AQ2140 Optical Multimeter
Instruction Manual

= For Reference =

Safety precausions are subject to change due to amandements made in laws and ordinaces.
Please operate the device at your own risk.
If you have any inquiries regarding the safety operation, please do not hesitate to contact your local Yokogawa sales office.

ANDO ELECTRIC CO., LTD.

AS-62333 Rev. 3.1

WARRANTY

All Ando Electric's products have been inspected with our severe quality assurance standards. However, if any defect or trouble occurring during transportation is found, contact us at our Customer Service Department, Headquarters, Marketing Department or local sales office or branch office of your convenience.

Ando Electric will replace, at no charge, the defective product(s) that occur within one year of the original date of product delivery. However, the defects due to an operation error, modification or retrofit by the customer, or those caused by the natural disasters are serviced with charge.

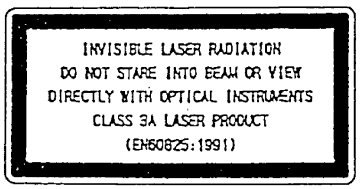
Initial Safety Information for Laser Source Units

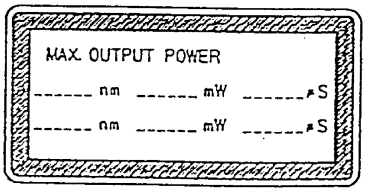
The Specifications for these Units are as follows;

	AQ4211(131)	AQ4211(155)	AQ4211(165)	AQ4212(130)
Laser Type	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Class				
According to EN60825:1991 (Europe)	3 A	3 A	3 A	3 A
According to CFR 1040.10 (Canada, USA)	1	1	1	1
Output Power	>0dBm	>0dBm	>0dBm	>0dBm
Beam Diameter	10um	10um	10um	50um
Numerical Aperture	0.1	0.1	0.1	0.2
Wavelength	1310±20nm	1550±20nm	1650+ 5nm	1300±20nm

	AQ4213 (131/155)	AQ4214(131)	AQ4214(155)
Laser Type	Dual FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Class			
According to EN60825:1991 (Europe)	3 A	3 A	3 A
According to CFR 1040.10 (Canada, USA)	1	1	1
Output Power	>-1dBm	>0dBm	>0dBm
Beam Diameter	10um	10um	10um
Numerical Aperture	0.1	0.1	0.1
Wavelength	1310/1550±20nm	1310±20nm	1550± 10nm

Note Europe

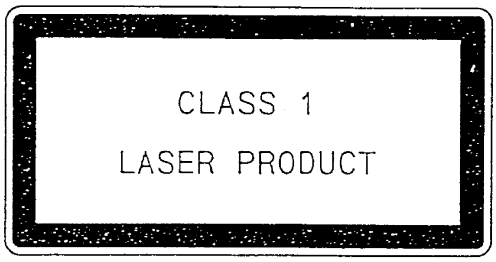




A sheet of laser safety warning labels are include with the laser unit. You must stick the labels in the local language onto the outside of the mainframe, in a position where they are clearly visible to anyone using the instrument.

Check that the wavelength, light emission and pulse width written on the attached safety caution seal (the same as the one in the center on the above) satisfy the above specifications.

Note Canada,USA



The laser safety warning labels are fixed on the laser module.

You MUST return instruments with malfunctioning laser boxes to a Service Center for repair and calibration.

WARNING

Use of controls or adjustments or performance of procedures other than those specified for the laser source may result in hazardous radiation exposure.

WARNING

Refer Servicing only to qualified and anthorized personnel.

WARNING

Do not emit a laser light when an optical fiber is not connected on the optical output connector.The optical output connector is located on the front panel of LD unit.
The LD unit emits laser light when "OPT" button is pressed.
"OPT" button is located on the front panel of LD unit, just above the optical output connector.A green LED on the front panel of LD unit goes on while a laser light is emitted.

WARNING

Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational.
The laser radiationis not visible to the human eye,but it can seriously damage your eyesight.

CAUTION

"EXT UNIT" located on the rear panel is exclusive use only.

Do not connect any equipment except the specified equipments with this interface.

The connection with unspecified equipment may cause damages for this unit and/or connected equipment.

WARNING

The invisible laser light is output from the light connector of this machine. Please do not look into the fiber connected with the light connector and the light connector.

WARNING

If you watch the laser light, your eyes are damaged.

Please turn off the light output when you detach the light connector.

CAUTION

There is a possibility that the laser light of high power is output when the inside of this machine is decomposed and is remodeled carelessly.

It is necessary to be requested by our company service man when you repair this machine.

WARNING

The lithium battery is used for this machine. It is only a service worker in an electric engineer of the qualified person or our company to be able to exchange the battery.

There is danger of the explosion when the battery is inadequately exchanged. Please use the battery of the same kind or the same type when you exchange. Please follow the rule in the region when you dispose of the battery.

CAUTION

Please wipe the dirt of this machine with a soft, dry cloth.

When the dirt of this machine is cruel, the cloth soaked in water is wiped squeezing hard.

Please use neither benzine nor thinner, etc.

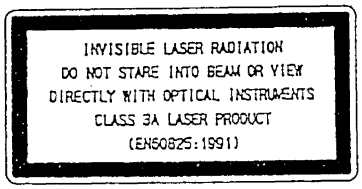
Sicherheitsinformation für Laser Quellen

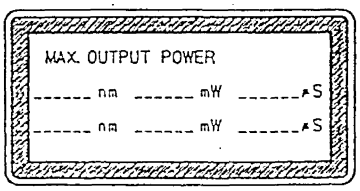
Die Spezifikationen für die Lasereinschübe sind wie folgt:

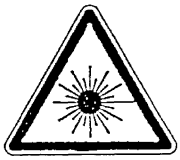
	AQ4211(131)	AQ4211(155)	AQ4211(165)	AQ4212(130)
Laser Typ	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Klasse Entsprechend EN60825:1991 (Europa)	3 A	3 A	3 A	3 A
Ausgangsleistung	>0dBm	>0dBm	>0dBm	>0dBm
Strahldurchmesser	10um	10um	10um	50um
Numerische Apertur	0.1	0.1	0.1	0.2
Wellenlänge	1310±20nm	1550±20nm	1650+ 5nm	1300±20nm

	AQ4213 (131/155)	AQ4214(131)	AQ4214(155)
Laser Typ	Dual FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Klasse Entsprechend EN60825:1991 (Europa)	3 A	3 A	3 A
Ausgangsleistung	>-1dBm	>0dBm	>0dBm
Strahldurchmesser	10um	10um	10um
Numerische Apertur	0.1	0.1	0.1
Wellenlänge	1310/1550±20nm	1310±20nm	1550±10nm

Hinweis Europe







Ein Blatt mit Laser Warnaufklebern ist jedem Lasereinschub beigefügt. Die Aufkleber müssen in der Landessprache, für den Anwender gut sichtbar, an der Aussenseite des Grundgerätes angebracht werden.

Überprüfen Sie, ob die Emissionswellenlänge und die Impulsbreite, die auf dem beigelegten Sicherheitsaufkleber ausgezeichnet sind (siehe Abbildung oben in der Mitte), tatsächlich den oben genannten Spezifikationen entsprechen.

Defekte Lasereinschübe müssen zur Reparatur oder zur Kalibration an ein Service Büro geschickt werden.

WARNUNG

Bedienung,Abgleicharbeiten oder die Durchführung von Tests,die nicht im Handbuch angegeben sind,können zum Austritt gefährlicher Strahlung führen.

WARNUNG

Reparaturarbeiten dürfen nur von qualifliziertem und bevollmächtigtem Personal durchgeführt werden.

WARNUNG

Wenn kein Lichtwellenleiter an die optische Ausgabe angeschlossen ist, die Laserausgabe nicht auf ENABLE stellen. Der optische Ausgabe-Anschluß befindet sich an der Vorderwand der LD-Einheit.
Der Laserstrahl wird durch Betätigen der "OPT"-Taste auf dem optischen Ausgabeanschluß an der Vorderwand der LD-Einheit ausgegeben.
Während der Laserstrahl ausgegeben wird, leuchtet die grüne LED auf der Vorderwand der LD-Einheit auf.

WARNUNG

Wenn der Laser eingeschaltet ist,darf unter keinen Umständen in das Ende des optischen Kabels oder in den Laserausgang am Gerät geschaut werden.
Der Laserstrahl ist für das menschliche Auge unsichtbar,kann aber das Sehvermögen ernsthaft verletzen.

ACHTUNG

Bei der "EXT UNIT"-Buchse an der Systemrückwand handelt es sich um eine zugeordnete Schnittstelle. Keine anderen als die vorgesehenen Geräte anschließen, da dies sonst zu Systemausfall oder Beschädigung des angeschlossenen Geräts führen kann.

WARNUNG

Vom otischen Anschluß des Systems wird ein mit bloßem Auge nicht sichtbarer Laserstrahl ausgegeben. Deshalb nie direkt in den optischen Anschluß oder den angeschlossenen Lichtwellenleiter blicken.

WARNUNG

Ein Eintreten des Laserstrahls ins Auge kann das Sehvermögen beeinträchtigen, Deshalb vor dem Auf- und Abbau des optischen Anschlusses diesen vorher immer abschalten.

ACHTUNG

Ein Zerlegen und Wiederzusammenbauen des Systeminneren kann zur Ausgabe eines starken Laserstrahls führen.
Deshalb bei notwendigen Reparaturen unseren Kundendienst kontaktieren.

WARNUNG

Die in diesem System verwendete Lithium-Batterie sollte nur von einem qualifizierten Elektroingenieur oder einem unserer Kundendienstleute ausgewechselt werden.
Ein Fehler bei der Auswechslung kann zur Explosion führen. Beim Auswechseln sicherstellen, daß Batterietyp und -modell identisch sind. Für die Beseitigung der Batterie die örtlichen Bestimmungen befolgen.

