HALF WIDTH SEARCH		
14.	Initial wavelength setup	600 ∿ 1600	STA ****	nm	NOTE 2
15.	Final wavelength setup	Initial wavelength to 1600	STO****	nm	NOTE 2
16.	Measurement interval setup	2 ∿ 10	INT ***	nm	NOTE 2
17.	Display mode setup	LOSS TRANS.M	LOSS MODE TRANS MODE		
18.	START turn-on		S or START		NOTE 2
19.	Mode switchover	SPECTRUM MODE LOSS MODE	MODE SPEC MODE LOSS		
20.	SWEEP mode	FUNCTION AUTO ON FUNCTION AUTO OFF Repetitive sweep Single sweep	FUNCTION AUTO or FAON FAOFF REPEAT SINGLE		NOTE 1
21.	Output data setup	Latest measurement DATA MEASDATA REF DATA MARKER value FUNCTION STATE	DDATA [,R***,R***] DMEAS [,R***,R***] DREF [,R***,R***] MARKER[,R***,R***] STATE [,R***,R***]		NOTE 3 NOTE 4 NOTE 5
22.	Display OFF	The measurement display is turned off and the transfer rate is increased.	CRT OFF		NOTE 6

NOTE 1 : Effective only in SPECTRUM mode

NOTE 2 : Effective only in LOSS mode

NOTE 3 : R*** indicates the output range. 1 and 560 are at the left and right end of the graph, respectively.

If no specification is made, 1 and 560 are selected.

NOTE 4 : For DDATA, the data is not sent until the measurement is completed. The apparatus cannot start the next measurement during transfer operation. To stop transfer operation, carry out IFC or untalk.

NOTE 5 : In output data setup, the current state is maintained until the succeeding setup is started.

When the apparatus is turned on, it is in DDATA mode.

NOTE 6 To return the apparatus to the normal display mode, carry out DCL (SPC) or disconnect the power. During CRT OFF operation, the following message is displayed.

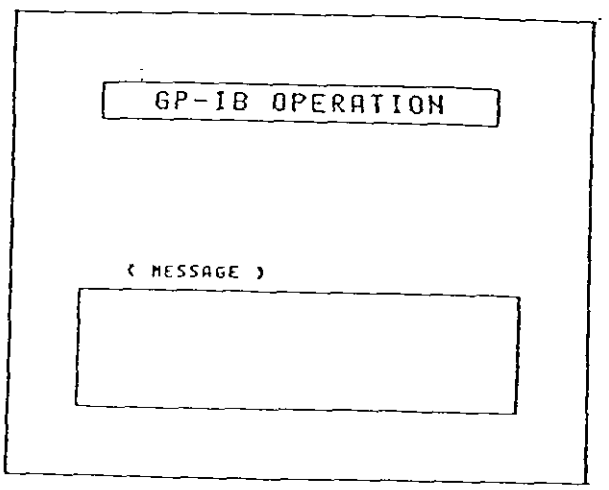


Table 3-5 Talker Format

No.	Item	Format	
1	DDATA DMEAS DREF	LOG	DBΔ data number, data, ..., data [CR] [LF] Data number 1 to 560 Data format ±**.**
		LIN	LNΔ data number, data, ..., data [CR] [LF] Data number 1 to 560 Data format 0≤**.***≤10 The data consists of values when REF LEVEL is 1.
2	MARKER	nmΔΔΔMARKERΔ****.*Δ,ΔMARKER1Δ ****.*Δ,ΔMARKER2Δ****.* [CR] [LF] Ex. nm MARKER 850.0,MARKER1 842.0,MARKER2 858.0	
3	STATE	STATEΔΔCWLΔ****.*Δ,ΔSWΔ* **.*/divΔ,ΔRESΔ**.*Δ,Δ REFΔLVLΔ-**Δ,ΔAVRΔ**** {,HIGH} [CR] [LF] Ex. STATE CWL 850.0,SW 2.0/div,RES 0.1, REF LVL-6,AVR 1	

Table 3-6 Description of STATUS

Bit	Description of STATUS
D8	Measurement is completed.
D7	SRQ signal is being sent.
D6	An unacceptable command is received.
D5	An error exists in the command sequence.
D4	Unspecified command mnemonic
D3	Erroneous command mnemonic
D2	A nonexisting command is received.
D1	Listener buffer overflow

Table 3-7 Interface Capabilities

Division	Code	Remarks
Source (send) handshake	SH1	All SH functions are provided.
Acceptor (receive) handshake	AH1	All AH functions are provided.
Talker	T6	Basic talker MLA talker clear Serial poll
Listener	L4	Basic listener MTA listener clear
Remote/local	RL1	Local lockout function is provided.
Service request	SR1	All SR functions are provided.
Parallel poll	PP0	PP function is not provided.
Device clear	DC1	All DC functions are provided.
Device trigger	DT1	All DT functions are provided.
Controller	C0	C0 function is not provided.

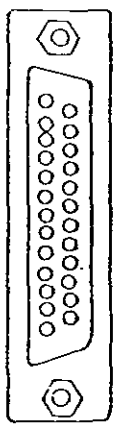
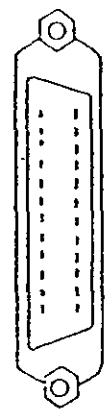
Connector view (Male)	Pin No.	Signal name	Pin No.	Connector view (Female)
	1	DIO 1	1	
	2	DIO 2	2	
	3	DIO 3	3	
	4	DIO 4	4	
	5	REN	17	
	6	EOI	5	
	7	DAV	6	
	8	NRFD	7	
	9	NDAC	8	
	10	IFC	9	
	11	SRQ	10	
	12	ATN	11	
	13	Cable shield	12	
	14	DIO 5	13	
	15	DIO 6	14	
	16	DIO 7	15	
	17	DIO 8	16	
	18	Ground	18	
	≀	≀	≀	
	25	Ground	24	
IEC-IB				IEEE-488

Fig. 3-13 Bus Line and Connector Differences

Fig. 3-14 Spectrum Measurement Flowchart (AUTO)