ACHTUNG

Falls das System verschmutzt ist, es mit einem weichen Tuch säubern.
Ein stark verschmutztes System mit einem feuchten und gut ausgewrungenen Tuch sä ubern. Kein Reinigungsbenzin oder Verdünnungsmittel verwenden.

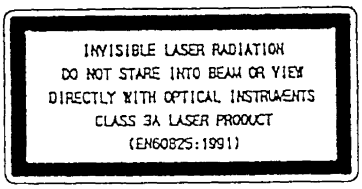
Informations et Consignew de Sécurité Relatives à l'Utilisation des Lasers.

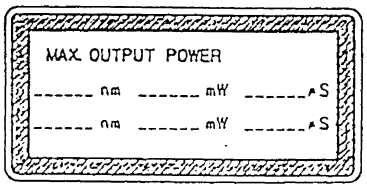
Les Spécifications des Modules Laser sont les Suivantes:

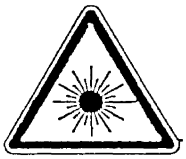
	AQ4211(131)	AQ4211(155)	AQ4211(165)	AQ4212(130)
Type de Laser	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Classe du Laser				
Conforme au STD EN60825:1991 (Europe)	3 A	3 A	3 A	3 A
Conforme au STD CFR 1040.10 (Canada, USA)	1	1	1	1
Puissance de Sortie	>0dBm	>0dBm	>0dBm	>0dBm
Diamêtre du Faisceau	10um	10um	10um	50um
Ouverture Numérique	0.1	0.1	0.1	0.2
Longueur d'Onde	1310±20nm	1550±20nm	1650+ 5nm	1300±20nm

	AQ4213 (131/155)	AQ4214(131)	AQ4214(155)
Type de Laser	Dual FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Classe du Laser			
Conforme au STD EN60825:1991 (Europe)	3 A	3 A	3 A
Conforme au STD CFR 1040.10 (Canada, USA)	1	1	1
Puissance de Sortie	>-1dBm	>0dBm	>0dBm
Diamêtre du Faisceau	10um	10um	10um
Ouverture Numérique	0.1	0.1	0.1
Longueur d'Onde	1310/1550±20nm	1310±20nm	1550± 10nm

Remarque Europe



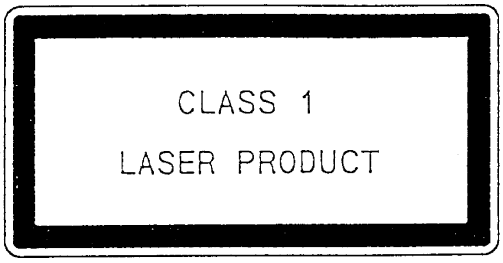




Les etiquettes de sécurité sont incluses dans le module laser. Il est obligatoire de coller une etiquette en langage local à l'exterieur de l'appareil de telle sorte qu'elle soit parfaitement visible par l'utilisateur.

Vérifier que la longueur d'onde d'émission de la lumière et la largeur d'impulsion inscrits sur le label de sécurité ci- joint (le même que celui dans le centre au dessus) correspondent aux specifications ci-dessus.

Remarque Canada,USA



Les etiquettes de sécurité sont affichées sur le module laser.

Il est obligatoire de retourner tout appareil présentant un défaut de fonctionnement du laser uniquement à un centre de réparation.

Attention

L'utilisation du laser en dehors de ses limites de performances et des procédures définies par peut conduire à une exposition dangereuse de l'utilisateur aux radiations.

Attention

Seul le personnel autorisé par est qualifié pour intervenir sur le laser.

Attention

Ne pas émettre de lumière quand la fibre optique n'est pas connecté au connecteur de sortie.
Le connecteur de sortie est plasé sur la face avant du module diode laser.
La diode laser émet une lumiére quand le bouton <OPT> est activé.
Le bouton <OPT> est situé sur la face avant du module diode laser, juste au dessus du connecteur de sortie.
Une DEL verte sur la face avant du module diode laser s'allume pendant que la lumière est émise.

Attention

En aucun cas ne tenter de regarder l'extrémité de la fibre optique attachée au connecteur lorsque le laser est en activité.
Bien que la lumière émise par le laser ne soit pas visible elle peut cependant être dangereuse pour la vue.

PRECAUTION

Comme l'UNITE EXTERNE ("EXT UNIT") sur la partie postérieure de ce système est une interface dédiée, ne pas la raccorder à d'autres dispositifs que ceux spécifiés. Si un dispositif non spécifié est raccordé à cette interface, un défaut de ce système ou du dispositif connecté pourrait se produire.

AVERTISSEMENT

Un rayon laser invisible est produit du connecteur optique de ce système. Ne pas regarder directement dans le connecteur optique ou la fibre raccordée à ce connecteur.

AVERTISSEMENT

Si le rayon laser pénètre dans les yeux, il risque d'affecter la vision. Pour éviter ce probl ème, s'assurer de bien déconnecter la sortie optique lorsque l'on monte ou démonte le connecteur optique.

PRECAUTION

Un démontage fait par mégarde ou un refaçonnage de l'intérieur de ce système peut causer la production du rayon laser de haute intensité.
Lorsque l'on doit réparer, s'assurer de contacter notre personnel de service.

AVERTISSEMENT

La batterie au lithium utilisée dans ce système ne devrait être remplacée que par un ingénieur de service qualifié ou par notre personnel de service.
Si la batterie de service est remplacée incorrectement, une explosion pourrait être caus ée. En cas de remplacement, veiller à utiliser le même modèle ou type de batterie. Lorsqe l'on se débarrasse de cette batterie, respecter les règlements locaux.

PRECAUTION

Lorsque le système est souillé, le nettoyer avec un chiffon bien propre. S'il est très souillé, le nettoyer avec un chiffon mouillé et bien pressé. Ne pas utiliser de benzine ou de diluant pour le nettoyage.

○ Read this manual and the precautions for safety in it carefully before using the device. ○ Maintain this manual at a location easy to access.

Precautions for Safety

This manual employs the following safety alert symbols to provide basic safety rules and precautions. They are intended to ensure correct use of the product and thus to prevent personal injury that could occur to your or other persons and physical damage. The meaning of the safety alert symbols are as follow.
Please take the time to familialize yourself with this section before going to other sections of this manual.

- Safety precautions and rules to be observed are identified with the following safety alert symbols:

This symbol represents safety precautions or rules (including Warning and Danger notices) that require users' attention.
(Actual "Signal Word" is entered inside the symbol.)

This symbol represents safety precautions or rules users must observe.
(Actual "Signal Word" is entered inside the symbol.)

This symbol represents banned user actions.

- Sample safety alert symbols

 WARNING	This symbol identifies hazards which can result in death or serious personal injury if this warning is unheeded and the system is improperly handled or operated.

 CAUTION	This symbol identifies hazards which can result in personal injury or physical damage if this caution is unheeded and the system is improperly handled or operated.

	This symbol identifies hazards which can result in fuming or fire hazard if this caution or safety rule is unheeded and they system is improperly handled or operated.
	This symbol identifies hazards which can result in electric shock if this precaution or safety rule is unheeded and the system is improperly handled or operated.
	This symbol identifies hazards which can result in bodily hurt if this precaution or safety rule is unheeded and the system is improperly handled or operated.
	This symbol instructs to remove the power plug from the plug outlet to ensure work safety.
	This symbol identifies general safety rules to be observed by users.

1. Restrictions on the Operating Environment

	Take care so that water may not flow into the system or the system may not be exposed to water, otherwise fire hazard, electric shock or system failure can result.
	Connect the system to the ground before starting it up, otherwise electric shock or system damage can result.

2. Restrictions on the Operating Conditions

	Don't operate the system at any other voltages than the specified, otherwise fire hazard, electric shock or system failure can result.
	When this system is operated on the supply mains, it must be directly connected to the dedicated plug outlet.
	Don't use an extension cord since it can cause overheat and thus fire hazard.

3. Setup and Installation Work

3.1 Precautions intended for setup and installation personnel

	Avoid disorderly, complex wiring from the power supply, otherwise cable overheating or fire hazard can result.
	Insert the power plug securely to the plug outlet, otherwise fire hazard or electric shock can result if a metal piece touches the power plug.

3.2 Restrictions and bans on the installation environment and conditions

	Don't install the system into a highly humid or dusty place, otherwise electric shock or system failure can result.
	Don't install the system on an unstable base or inclined place, otherwise personal injury can result when it falls or tumbles down.
	Don't install the system in a place exposed to severe vibrations or shocks, otherwise personal injury can result when it falls or tumbles down.
	Don't insert or drop a metal bar from the system openings, otherwise fire hazard, electric shock or other personal injury can result.
	Keep the power cord away from the heating units, otherwise fire hazard or electric shock can result from the damaged coating.
	Hold the plug portion when pulling the power cord out of the outlet, otherwise fire hazard or electric shock can result from the damaged cord.
	Don't handle the power cord with wet hands, otherwise electric shock can result.
	Don't place the system in a high temperature environment such as a place exposed to direct sunlight or inside of a vehicle, otherwise system failure can result from overheating of inside the system.

3.3 Banned actions in the system installation

	Don't try to move the system without making sure that the power plug has been removed from the plug outlet and external connection cables have been disconnected.
	Don't block the system ventilation hole, otherwise fire hazard can result from the entrapped heated air inside the system.
	Don't damage or rework the power cord, otherwise fire hazard or electric shock can result from the cord damaged by heavy substance placed on it, excessive heat or tension applied to it.

4. Precautions Before Starting the System

Please read this instruction manual carefully and familiarize yourself with the information provided in it.

5. Usage

	Operate the system in accordance with the procedure provided in the instruction manual.
	When a safety alert symbol (Warning, Danger or Caution mark) is provided, operation instructions provided in the manual must be heeded.
	Area surrounding the system must be free of a water filled container or metal pieces, otherwise fire hazard, electric shock or system failure can result from the spilt water or dropped metal piece.
	Don't rework the power cord nor forcibly bend, twist or pull it, otherwise fire hazard or electric shock can result.
	Don't try to disassemble or retrofit the system, otherwise fire hazard, electric shock or bodily injury can result.
	When the system is not to be used for a long period of time, remove the power plug from the plug outlet to ensure safety, otherwise fire hazard, electric shock or system failure car result from lightning.
	Use caution when opening or closing doors on the system so that your fingers may not be pinched.
	The power plug must be removed from the plug outlet whenever a fuse replacement takes place, otherwise electric shock or the system damage due to shorting can result.
	Don't use any fuse other than one having the specified rating and property, use of a short bar can aggravate should an accident happened. It can also cause fire hazard.

6. Maintenance and Inspection

Periodic system maintenance and inspection is recommended.

When you have any question on the maintenance or inspection, contact us at the list attached to the end of this manual.

	Dusts settled inside the system for a long period can cause fire hazard or system failure.

7. Actions Required for a System Failure

	If the power cord is damaged, contact us for its replacement. Continued use of such cord can cause fire hazard or electric shock.
	Should a foreign substance dropped into the system, turn the system power off first, then remove the power cord from the plug outlet and contact us. Fire hazard, electric shock or system failure can result from continued use of the system in such state.
	Should an abnormal state such as fume, smoke or offensive odor is detected on the system, turn the system power switch off immediately, then remove the power plug from the plug outlet. Making sure that fume or smoke is not present any more, contact us for repair. Continued use of the system in such state can result in fire hazard, electric shock or system failure. Never try to fix the trouble on your own. It is an extremely dangerous try.
	Should the system is dropped or damaged, turn the system power off, remove the power plug from the plug outlet, then contact us. Continued use of the system in such state can result in fire hazard, electric shock or system failure.
	Should the system failed, customers strongly advised not to try fix the failure, otherwise electric shock or personal injury can result. Our warranty is not applicable to the system repaired without previous notice to and consent from us.

8. Precautions on Disposal

	Don't place the system in fire for its disposal, otherwise fire hazard or burn can result if it exploded.

Hazard Identification

This manual uses the following hazard identification markings that the operators and service personnel must be aware of all hazards associated with this system.

1. Dangers, Warnings, Cautions, and Notes

   (1) Priority of hazard information
   The priority of hazard information is as follows:
   Dangers > Warnings > Cautions > Notes

   (2) Meanings of hazard information

   DANGER: Identifies immediate hazards that will result in death or severe personal injury. This is the highest priority hazard identification marking.

   WARNING : Identifies hazards or unsafe practices that can result in severe personal injury.

   CAUTION: Identifies hazards or unsafe practices that can result in damage to system units or can "interrupt" system operations.

   Note: Identifies an auxiliary information about exceptional rules, corrections, and restrictions.

2. Reference Pages

   The page or pages that you should refer to are shown.
   An example of "See Page 2-1".

3. Pictorials of Operation Keys

   This manual shows the system operation keys as follows:

   [ ] : Indicates a key top character.
   [ ] : Indicates a front panel or rear panel name.

Notes to Ensure Stabilized Measurement

This equipment fears to disable a stabilized measurement, if the return loss of its optical connector increases due to scratches or stain, etc. To avoid this, be sure to use it by strictly observing the following items:

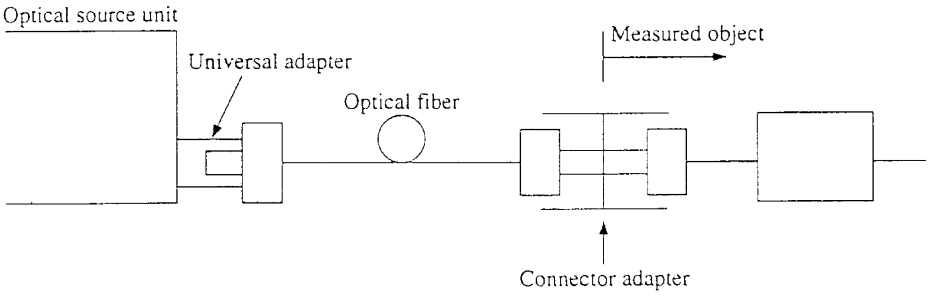
1. Use an optical connector to be connected to this equipment beyond the specified return loss (above 40 dB). It is recommended to use an ultra PC (above 50 dB in return loss).

2. When connecting an optical connector to this equipment, first check that no scratch or stain exists on its end face using a microscope, etc.

⚠ CAUTION
When checking the end face of optical connector using a microscope, etc., make sure that no light emits from the end face of the optical connector.

3. Clean the optical connector according to the following steps:
   (1) Soak a sheet of cleaning paper (free from dust raising) in alcohol and wipe the optical connector lightly with it.
   (2) Wipe the optical connector with a sheet of dried cleaning paper.
   (3) When a special optical fiber end face cleaning tool is available at hand, clean the connector with the tool over again.

4. Putting on and off the optical connector so often causes to damage the end face of the optical connector. To avoid this, it is recommended to first connect a shorter optical fiber to the equipment and then connect a measured object to the open end of the optical fiber using a connector adapter (J-J).



5. Refrain from using this equipment at a dusty place.

6. Do not connect optical fiber to this equipment using a bare fiber adapter, etc. Otherwise, it causes to damage the optical connector of this equipment.

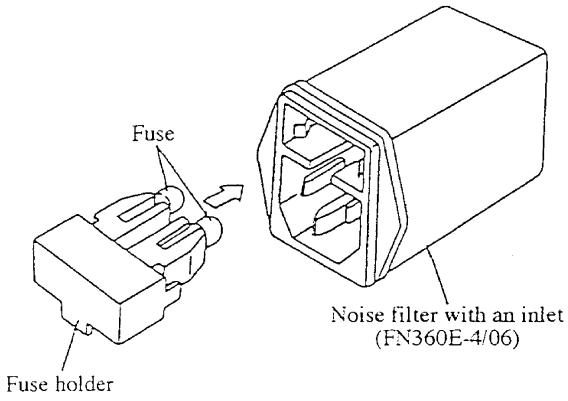
7. When this equipment is kept unused, put on the connector protection cap to protect it from dust and dirt, etc.

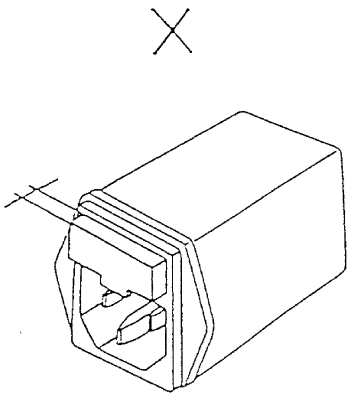
Precautions on Mounting the Fuse

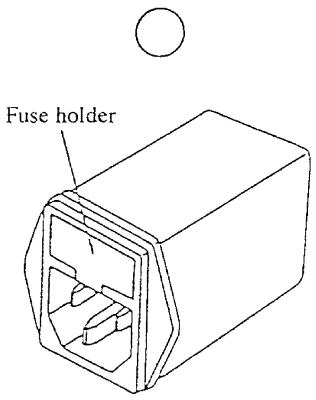
When mounting the fuse holder again after replacing or checking the fuse, be sure to push it in until the fuse holder surface becomes even with that of the filter body.

You will feel click while inserting the fuse holder into the noise filter with an inlet (from Shafner Co., Ltd.).

Don't stop inserting the fuse holder when you felt click, otherwise inappropriate electrical contact or non-contact can result. And, using the fuse in this condition can blow it out due to built up heat.







Push the fuse holder in deep enough until its face is aligned with that of the filter body.

TABLE OF CONTENTS

FIGURE AND TABLE CONTENTS

DRAWING CONTENTS

1. System Overview

This manual describes how to operate your AQ2140 Optical Multimeter (called the "AQ2140" hereafter) and its various optional units.

1.1 System Outline

The AQ2140 is a two-channel, general-use controller that supports an easy plug-in unit replacement. However, you must connect only the dedicate Optical Source Unit and Return-Loss Measurement Unit to the AQ2140. You cannot use the conventional optical units for the AQ2140.

By connecting two sensor units to your AQ2140, you can measure the optical power of two DUTs (devices under test) simultaneously. Also, by connecting a single Sensor Unit and an Light Source Unit to the AQ2140, you can easily measure the optical signal transmission loss.

If both the Return-Loss Measurement Unit and the LD Unit are attached to the AQ2140 simultaneously, the AQ2140 Optical Multimeter can be used as a wide dynamic range, and highly precision optical return-loss measurement unit.

Also, if an optional AQ2141 Optical Multimeter Expansion Frame is attached, the AQ2140 can control up to 18 channels of sensor units and/or optical source units. (For the handling of AQ2141 Optical Multimeter Expansion Frame, refer to its Instruction Manual.)

1.2 Specifications

Table 1-1 gives the standard AQ2140 specifications, and Tables 1-2 to 1-6 give the specifications of its various units.

1.3 System Configuration

The standard system consists of the AQ2140 itself and the accessories listed on the following table.
Repair for maintenance parts will be under chargable bases within the term of warranty.

List of Standard System Accessories

No.	Accessory Name	Quantity	Remarks
1	Instruction manual	1	
2	Blank panel	1	Mounted on the unit accommodation location.
3	External unit dust cover	1	Mounted on the [EXT UNIT] section of the rear panel.
4	Power cord	1	A three-pole power cord (with a three-to-two pole conversion adapter)
5	GPIB connector dust cover	1	Mounted on the [GPIB] section of the rear panel.