When the wavelength is completely unknown (AUTO measurement example)

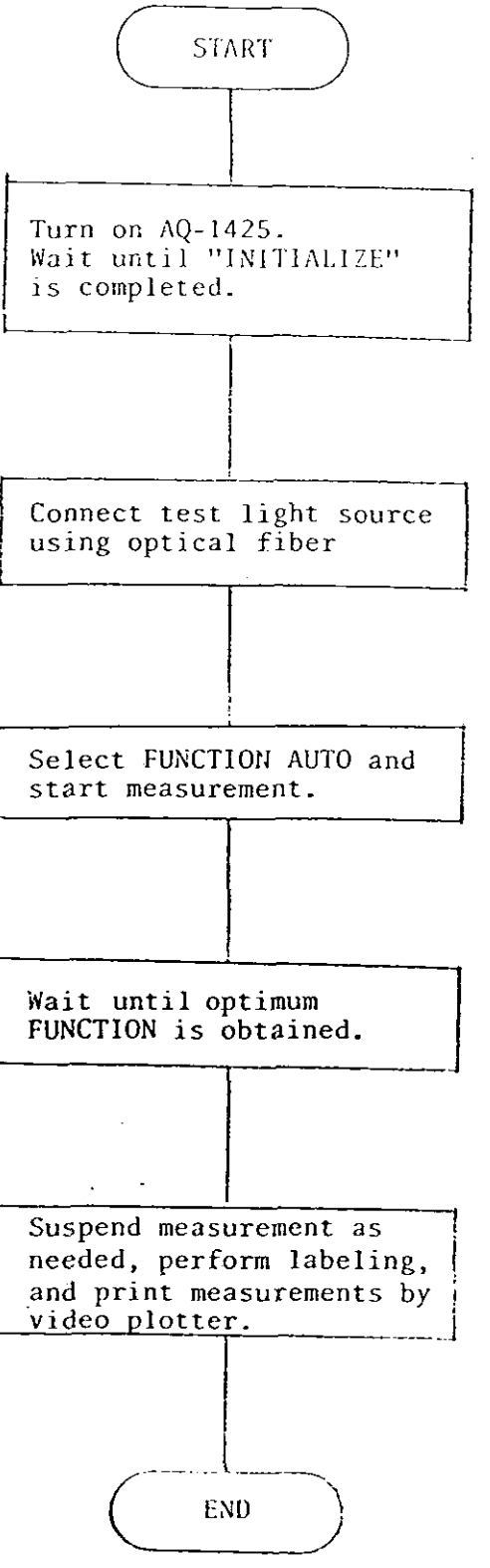
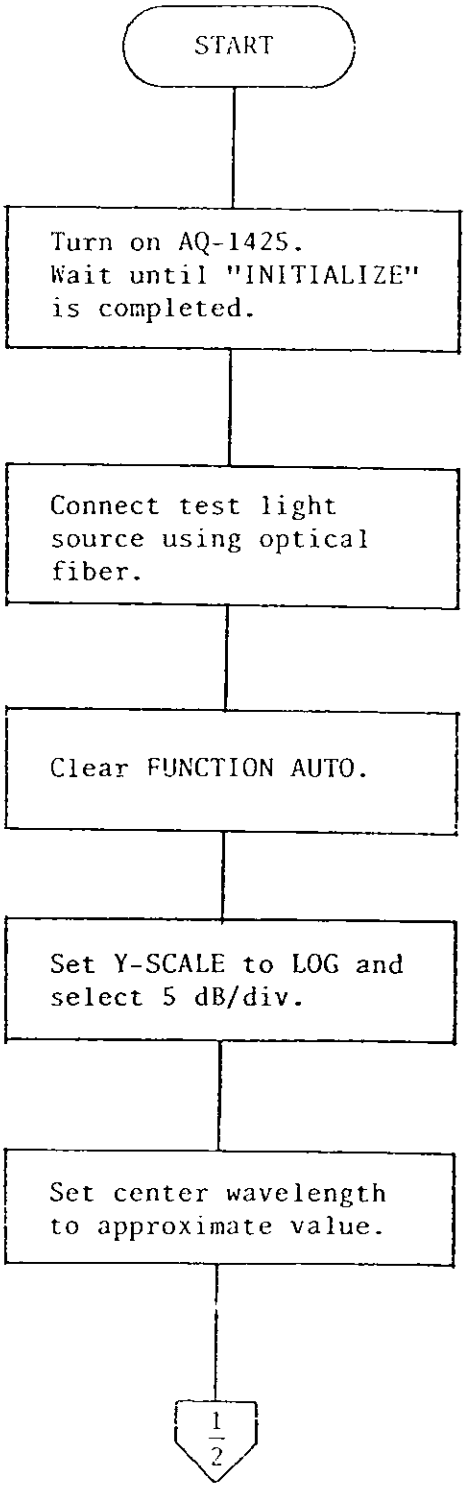
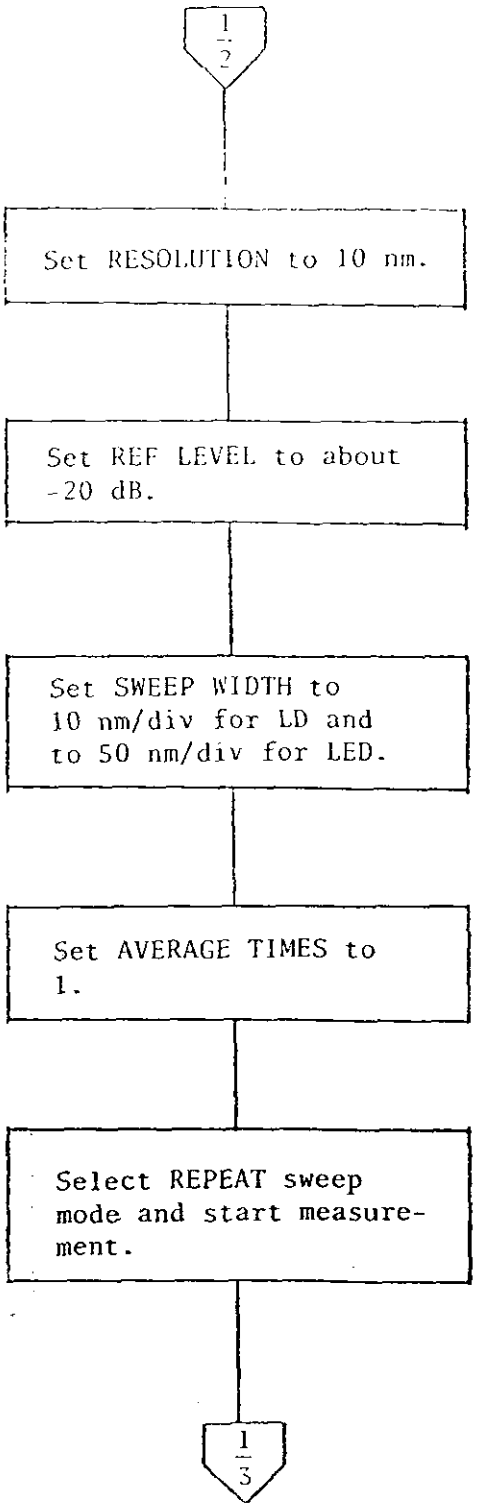


Fig. 3-15 Spectrum Measurement Flowchart (MANUAL)

When approximate wavelength is known (manual measurement example)





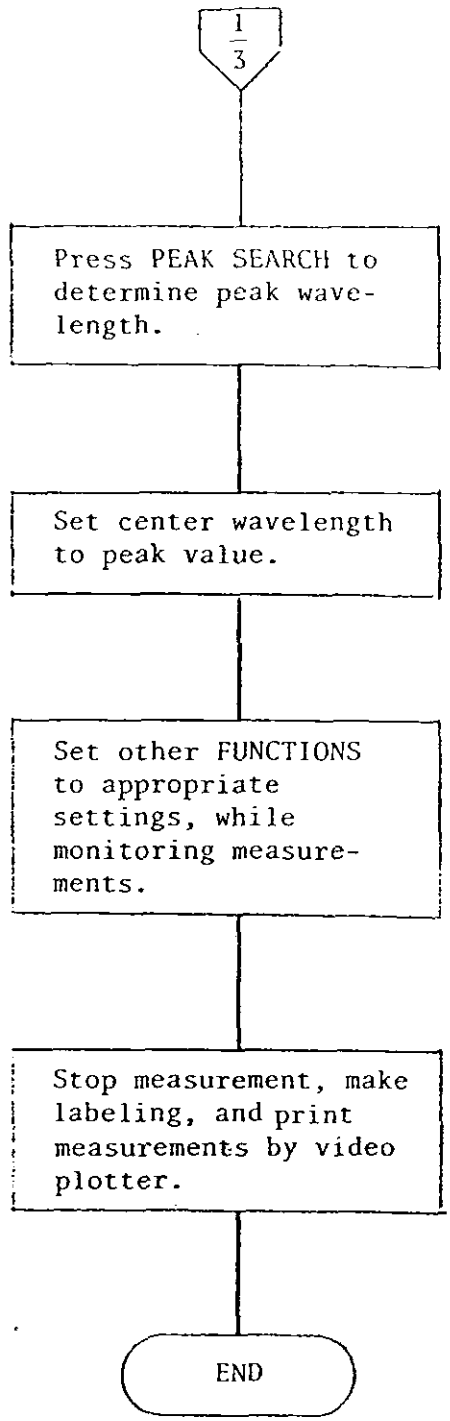
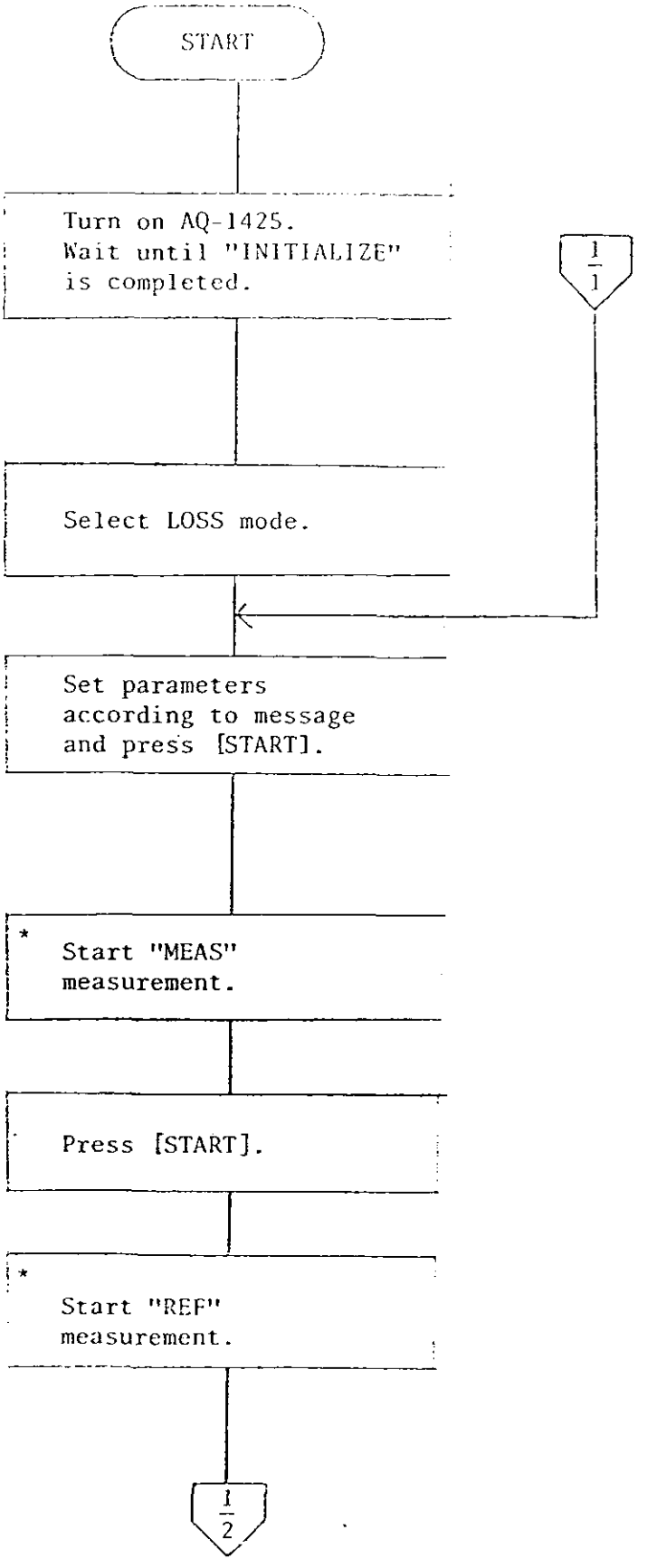
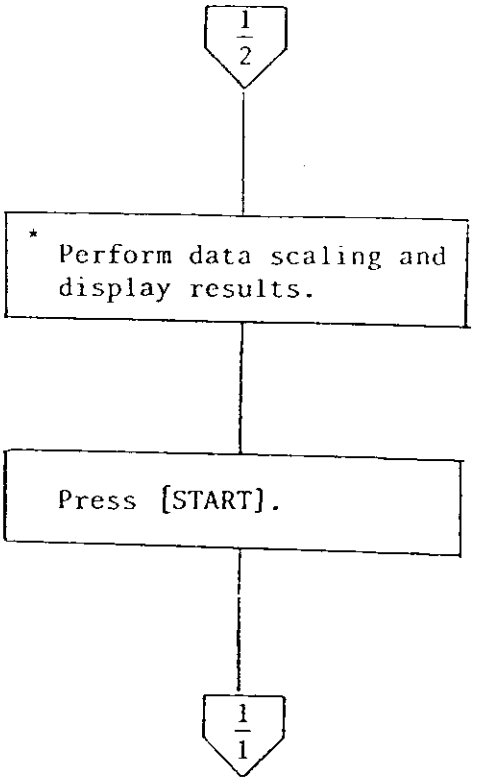