List of Maintenance Parts

No.	Maintenance Parts Name	Remarks
1	Connector adapter (Universal adapter)	Mounted on the sensor unit and optical source unit.
2	Optical connector	Mounted on the output end of optical input-and output panel.

⚠ CAUTION

Read your handling instructions before handling the optical connector the optical connector and connector adapter. Keep the instructions to avoid any breakage. Repair for these parts will be under chargable bases.

List of Consumable Parts

No.	Consumable Parts Name	Remarks
1	Manganese dioxide lithium battery (CR2450-P2)	Mounted on the print board of this unit.

⚠ CAUTION

There is a risk of damaging the product when chaging the consumable parts. Please contact your nearby Ando branch office, sales office or technical service office at the time of replacement.

NOTE

This unit uses the manganese dioxide lithium battery for date backup. When this battery becomes low, error alarm "ERR02" will show on a display. Push ENTER key to cancel this alarm and resume operation. However, data backup will not be available.

NOTE

The lifetime of manganese dioxide lithium battery is expected to be approx. 10 years in ambient condition. However, lifetime of the battery may vary depending on the condition of the environment (temperature, humidity, etc.).

Table 1-1 Specifications of AQ2140 Optical Multimeter (1/2)

Display	Measurement data : 7-segment fluorescent display tube with 5-1/2 digit, 13-dot bar graph Intensity : One of four levels (100%, 75%, 50% and 25%) is selectable.
BEEP volume adjustment	Volume level (100% / 75% / 50% / 25% / 0%) is selectable.
BEEP tone adjustment	16 levels are selectable.
Display unit	Absolute value : dBm, mW, μW, nW, or pW Relative value : dB rate (without unit)
Calibration coefficient	The sensor wavelength selectivity is corrected (at 1-nm step), or the relative value can be entered and corrected.
Range	Automatic or fixed measurement range is selectable (manually UP/DOWN when fixed).
Measurement mode	CW or CHOP light (270 Hz, 1 kHz or 2 kHz) is switched.
Optical output waveform	CW or CHOP light (270 Hz, 1 kHz or 2 kHz) is selectable.
Measurement interval function (*1)	10 (20), 50, 100 or 200 msec is selectable.
Averaging	Sequential additional averaging (by 2, 5, 10, 20, 50, 100 or 200 times) can be turned ON or OFF.
Display resolution	0.1, 0.01 or 0.001 is selectable.
Zero set	Zero point is automatically adjusted.
Relative value measurement	The relative measurement to the reference setup the relative measurement to the displayed value or channel-to-channel comparison is selectable.
Data storage	Up to 1000 data sets of each channel (total of two channels) can be stored.
Optical attenuation	Maximum attenuation amount: 6.0 dB (at 0.1 dB step)
Measuring condition setup	Up to 10 measuring conditions can be stored and any of them can be read. (However, one of them is fixed to the initial value.)
Plotter function (*2)	The memory data can be plotted to a graph and output to an external plotter.
Data hold	The maximum, minimum, and difference values of the measurement are shown in the auxiliary display area.
GPIB interface	The IEEE-488.1 interface standards are satisfied.

Table 1-1 Specifications of AQ2140 Optical Multimeter (2/2)

Power supply	100 to 120 VAC, 200 to 240 VAC, 48 to 63 Hz, 80 VA maximum
Ambient conditions	Operating temperature : 0 to +50°C Storage temperature : –25 to +70°C Relative humidity : Up to 85%
Dimensions and weight	Approx. 212W × 88H × 350D mm, approx. 3 kg

Note: These specifications are valid if the AQ2140 does not have the optional AQ2141 Optical Multimeter Expansion Frame.

(*1) If two sensor units are attached to the AQ2140, its minimum value is shown in a pair of parentheses.
If the AQ2141 Optical Multimeter Expansion Frame is attached, refer to its Instruction Manual for details.
Reference information:

- If the AQ2141 Optical Multimeter Expansion Frame is attached to the AQ2140, the measurement interval is fixed to 200 msec.
- If the AQ2141 Optical Multimeter Expansion Frame is NOT attached, the measurement interval (10 (20), 50, 100 or 200 msec.) is selectable.

(*2) The plotter function supports the plotters equivalent to the HP7475A provided by Hewlett Packard.

Table 1-2 Optical Sensor Specifications (1/2)

Model name		AQ2731	AQ2732	AQ2733	AQ2734
Product name		Sensor unit	Sensor unit	Sensor unit	Sensor unit
Wavelength range		400 to 1100 nm	700 to 1700 nm		900 to 1870 nm
Photosensor element		Si	InGaAs	Cooled InGaAs	
Application		Small-diameter, crystal fiber emission light (*1)			
Signal input format		AQ9335 (*) connector adapter: Optional (*3)	AQ9389B (FC) connector adapter: Standard (*4)		
Polarization dependency (*6)		Undefined	0.02 dBp-p (Typical)	0.02 dBp-p or less	
Power range (*7)	CW light	−100 to +3 dBm (0.1 pW to 2 mW)	−80 to +10 dBm (10 pW to 10 mW)	−110 to +10 dBm (0.01 pW to 10 mW)	−90 to +3 dBm (1 pW to 2 mW)
	CHOP light	−100 to 0 dBm (0.1 pW to 1 mW)	−90 to +7 dBm (1 pW to 5 mW)	−110 to +7 dBm (0.01 pW to 5 mW)	−90 to 0 dBm (1 pW to 1 mW)
Uncertainty at reference conditions (*8)		±2.5% (850 nm calibration point)	±2.5% (1310 nm calibration point)		
Total uncertainty (*9)		±5% (500 to 900 nm)	±5% (1000 to 1600 nm)	±5% (1000 to 1650 nm)	±5% (1200 to 1700 nm)
Linearity at fixed temperature (23 ±5°C) (*10)		±0.05 dB (500 to 900 nm −70 to +3 dBm)	±0.05 dB (1000 to 1600 nm −50 to +10 dBm)	±0.05 dB (1000 to 1650 nm −70 to +10 dBm)	±0.05 dB (1200 to 1700 nm −60 to +3 dBm)
Noise level (*11)	CW light	−93 dBm or less	−73 dBm or less	−93 dBm or less	−83 dBm or less
	CHOP light		−83 dBm or less		
Analog out		0 to approx. 2 V output impedance (in each range): 1.5 KΩ or less			
Ambient conditions		Operating temperature: 0 to +50°C Storage temperature: -25 to +70°C Relative humidity: 85% or less			
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg			

Table 1-2 Optical Sensor Specifications (2/2)

Model name		AQ2735	AQ2730		
			AQ2741	AQ2742	AQ2743
Product name		Sensor unit	OPM unit		
			Sensor	Sensor	Sensor
Wavelength range		700 to 1700 nm	400 to 1100 nm	750 to 1800 nm	
Photosensor element		Cooled InGaAs	Sil10 mm	Geϕ5 mm	Cooled Geϕ5 mm
Application		Small-diameter, crystal fiber emission light (*1)	Large-diameter, fiber emission light, space light (*2)		
Signal Input format		AQ9389B (FC) connector adapter: Standard (*4)	Direct photodiode (*5)		
Polarization dependency (*6)		0.02 dBp-p (Typical)	Undefined	0.03 dBp-p (Typical)	
Power range (*7)	CW light	–80 to +27 dBm (10 pW to 0.5 mW)	–80 to +10 dBm (10 pW to 10 mW)	–60 to +10 dBm (1 nW to 10 mW)	–80 to +10 dBm (10 pW to 10 mW)
	CHOP light	–80 to 24 dBm (10 pW to 0.25 mW)	–90 to +7 dBm (1 pW to 5 mW)	–70 to +7 dBm (0.1 nW to 5 mW)	–90 to +7 dBm (1 pW to 5 mW)
Uncertainty at reference conditions (*8)		±2.5% (1310 nm calibration point)	±2.5% (850 nm calibration point)	±2.5% (1310 nm calibration point)	
Total uncertainty (*9)		±5% (1000 to 1650 nm)	±5% (500 to 900 nm)	±5% (950 to 1600 nm)	
Linearity at fixed temperature (23 ±5°C) (*10)		±0.05 dB (1000 to 1650 nm –40 to +27 dBm)	±0.05 dB (500 to 900 nm –50 to +10 dBm)	±0.05 dB (950 to 1600 nm –30 to +10 dBm)	±0.05 dB (950 to 1600 nm –50 to +10 dBm)
Noise level (*11)	CW light	–73 dBm or less	–73 dBm or less	–53 dBm or less	–73 dBm or less
	CHOP light		–83 dBm or less	–63 dBm or less	–83 dBm or less
Analog out		0 to approx. 2 V output impedance (in each range): 1.5 KΩ or less			
Ambient conditions		Operating temperature: 0 to +50°C Storage temperature: -25 to +70°C Relative humidity: 85% or less			
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg			

(*1) Applicable optical fiber ≤ 62.5/125 μm (GI); NA ≤ 0.275

(*2) Applicable optical fiber ≤ 730/750 μm (SI); NA ≤ 0.5 (AQ2741 sensor)

Applicable optical fiber ≤ 100/140 μm (SI); NA ≤ 0.28 (AQ2742/2743 sensor)

(*3) Connector type. Any one of FC, SC, ST, DIN and HMS-10/A connectors is required. Consult to our agency for the other connectors.

(*4) A non-FC connector can also be used. Consult to our agency for the other connectors.

(*5) The AQ9335* connector adapter can also be combined. An asterisk represents the connector type.
Specify the FC, SC, ST, DIN or HMS-10/A connector. Consult to our agency for the other connectors.

(*6) Measured at 1550 nm wavelength, with SM fiber

(*7) Measured with the AQ2731 sensor unit and the 850-nm AQ2741 sensor. Also, the AQ2732/2733/2734/2735 sensor unit and the 1310-nm AQ2742/2743 sensor are used for measurement.