Fig. 3-16 Loss-wavelength characteristics measurement flowchart





*: Indicates AQ-1425 operation.

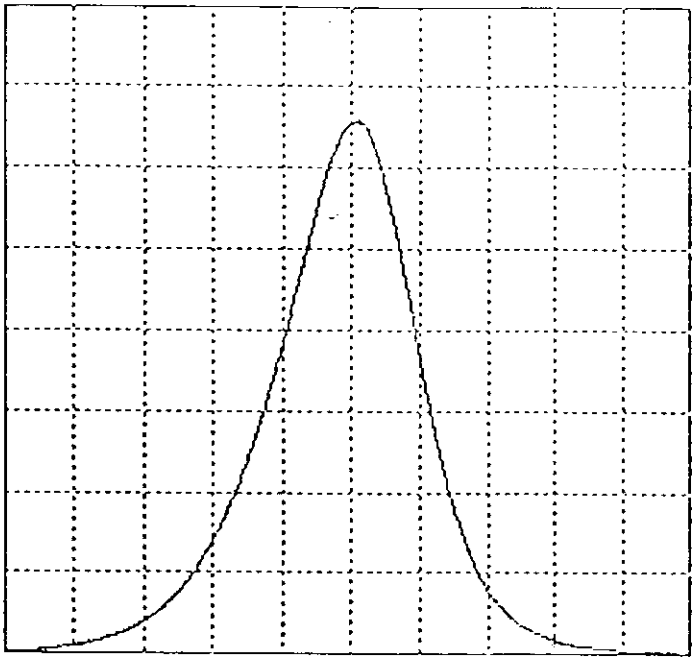
```
10    ! AQ-1425 GP-IB TEST
20    ! FILE NAME 1425GP
30    !
40    PRINTER IS 16
50    DIM A(1000)
60    REMOTE 7
70    Add=0
80    Cw10=854.2
90    Sw0=20
91    Level=-34
92    Scl=5
120   OUTPUT 700;"CWL";Cw10;",SW";Sw0
121   OUTPUT 700;"REFLVL";Level;",AVR1,RES10,SCL";Scl
131   PAUSE
160   OUTPUT 700;"DDATA,SINGLE"
180   ENTER 7,Add USING "#,F";B
190   PRINT
200   PRINT B
210   PRINT
220   M0=1E6
230   M1=-1E6
240   FOR I=1 TO B
250   ENTER 7,Add USING "#,F";A(I)
260   IF A(I)>=M0 THEN 290
270   M0=A(I)
280   I0=I
290   IF A(I)<M1 THEN 320
300   M1=A(I)
310   I1=I
320 ! PRINT A(I);
330   NEXT I
340   PRINTER IS 0
341   C=C+1
380   Cw1=Cw10
390   Sw=Sw0
450 ! PRINT USING 460;C,Add,I1,M1,I0,M0
451 ! PRINT PAGE
452 ! PRINT USING 453;C
453   IMAGE "[",DDD,"]"
460   IMAGE "[",DDDDD,"]",2X,"Add=",D,2X,"MAX     I=",DDD,2X,"P=",DDD.DDD,4X,"MI
N     I=",DDD,4X,"P=",DDD.DDD
470   PRINTER IS 16
480   ENTER 7,Add;A$
490   LOCAL 7
500   REMOTE 7
510   GRAPHICS
511   GCLEAR
520   LIMIT 0,180,0,140
```

```
530   LINE TYPE 3
540   Wmax=Cwl+5*Sw
550   Wmin=Cwl-5*Sw
570   Pmax=Level+2.0*Scl
580   Pmin=Level-6*Scl
590   LOCATE 60,125,20,80
600   SCALE Wmin,Wmax,Pmin,Pmax
610   FRAME
611   LINE TYPE 3
620   FOR I=-6 TO 2.0
621   IF I<>0 THEN 630
622   LINE TYPE 1
630   MOVE Wmin,Level+I*Scl
640   DRAW Wmax,Level+I*Scl
641   IF I<>0 THEN 650
642   LINE TYPE 3
650   NEXT I
660   FOR I=1 TO 9
670   MOVE Wmin+I*Sw,Pmin
680   DRAW Wmin+I*Sw,Pmax
690   NEXT I
691   LINE TYPE 3
700   SETGU
701   LINE TYPE 1
710   MOVE 0,83
720   LABEL "EXAMPLE OF AQ-1425 DATA OUTPUT"
730   IMAGE 8A
740   MOVE 110,83
750   MOVE 0,70
760   LABEL USING 770;Sw
770   IMAGE "SWEEP WIDTH ",ØDD.D,"[nm/div]"
780   MOVE 0,65
790   LABEL USING 800;Scl
800   IMAGE "SCALE          ",D.DD,"[/div]"
810   SCALE 1,560,Pmin,Pmax
811   LINE TYPE 1
820   FOR I=1 TO 560
830   PLOT I,A(I)
840   NEXT I
841 ! DUMP GRAPHICS
870   GOTO 160
880   END
```

[1]

EXAMPLE OF AQ-1425 DATA OUTPUT

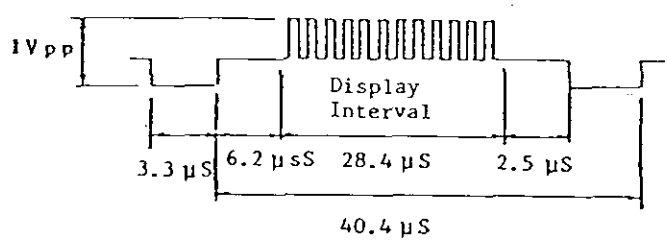
SWEEP WIDTH 20.0[nm/div]
SCALE .17[/div]



3.6 VIDEO INTERFACE

The video composite signal corresponding to the disply shown on the CRT screen, as shown in Fig. 3-28, is developed at the [VIDEO OUT] terminal on the rear panel.

Horizontal Sync Interval



Vertical Sync Interval

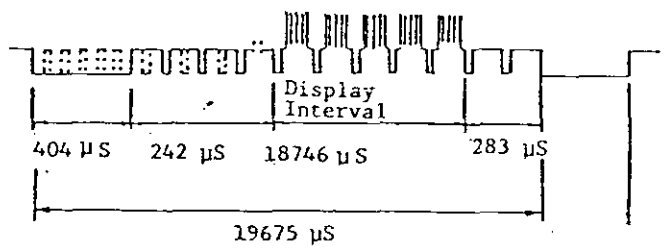


Fig. 3-17 Output Video Signals

With this terminal connected to a video connector suited for the above output video signal, hard copies of displays on the CRT screen can be obtained with ease.

Fig. 3-3 shows an example of recording by a video plotter.

If this terminal is connected to a TV monitor compatible with the above output video signal, the display on the CRT can be monitored. The video signal band of the TV monitor must be 25 MHz or more.

When selecting a camera for shooting the CRT screen, refer to the CRT bezel dimensions shown in Fig. 3-18.

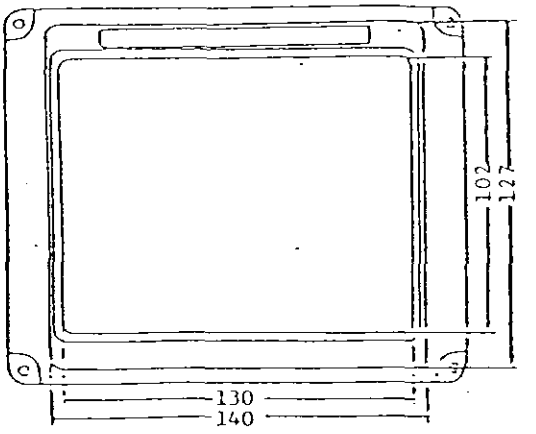
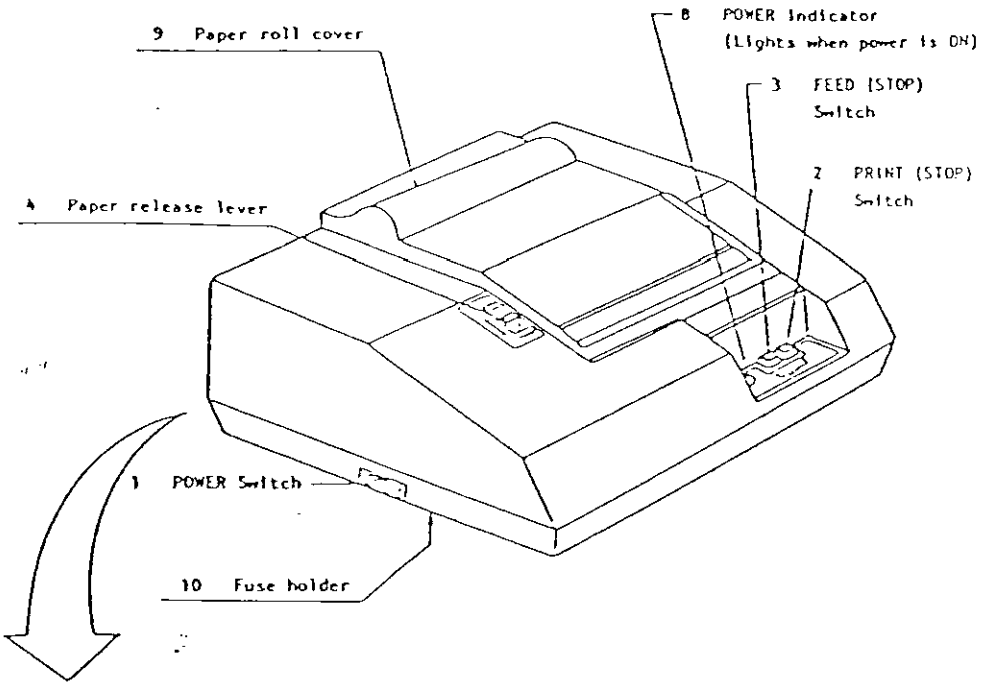


Fig. 3-18 CRT Bezel Dimensions

To obtain hard copies of displays on the CRT, it is necessary to adjust the video plotter beforehand.