(*8) Reference conditions

① Power level: –20 dBm (10 μW), CW

② Use of AQ2731 sensor unit and AQ2741/2742/2743 sensor having approximately 0.1 NA SM fiber; or use of AQ2732/2733/2734/2735 sensor unit, SM fiber and master FC connector

③ Ambient temperature:
23 ±1°C (AQ2731/3732 sensor unit and AQ2741/2742 sensor)
23 ±5°C (AQ2733/2734/2735 sensor unit and AQ2743 sensor)

④ Calibration using the AQ9335 (FC) connector adapter (for AQ2731 sensor unit and AQ2741/2742/2743 sensor); or calibration using the AQ9389B (FC) connector adapter (for AQ2732/2733/2734/2735 sensor unit)

⑤ If the connector adapter is removed from any of AQ2731 to AQ2735 sensor units, the system specifications may not be satisfied. When replacing the connector adapter, consult to our agency for re-calibration.

(*9) Operating conditions

① Power level: –20 dBm (10 μW), CW

② ≤ 50 μm or less optical fiber, NA ≤ 0.2

③ Ambient temperature:
23 ±1°C (AQ2731/2732 sensor unit and AQ2741/2742 sensor)
23 ±5°C (AQ2733/2734/2735 sensor unit and AQ2743 sensor)

④ Calibration using the AQ9335 (*) connector adapter (for AQ2731 sensor unit and AQ2741/2742/2743 sensor); or calibration using the AQ9389B (FC/SC) connector adapter (for AQ2732/2733/2734/2735 sensor unit)

(*10)

① Linearity of any single wavelength within the wavelength operating range defined by the total measurement accuracy.

② CW and ambient temperature:
23 ±1°C (AQ2731/2732 sensor unit and AQ2741/2742 sensor)
23 ±5°C (AQ2733/2734/2735 sensor unit and AQ2743 sensor)

(*11)

① Averaging: 1 sec (100 msec measurement interval, 10 time averaging)

② Wavelength:
700 to 900 nm (AQ2731 sensor unit and AQ2741 sensor)
1200 to 1600 nm (AQ2732/2733/2734/2735 sensor unit and AQ2742/2743 sensor)

③ CW or CHOP mode (270 Hz)

④ Ambient temperature:
0 to 30°C (AQ2734 sensor unit)

Table 1-3 Specifications of LD Optical Source Unit (1/2)

Model name		AQ4211(131)	AQ4211(155)	AQ4211(165)	AQ4212(130)
Product name		LD unit	LD unit	LD unit	LD unit
Light emitting element		LD			
Center wavelength (*1)		1310±20 nm	1550±20nm	1650+5 nm/–10 nm	1300±20 nm
Applicable fiber		SM (10/125 μm)			GI (50/125 μm)
Spectrum half width (*2)		5 nm or less	10 nm or less		5 nm or less
Optical output Level (*3)(*4)	GI (50/125 μm)	—			0 dBm or more
	SM (10/125 μm)	0 dBm or more			—
Output level	Temperature stability	Within 0.2 dB (*5)		Within 0.3 dB (*6)	Within 0.3 dB (*7)
Stability (CW)	Time stability	Within ±0.003 dB (*9) Within ±0.3 dB (*10)		Within ±0.005 dB (*9) Within ±0.05 dB (*11)	Within ±0.01 dB (*12) Within ±0.05 dB (*13)
Optical connector		AQ9434(*) universal adapter: Optional (*16)			
Ambient conditions		Storage temperature: -25 to +70°C Relative humidity: 85% or less			
	Operating temperature	0 to +50°C		0 to +40°C	0 to +50°C
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg			

Table 1-3 Specifications of LD Optical Source Unit (2/2)

Model name		AQ4213(131/155)	AQ4214(131)	AQ4214(155)
Product name		LD unit	DFB-LD unit	DFB-LD unit
Light emitting element		LD	DFB-LD	
Center wavelength (*1)		1310/1550±20 nm	1310±10 nm	1550±10 nm
Applicable fiber		SM (10/125 μm)		
Spectrum half width (*2)		5/10 nm or less	0.1 nm or less	
Optical output level (*3) (*4)	GI (50/125 μm)	—		
	SM (10/125 μm)	−1 dBm or more	0 dBm or more	
Output level stability (CW)	Temperature stability	Within 0.3 dB (*6)	Within 0.3 dB (*8)	
	Time stability	Within ±0.005 dB (*9) Within ±0.05 dB (*11)	Within ±0.01 dB (*14) Within ±0.05 dB (*15)	
Optical connector		AQ9434(*) universal adapter: Optional (*16)	SC/APC (*17)	
Ambient conditions		Storage temperature: -25 to +70°C Relative humidity: 85% or less		
	Operating temperature	0 to +40°C		
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg		

(*1) Measured at 25°C

(*2) The spectrum width is indicated in RMS (2σ, -20 dB) at 25°C.

(*3) CW light:
GI fiber emission end (50/125 μm, both-end FC/SPC, 2 m) for AQ4212 LD unit
SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m) for AQ 4211 and 4213 LD unit
SM fiber emission end (10/125 μm, one-end FC/SPC·SC/APC, 2 m) for AQ4214 DFB-LD unit.

(*4) Maximum optical output level : +1.5 dBm

(*5) 0 to 50°C (8 hours), at SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m)

(*6) 0 to 40°C (8 hours), at SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m)

(*7) 0 to 50°C (8 hours), at GI fiber emission end (50/125 μm, both-end FC/SPC, 2 m)

(*8) 0 to 40°C (8 hours), at SM fiber emission end (10/125 μm, one-end FC/SPC·SC/APC, 2 m)

(*9) Fixed temperature, five minutes, (at a point of 20 to 30°C), SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m)

(*10) ±1°C within 0 to 50°C (1 hour), SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m)

(*11) ±1°C within 0 to 40°C (1 hour), SM fiber emission end (10/125 μm, both-end FC/SPC, 2 m)

(*12) Fixed temperature, five minutes, (at a point of 20 to 30°C), GI fiber emission end (50/125 μm, both-end FC/SPC, 2 m)

(*13) ±1°C within 0 to 50°C (1 hour), GI fiber emission end (50/125 μm, both-end FC/SPC, 2 m)

(*14) Fixed temperature, five minutes, (at a point of 20 to 30°C), SM fiber emission end (10/125 μm, one-end FC/SPC·SC/APC, 2 m)

(*15) ±1°C within 0 to 40°C (1 hour), SM fiber emission end (10/125 μm, one-end FC/SPC·SC/APC, 2 m)

(*16) Letter "*" must be a connector type of FC, SC, ST, DIN or HMS-10/A.
The connector type must always be set. Consult to our agency for the other connectors.

(*17) Seiko Giken's Angled PC (APC)

Table 1-4 Specifications of LED Source Unit (1/2)

Model name		AQ4215(085)	AQ4215(131)	AQ4215(155)	AQ4218(131)
Product name		LED unit	LED unit	LED unit	LED unit
Light emitting element		LED			
Center wavelength (*1)		850±15 nm	1310±30nm	1550±35 nm	1310±10 nm
Applicable fiber		GI (50/125 μm, 62.5/125 μm)	GI (50/125 μm, 62.5/125 μm)/ SM (10/125 μm)	SM (10/125 μm)	
Spectrum half width (*2)		60 nm or less	140 nm or less	195 nm or less	20 nm or less
Optical output level (*3)	GI (50/125 μm)	−15 dBm or more	−21 dBm or more	—	
	SM (10/125 μm)	—	−40 dBm or more	−43 dBm or more	−50 dBm or more
Output level stability (CW)	Temperature stability	—			0.2 dB or less (*5)
	Time stability	Within ±0.005 dB (*5) Within ±0.03 dB (*7)	Within ±0.005 dB (*6) Within ±0.03 dB (*8)		Within ±0.003 dB (*6) Within ±0.03 dB (*8)
Optical connector (*9)		AQ9433(*) connector adapter: Optional			AQ9434(*) universal adapter: Optional
Ambient conditions		Operating temperature: 0 to +50°C Storage temperature: -25 to +70°C Relative humidity: 85% or less			
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg			

Table 1-4 Specifications of LED Source Unit (2/2)

Model name		AQ4218(155)	AQ4221(131)	AQ4221(155)
Product name		LED unit	EE-LED unit	EE-LED unit
Light emitting element		LED	EE-LED	
Center wavelength (*1)		1550±10 nm	1310±10 nm	1550±10 nm
Applicable fiber		SM (10/125 μm)		
Spectrum half width (*2)		25 nm or less	20 nm or less	25 nm or less
Optical output level (*3)	GI (50/125 μm)	—		
	SM (10/125 μm)	−50 dBm or more	−28 dBm or more	−32 dBm or more
Output level stability (CW)	Temperature stability	0.2 dB or less(*4)	—	
	Time stability	Within ±0.003 dB (*6) Within ±0.03 dB (*8)	Within ±0.005 dB (*6) Within ±0.05 dB (*8)	
Optical connector (*9)		AQ9434(*) universal adapter: Optional		
Ambient conditions		Operating temperature: 0 to +50°C Storage temperature: -25 to +70°C Relative humidity: 85% or less		
Dimensions and weight		Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg		

(*1) Measured at 25°C

(*2) The spectrum width is indicated in FWHM at 25°C.