Set the video plotter rear panel DIP switch 1 to ON and the other DIP switches to OFF. Next, adjust the trimmers 1 through 8 to as specified in Fig. 3-19. The rough adjustent of the plotter is now completed. However, a satisfactory picture quality may not be obtained because of the product variations. In such a case, make a fine adjustment of the plotter according to Fig. 3-20.

As the plotter supplied together with the apparatus has been factory adjusted, the trimmers should not be tampered with.



Rear Panel

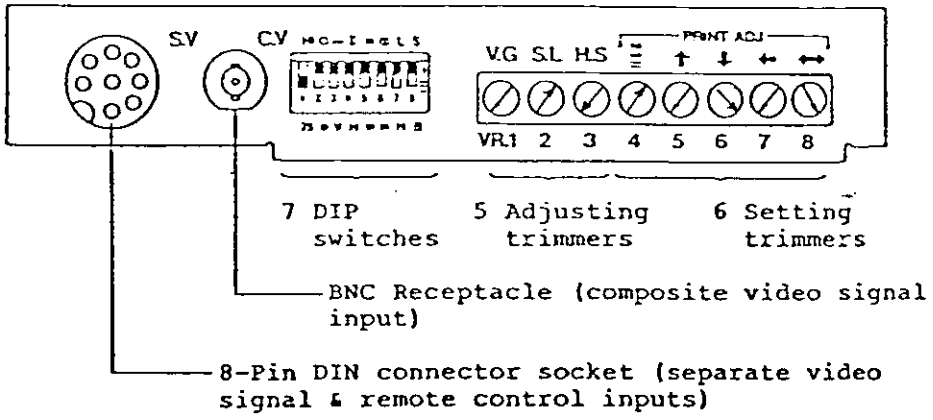
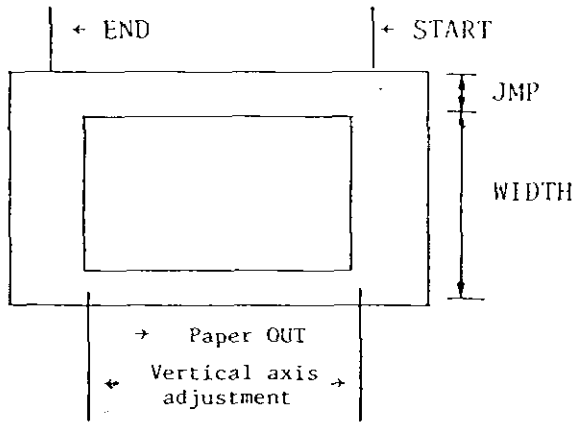


Fig. 3-19



VR 1	Gain adjustment	VR 5	Print screen START adjustment
VR 2	Print screen density adjustment	VR 6	Print screen END adjustment
VR 3	Video timing adjustment	VR 7	Print screen erasure
VR 4	Print screen vertical axis adjustment	VR 8	Print screen WIDTH adjustment

Fig. 3-20

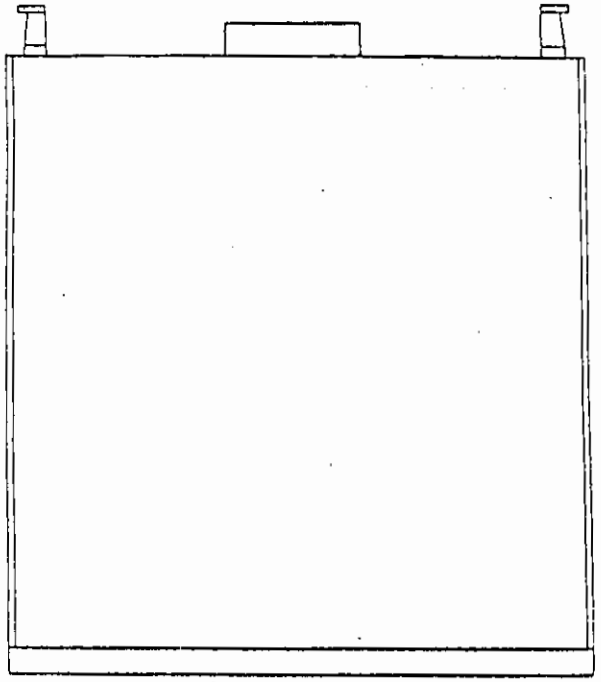
3.7 ABBREVIATIONS

The abbreviations shown on the CRT has the following meanings.