(*3) CW light within 0 to 50°C at GI fiber emission end (50/125 μm, both-end FC/PC, 2 m) and SM fiber emission end (10/125 μm, both-end FC/PC, 2 m)

(*4) 0 to 50°C (8 hours), at SM fiber emission end (10/125 μm, both-end FC/PC, 2 m)

(*5) Fixed temperature, five minutes, (at a point of 20 to 30°C), GI fiber emission end (50/125 μm, both-end FC/PC, 2 m)

(*6) Fixed temperature, five minutes, (at a point of 20 to 30°C), SM fiber emission end (10/125 μm, both-end FC/PC, 2 m)

(*7) ±1°C within 0 to 50°C (1 hour), GI fiber emission end (50/125 μm, both-end FC/PC, 2 m)

(*8) ±1°C within 0 to 50°C (1 hour), SM fiber emission end (10/125 μm, both-end FC/PC, 2 m)

(*9) Letter "*" must be a connector type of FC, SC, ST, DIN or HMS-10/A. The connector type must always be set. Consult to our agency for the other connectors.

Table 1-5 Specifications of Return Loss Measurement Unit

Model name	AQ7310
Product name	Optical return loss measurement unit
Wavelength range	1280 to 1600 nm
Measurement dynamic range (*1)	65 dB or higher
Relative measurement accuracy (*2)	Within ±0.4 dB (0 to 50 dB) Within ±0.7 dB (50 to 60 dB)
Measurement stability (*3)	Within ±0.02 dB
Applicable fiber	SM (10/125 μm)
Optical source connection fiber	FC / PC
Measurement end connector	SC / APC (*4)
Ambient conditions	Operating temperature: 0 to +50°C Storage temperature: –25 to +70°C Relative humidity: 85% or less
Dimensions and weight	Approx. 31W × 71.5H × 324D mm; approx. 0.6 kg

* If the AQ4211LD unit or AQ4213LD unit is used, the wavelength range is 1280 to 1600 mm, and the Fresnel reflection standard at 23 ±1°C is used
* The AQ7310 master cord is required.

(*1) Depends on the master cord used.

(*2) Depends on the stability of used optical source, the linearity of photosensor unit, and the isolation of optical directional coupler.

(*3) Display stability during Fresnel reflection measurement, 5 minutes

(*4) Seiko Giken's Angled PC (APC)

Table 1-6 Specifications of Optical Fiber Cords having Master Connectors (Optional)

Model name	Connector type	Reflection attenuation	Remarks
AQ7310 master cord (FC)	SC/APC high-reflection attenuation FC master connector	50 dB or more	1 meter long
AQ7310 master cord (SC)	SC/APC high-reflection attenuation SC master connector	50 dB or more	1 meter long
AQ7310 master cord (open end)	SC/APC open end (*1)		2 meters long

(*1) The customer needs to terminate the master connector open end.

2. Before Starting System Operations

This chapter describes the unpacking and acceptance inspection rules and the general notes that you must follow before starting the operation of your AQ2140 and its various units.

2.1 Unpacking and Acceptance Inspection

Your AQ2140 has been checked both mechanically and electrically at the factory, and its normal operations have been guaranteed. However, when you receive your system, immediately unpack and check it for any defect caused by the transportation.
We recommend to keep the insulator materials and fiberboard containers for future reuse (except for consumable materials).

2.1.1 Mechanical Operation Checkout

Check the appearance, and switch and control operations of the AQ2140 and its various units for any damage due to transportation. Also, check the inventory of accessories and spare parts by referring to the packing list.

2.1.2 System Operation Test

When the system mechanical operations are normal, check the system performance by system operation test.

2.2 If any Defect or Trouble is Found

If any have found any defect or trouble on your system, call the service immediately.

2.3 Repacking

When packing the AQ2140 and its units again for movement, use the packing materials that you have stored during unpacking.
If they are lost or damaged, use the following steps:

(1) Wrap the AQ2140 and its various units with the thick papers or polyethylene sheets. Protect any protrusion with a cushion material.

(2) Prepare a wooden or fiberboard container that has a clearance of approximately 5 to 10 cm between the container walls and the AQ2140 and its units. Carefully place the AQ2140 and its units in the container.

(3) Fill the clearance using the polyurethane forms or other cushion materials. The insufficient cushion materials can cause a damage of the AQ2140 and its units due to vibration during transportation.

(4) Close the top cover of the wooden container, and bundle using steel bands, or close the top cover of the fiberboard container and seal it securely using adhesive tapes or others.

(5) Write down the following information in the easy-to-read position of the container:

- Name of products
- Destination
- Consignor (sender)

2.4 Safety of Electric Systems

The AQ2140 operates with the 100 to 120 VAC or 200 to 240 VAC, 50/60 Hz power supply. Take the appropriate actions to prevent the following personal injury and problems:

- Personal injury due to an electrical shock
- Damage of internal system units due to abnormal voltage
- Problems due to the ground current

Always follow the operation instructions given below.

2.4.1 Polarity of Power Cords

The three-pole power receptacle has the live (L) line, the neutral (N) line and the ground (G) terminal as shown in Figure 2-1. You can just plug the power cord into the receptacle.

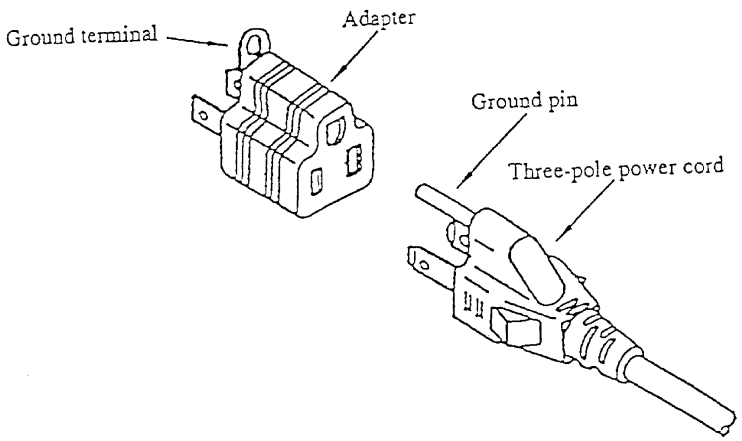


Figure 2-1 Three-Pole Power Cord (For JAPAN)

2.4.2 Protection Grounding

(1) Grounding using the three-pole power receptacle
If the three-pole power socket is provided, you can plug the system power cord into the socket. The system frame is grounded to the earth potential.

(2) Grounding using the power adapter
If the three-pole power socket is NOT provided, use the three-to-two pole conversion adapter of the accessory kit and ground the adapter GND terminal.

2.4.3 Fuse Replacement

Two power fuses are mounted in the AC voltage input receptacle of the AQ2140 rear panel. See Table 2-1 for the power fuses used, and see Figure 2-2 for fuse replacement.

Table 2-1 Power Fuses

Power Voltage	Fuse Rating	Remarks
100 to 120 VAC	F 2.0 A 250 V	5.2 mm dia by 20 mm long, fast acting type
200 to 240 VAC	F 2.0 A 250 V	

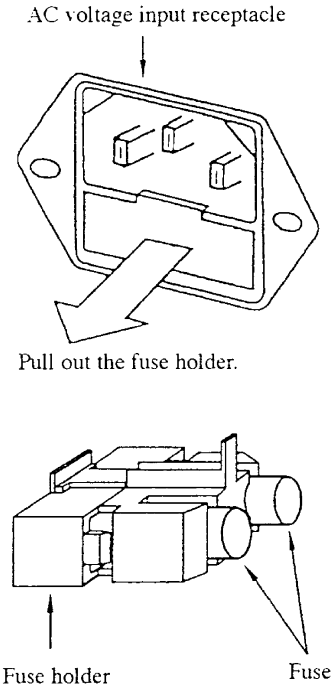


Figure 2-2 Replacement of Power Fuse

The AC voltage input receptacle is mounted on the AQ2140 rear panel.

The power fuses are mounted on the fuse holder of AC voltage input receptacle.

Use the following procedure to replace the fuses.

(1) Turn the POWER switch OFF, and unplug the power cord.

(2) Pull out the fuse holder toward you.

(3) Replace both of two fuses with the new ones.
If any of them is not blown, it may be damaged and you must replace it.

(4) Insert the fuse holder securely, and plug the power cord into the power socket.

⚠ WARNING

- Before replacing the fuses, turn the POWER switch OFF and unplug the power cord from the receptacle.
  If you try to replace the fuse with the power ON, you may be injured by the electrical shock.
- After you have replaced the fuses, make sure that the system has been grounded correctly and the AC power voltage is appropriate to your system. Then, turn the POWER switch ON. If you turn the system power ON without grounding, you may be injured by the electrical shock.
  Also, if the AC power voltage is inappropriate to your system, the internal system units may be damaged by the abnormal voltage.

3. System Operation Notes

This chapter gives the basic system operation notes that you must follow when using your AQ2140.

3.1 Main System (AQ2140)

3.1.1 Handling Notes

(1) The AQ2140 is a Safety Class-1 (IEC348) instrument.

(2) Avoid an excessive impact onto your optical multimeter. Although the display panel is covered with a plastic cover, the glass surface can be scratched or broken by the impact.

(3) Do not leave your optical multimeter in a high temperature or high humidity for a long period.

(4) Keep your optical multimeter away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause system malfunction.

(5) Do not connect your AQ2140 to an undefined instrument, or your optical multimeter will fail.

(6) Power OFF your AQ2140 before connecting or disconnecting it to/from another instrument. Otherwise, your AQ2140 and the mating instrument may fail.

(7) Keep the rear ventilation hole of your AQ2140 away from the wall and others. Poor ventilation causes an overheating that can damage your AQ2140 and other instruments.

(8) Do not turn the power supply OFF during data storage (P. 5-23) and during key switch operations (P. 4-2). If done, the parameter table (P. 5-18) may be erased from memory.

(9) Your AQ2140 has a fuse against an overcurrent. If it blows, unplug the power cord, and replace the fuse at the AC voltage input socket.

(10) Your AQ2140 has a temperature fuse against an instrument overheating. If the power supply does not turn ON after recovery processing of paragraph (9) above, the temperature fuse may have been blown. Call the service.

(11) Do not remove covers of your AQ2140 except by the service personnel.