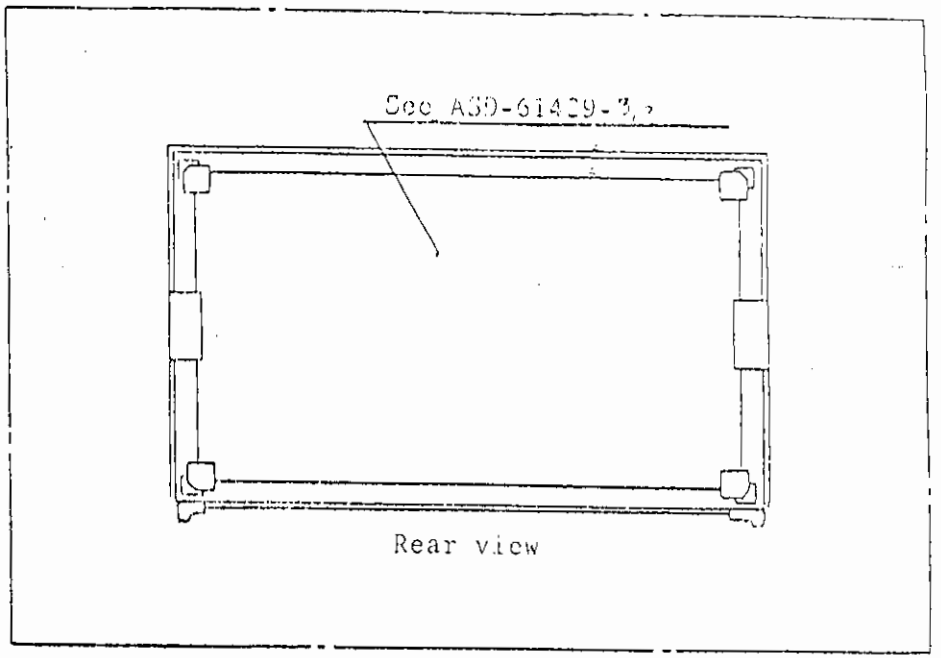
Abbreviation	Meaning
ALU	Arithmetic and Logic Unit
AMP-GAIN	Amplifier Gain
ATN.	Attention
AUTO	Automatic Setting Scale
AUTO-SWEEP	Automatic Sweeping
AVERAGE	Averaging Times
AVERAGE TIME	
AVERAGE TIMES	
AVR	
CENTER	Center Wavelength
CNTR	
CNT-WAVE	
INTERVAL	Interval Wavelength
LIN	Liner Scale
LOSS	Loss Mode or Loss Characteristics
MARK	Marker
MES	Main Measurement
REF	Reference Measurement (NOTE)
REF	Reference Level
REF LEV	
REF-LEV	
REF-LEVEL	

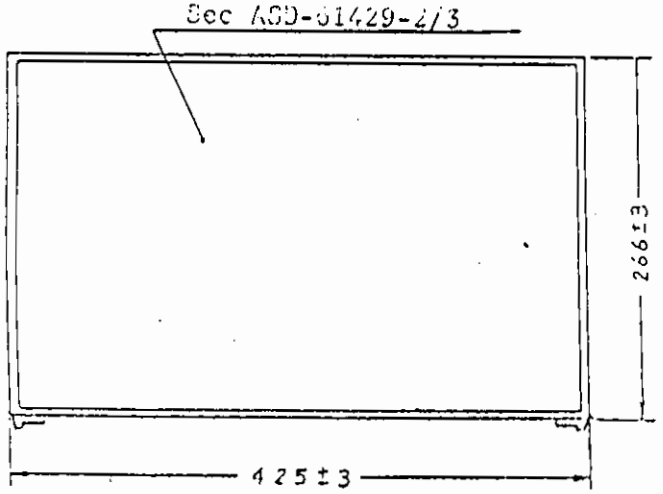
RES RESO	Resolution
SPECTRUM	Spectrum Mode
SW-WIDTH XSCL	Sweep Width
TRANS	Transmission Characteristics
YSCL	Y - Scale
m	10^{-3}
μ	10^{-6}
n	10^{-9}
p	10^{-12}

NOTE: When "REF" is displayed on the upper righthand corner of the CRT screen, REF means "Reference Measurement".

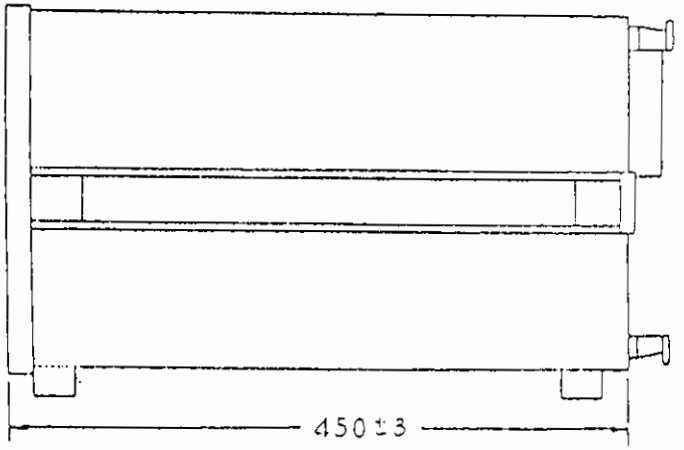


Top view



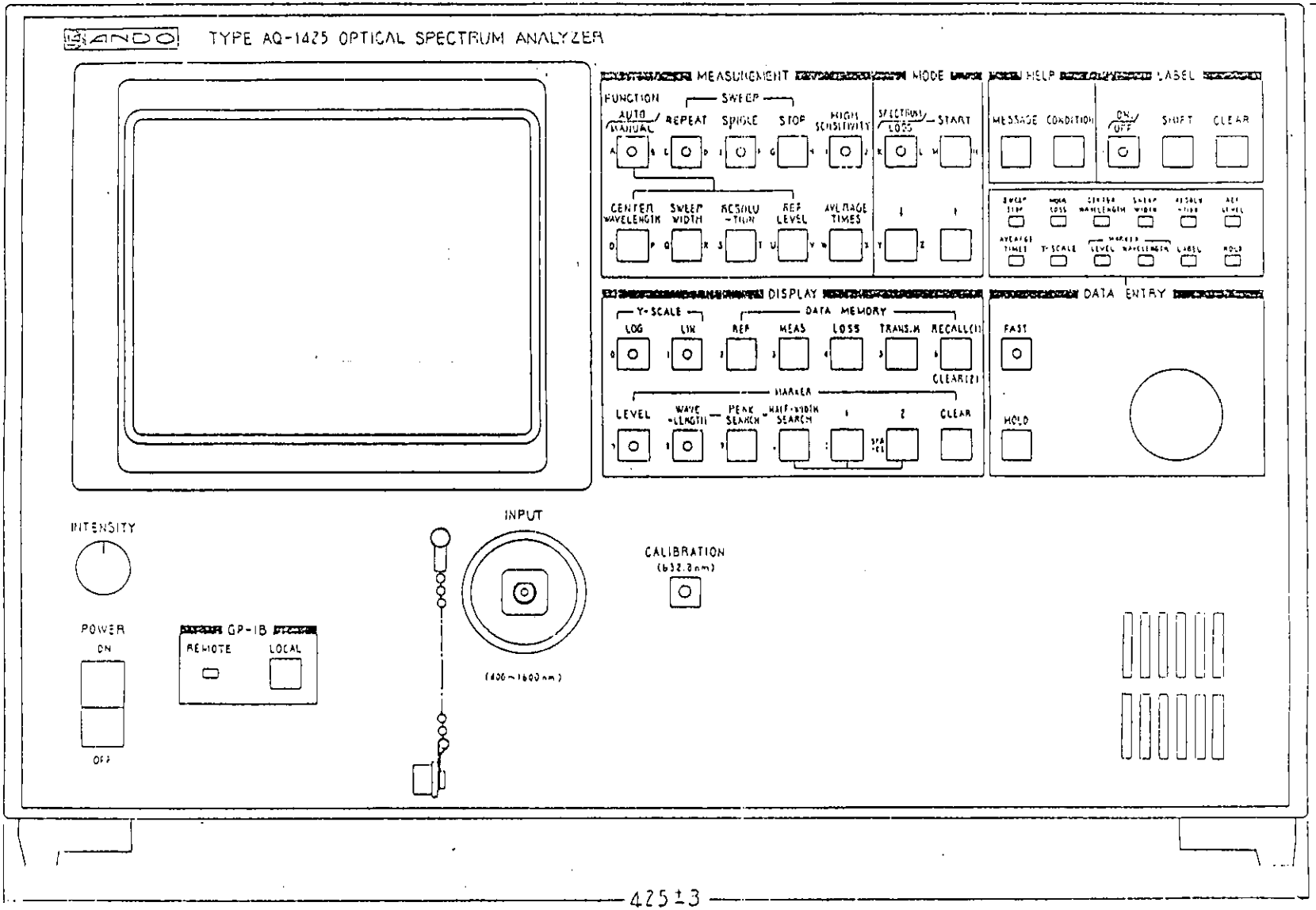


Front view



Side view

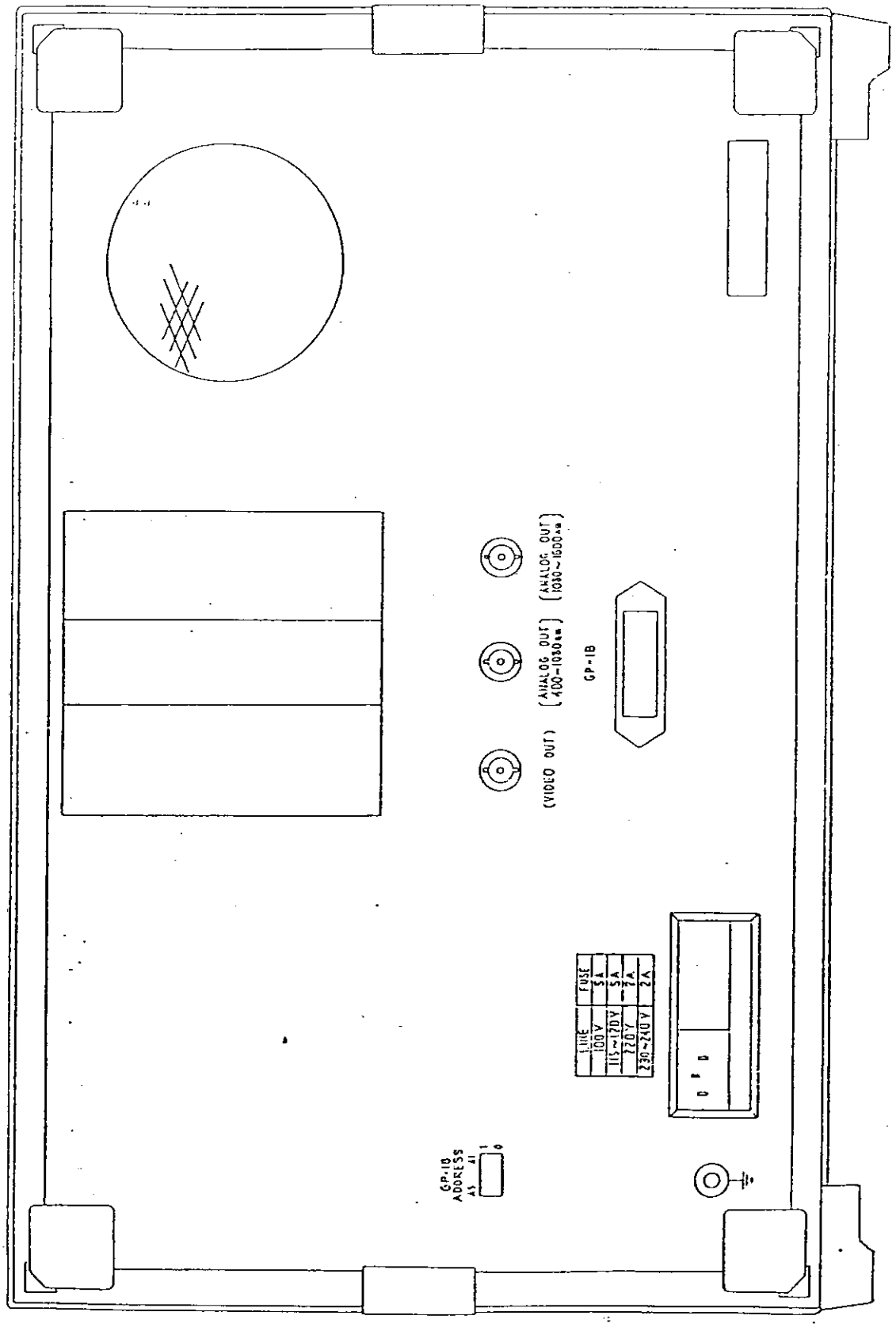
EXTERNAL VIEW ASD-61429-1/3



Depth 450±3

FRONT PANEL VIEW

ASD-61429-2/3



REAR PANEL VIEW