3.1.2 Application Notes on Optical System Components

Your AQ2140 has the very high precision optical system components. They are critical parts for assured system performance.

3.2 OPM Unit, Sensor Unit and Sensor (AQ2730 to 2735, AQ2741 to 2743)

3.2.1 Handling Notes

(1) Avoid an excessive impact onto the units.

(2) Do not leave the units in a high temperature or high humidity for a long period.

(3) Keep the units away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause the unit malfunction.

(4) Attach these units to the AQ2140 or AQ2141 only. Otherwise, the units may malfunction.

(5) Before attaching or removing these units to/from the AQ2140 or AQ2141 system, always turn the system POWER switch OFF. If attached or removed with power ON, the unit itself, the AQ2140 or the AQ2141 may malfunction.

(6) Do not store or operate these units in a place subject to static electricity, Otherwise, the units may malfunction.

(7) Do not touch the connector's metal terminal parts of the units (AQ2741 to 2743). Otherwise, the units may malfunction due to static electricity.

(8) The AQ2140 does not satisfy the specification during the application of noise in some cases.

3.2.2 Application Notes on Optical System Components

Your AQ2140 and the sensor (AQ2741 and 2743) has the very high precision optical system components. They are critical parts for assured system performance. Use the operation instructions and notes given below.

(1) Do not enter the excessive incident light exceeding the optical power measurement range, or the photosensor elements may be damaged.

(2) If the photosensor surface or optical connector is damaged or dirty, the sensor unit and the sensor (AQ2741 to 2743) cannot satisfy its performance.

(3) When using the photosensor element to directly receive the incident light, take care not to scratches the photosensor surface.

⚠ CAUTION

Make sure that optical fiber is not pushed inward from the ferrule edge when using the bare fiber adapter.
Further more, be alert for the stress to the fiber when using. Do not pull the optical fiber.

⚠ CAUTION

When using AQ2735 sensor unit, do not attach or detach the optical connector with high optical power (Approx. +20dBm or more) on. It may damage the photosensor and damage may ruin the precision for measurement.
Considering safety, attach and detach the optical connector in the state of "unlit".

NOTE

If the photosensor surface or the connector adapter is dirty due to dusts, wipe and clean them using an absolute alcohol or others.

3.3 Optical Source Unit (AQ4211 to AQ4213, AQ4218 and AQ4221)

3.3.1 Handling Notes

(1) Avoid an excessive impact onto the sensor units.

(2) Do not leave the optical source units in a high temperature or high humidity for a long period.

(3) Keep the sensor units away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause the unit malfunction.

(4) Attach these units to the AQ2140 or AQ2141 only. Otherwise, the units may malfunction.

(5) Before attaching or removing these units to/from the AQ2140 or AQ2141 system, always turn the system POWER switch OFF. If attached or removed with power ON, the optical source unit itself, the AQ2140 or the AQ2141 may malfunction.

(6) Do not store or operate these units in a place subject to static electricity. Otherwise, the units may malfunction.

3.3.2 Application Notes on Optical System Components

⚠ WARNING
The optical output from the source unit is the ultraviolet rays and they are NOT visible at all. Take extremely care NOT to watch the optical source emission. If you watch it, your eyes are damaged.

⚠ WARNING
If you use an optical device for the optical source unit, your eyes may be damaged.

If the optical connector of the optical source unit is scratched, its stability may be lost. Use the following handling notes.

(1) Keep the optical source unit away from the excessive dusts.

(2) Use an optical fiber having no scratches on the fiber end when connecting it to the optical source unit.

(3) Wipe and clean the optical fiber end with an alcohol or others when connecting it to the optical source unit.

(4) First, make sure that the optical light is NOT emitted from the optical fiber end. Check the optical fiber end for scratches and dirt by using a microscope. Then, connect the fiber to the optical source unit.

(5) Do not use a bare fiber adapter or others when connecting an optical fiber to the optical source unit.

(6) When you are not using the optical source unit, cover the optical connector with a connector protection cap against the dusts and others.

3.4 DFB-LD Unit (AQ4214)

3.4.1 Handling Notes

(1) Avoid an excessive impact onto the LD unit.

(2) Do not leave the unit in a high temperature or high humidity for a long period.

(3) Keep the unit away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause the unit malfunction.

(4) Attach the unit to the AQ2140 or AQ2141 only. Otherwise, the unit may malfunction.

(5) Before attaching or removing the unit to/from the AQ2140 or AQ2141 system, always turn the system POWER switch OFF. If attached or removed with power ON, the DFB-LD unit itself, the AQ2140 or the AQ2141 may malfunction.

(6) Do not store or operate these units in a place subject to static electricity. Otherwise, the units may malfunction.

3.4.2 Application Notes on Optical System Components

⚠ WARNING
The optical output from the DFB-LD unit is the ultraviolet rays and they are NOT visible at all. Take extremely care NOT to watch the optical source emission. If you watch it, your eyes are damaged.

⚠ WARNING
If you use an optical device for the DFB-LD unit, your eyes may be damaged.

If the optical connector of the DFB-LD unit is scratched, its stability may be lost. Use the following handling notes.

(1) Keep the unit away from the excessive dusts.

(2) Use an optical fiber having no scratches on the fiber end when connecting it to the DFB-LD unit.

(3) Wipe and clean the optical fiber end with an alcohol or others when connecting it to the unit.

(4) First, make sure that the optical light is NOT emitted from the DFB-LD unit. Then, check the optical fiber end for scratches and dirt by using a microscope.

(5) Do not use a bare fiber adapter or others when connecting an optical fiber to the DFB-LD unit.

(6) When you are not using the DFB-LD unit, cover it with a protection cap against the dusts and others.

3.5 LED Unit (AQ4215)

3.5.1 Handling Notes

(1) Avoid an excessive impact onto the LED unit.

(2) Do not leave the unit in a high temperature or high humidity for a long period.

(3) Keep the unit away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause the unit malfunction.

(4) Attach the unit to the AQ2140 or AQ2141 only. Otherwise, the unit may malfunction.

(5) Before attaching or removing the unit to/from the AQ2140 or AQ2141 system, always turn the system POWER switch OFF. If attached or removed with power ON, the LED unit itself, the AQ2140 or the AQ2141 may malfunction.

(6) Do not store or operate these units in a place subject to static electricity. Otherwise, the units may malfunction.

3.5.2 Application Notes on Optical System Components

⚠ WARNING
The optical output from the LED unit is the ultraviolet rays and they are NOT visible at all. Take extremely care NOT to watch the optical source emission. If you watch it, your eyes are damaged.

⚠ WARNING
If you use an optical device for the LED unit, your eyes may be damaged.

If the optical connector of the LED unit is scratched, its stability may be lost. Use the following handling notes.

(1) Keep the unit away from the excessive dusts.

(2) Wipe and clean the optical fiber end with an alcohol or others when connecting it to the unit.

(3) First, make sure that the optical light is NOT emitted from the LED unit. Then, check the optical fiber end for scratches and dirt by using a microscope.

(4) Do not use a bare fiber adapter or others when connecting an optical fiber to the LED unit.

(5) When you are not using the LED unit, cover it with a protection cap against the dusts and others.

3.6 Return-Loss Measurement Unit (AQ7310)

3.6.1 Handling Notes

(1) Avoid an excessive impact onto the unit.

(2) Do not leave the unit in a high temperature or high humidity for a long period.

(3) Keep the unit away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause the unit malfunction.

(4) Attach the unit to the AQ2140 only. Otherwise, the unit may malfunction.

(5) Before attaching or removing the unit to/from the AQ2140 system, always turn the system POWER switch OFF. If attached or removed with power ON, the measurement unit itself, the AQ2140 may malfunction.

(6) Do not store or operate these units in a place subject to static electricity. Otherwise, the units may malfunction.

(7) The AQ2140 does not satisfy the specification during the application of noise in some cases.

3.6.2 Application Notes on Optical System Components

Your AQ7310 has the very high precision optical system components. They are critical parts for assured system performance. Use the operation instructions and notes given below.

(1) Connect only the authorized master cord to the master cord attachment, or the ferure will be damaged.

(2) If the optical connector is damaged or dirty, the return-loss measurement unit cannot satisfy its performance.

NOTE
If the connector adapter is dirty due to dusts, wipe and clean them using an absolute alcohol or others.

4. System Functions

This chapter explains the basic functions of operation and display sections of the AQ2140 and its various units.

4.1 Operator Panel

4.1.1 Explanation of Operation Section

Figure 4-1 shows the controls and indicators on the operator panel. The numbers of this figure correspond to the name and functions of the operator panel given on Table 4-1.

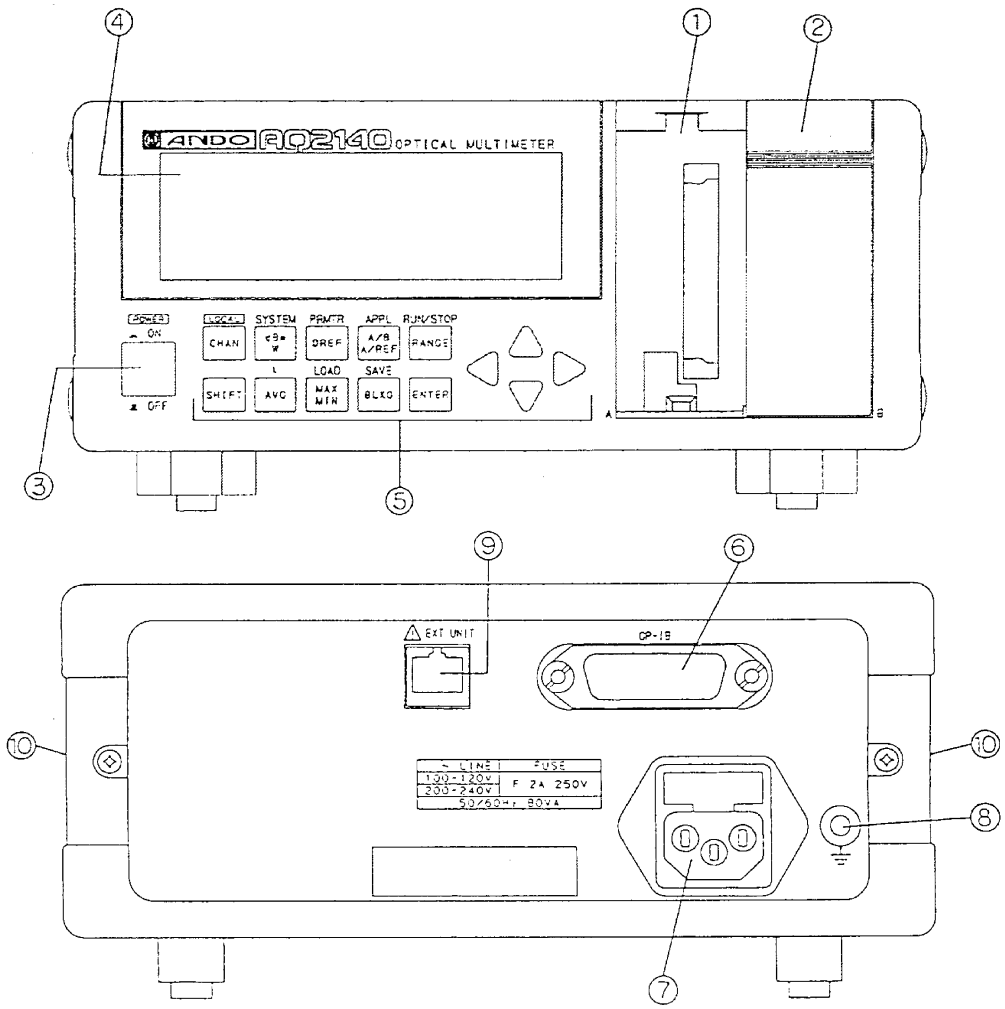


Figure 4-1 Operator Panel Layout

Table 4-1 Name and Functions of Operator Panel

No.	Name	Unit Display	Functions
①	Unit storage	[A], [B]	Accommodates two different types of units. **CAUTION** **Turn the power switch OFF before inserting or removing the units into/from these storage slots.**
②	Blank panel		This is a dummy panel that is used when you do not insert any unit into the storage.
③	Power switch	[POWER] [▬ ON] [■ OFF]	Turns the multimeter power supply ON or OFF.
④	Display panel		A fluorescent lamp display panel that shows the set values, measurement results and other information.
⑤	Key switches		Used for multimeter control. See Table 4-2 for details.
⑥	GPIB interface	[GP-IB]	A 24-pole signal connector for GPIB interfacing
⑦	AC power cable socket		Plug the power cord into this socket. The socket has a built-in fuse.
⑧	GND terminal	[⏚]	The ground (GND) terminal
⑨	External unit signal socket	[⚠ EXT UNIT]	Used for signal I/O to/from an external unit (AQ2141, AQ3150 or others).
⑩	Ventilation hole		The ventilation hole for heat radiation. **CAUTION** **Keep the ventilation hole 15 cm or more away from the wall and others.**

⚠ CAUTION
Specified external units (AQ2141 and AQ3150) alone can be connected to the [⚠ EXIT UNIT]. If any other equipment is connected, damages can result on the AQ2140 or the specified external unit currently connected.

Table 4-2 Indication and Functions of Key Switches (1/4)

Key name	Functions
SHIFT	Switches between the Measurement mode and Parameter Setup mode each time it is pressed as follows: Measurement mode → Parameter Setup mode → Measurement mode → ... During Measurement mode, the function shown on each key top is valid. During Parameter Setup mode, the function shown above each key (and the CHAN key top function) is valid.
[LOCAL] CHAN	Selects a channel to control. The channels are selected one after the other when this key is pressed. If no unit is connected, its channel is skipped. If you select the "A&B" channel, the unit connected to channel A is controlled (as channel A has the higher priority). Your subsequent key operations are valid for the selected channel only. The GPIB interface is switched to the Local mode if it is in the Remote mode. No units can operate during Local Lockout.
	Parameter Setup mode(Measurement mode) A → B → A&B → A → ...
[SYSTEM] dBm W	**Parameter Setup mode:** Used for system parameter setup (P.5-17). The cursor shifts in the following sequence when the key is pressed: ADRS → TONE → VOLUME → BRIGHT → INT → ADRS → ... Modify the parameter values using the [MODIFY] key △◁▷▽, and press the ENTER key for setup.
	Measurement mode (valid for the sensor unit only): Selects a measurement unit (dBm or W) each time it is pressed. dBm → W → dBm → ... When it is pressed during relative measurement or during MAX/MIN measurement, the unit setup is released and the absolute value measurement is selected.

Table 4-2 Indication and Functions of Key Switches (2/4)

Key name	Functions
[PRMTR] DREF	**Parameter Setup mode:** Selects a unit parameter (P.5-18). The cursor shifts in the following sequence when the key is pressed. Sensor unit: CALF → REF → CHOP → AVG → CALF → ... Optical source unit: CHOP → ATT → CHOP → ... Modify the parameter values using the [MODIFY] key △ ▽, and press the ENTER key for setup.
	Measurement mode (valid for the sensor unit only): Starts the Display Reference measurement that shows the subsequent measurement data that is relative to the reference data you have selected. To release the Display Reference measurement, press the dBm W and A/B A/REF keys simultaneously. If you select the unit of "W" and start this measurement, the relative value is shown as the ratio and no unit is shown.
[APPL] A/B A/REF	**Parameter Setup mode** (valid for the sensor unit only): Selects an application (P.5-22). The parameters are selected in the following sequence when the key is pressed: STOR → GRPH → ALIGN → STOR → ...
	Measurement mode (valid for the sensor unit only): Selects the Channel-to-Channel Comparison Measurement (A/B or B/A channel comparison) or the Reference Measurement based on the reference values (A/REF or B/REF). To release these modes, press the dBm W and DREF keys simultaneously. The measurement modes are switched as follows each time this key is pressed: Channel Comparison measurement → Reference measurement → Channel Comparison measurement → ... No channel comparison measurement starts if there is only a single sensor unit. If you select the unit of "W" and start this measurement, the relative value is shown as the ratio and no unit is shown.

Table 4-2 Indication and Functions of Key Switches (3/4)

Key name	Functions
[RUN/STOP] RANGE	**Parameter Setup mode:** Starts or stops the application execution.
	Measurement mode (valid for the sensor unit only): Turns the fixed measurement range ON or OFF. During fixed measurement range, you can increase or decrease the measurement range using the [MODIFY] keys △ ▽.
[λ] AVG	**Parameter Setup mode** (valid for the sensor unit only): Selects a calibration wavelength. The wavelength is changed in the following sequence each time the key is pressed. The values outside of the wavelength operating range of sensor are skipped. 850 → 1300 → 1310 → 1550 → 850 → ... During this mode, you can modify the wavelength at every 1-nm step using the [MODIFY] key △ ▽. Press the ENTER key for its setup. You can set the calibration wavelength within the wavelength operating range of each sensor.
	Measurement mode (valid for the sensor unit only): Turns the averaging processing ON or OFF.
[LOAD] MAX MIN	**Parameter Setup mode:** Recalls the parameter table (P.5-18). During this mode, select a table to recall using the [MODIFY] key and press the ENTER key for setup.
	Measurement mode (valid for the sensor unit only): Displays the maximum value, minimum value, and difference from the point where you have pressed the key. The values are updated each time this key is pressed. To release it, press the dBm W , DREF , and A/B A/REF keys.

Table 4-2 Indication and Functions of Key Switches (4/4)

Key name	Functions
[SAVE] BLKG	**Parameter Setup mode:** Stores the parameter table (see Section 5.4.2-P.5-18) in memory. During this mode, select the table to store using the [MODIFY] key and press the ENTER key for setup.
	Measurement mode (valid for the sensor unit only): Sets the display resolution of measurement. Undisplayed digits are truncated. It is changed as follows each time the key is pressed: Full-digit display → No display of lowest-order digit → No display of low-order 2 digits → Full-digit display → ...
ENTER	Enters your modification in the Parameter Setup mode. If you press any other key before the ENTER key, the value is not updated. This key is invalid during Measurement mode.
(MODIFY) △ ▽	**Parameter Setup mode:** Increases or decreases a numeric value.
	Measurement mode (valid for the sensor unit only): Increases or decreases the range during fixed measurement range. This key is invalid during variable measurement range.
(MODIFY) ◁ ▷	**Parameter Setup mode:** Changes the numerical digits.
	Measurement mode: Switches the auxiliary display parameters. Use the ◁ key to switch the parameters in the following sequence. Use the ▷ key to switch them in the reverse procedure. Sensor unit: λ → CALF → REF → MAX → MIN → DIFF → CHOP → AVG → RANGE → λ → ... If the maximum and minimum value displays are OFF, the MAX, MIN and DIFF displays are skipped. If the measurement range is not fixed, the RANGE display is skipped. Optical source unit: TYPE → λ1 → λ2 → ATT → CHOP → TYPE → ... If a single optical source is used, the λ2 parameter is skipped.

NOTE
If an optical source unit is connected to channel A, the sensor unit is connected to channel B, and the "A&B" channel is selected to control, the optical source unit is controlled (as channel A has the higher priority). The keys only valid for the sensor unit (such as [dBm W] key) are all invalid.

4.1.2 Explanation of Display Panel

Figure 4-2 shows the display panel (when all lamps light by the lamp test during power ON). Table 4-3 explains each display.

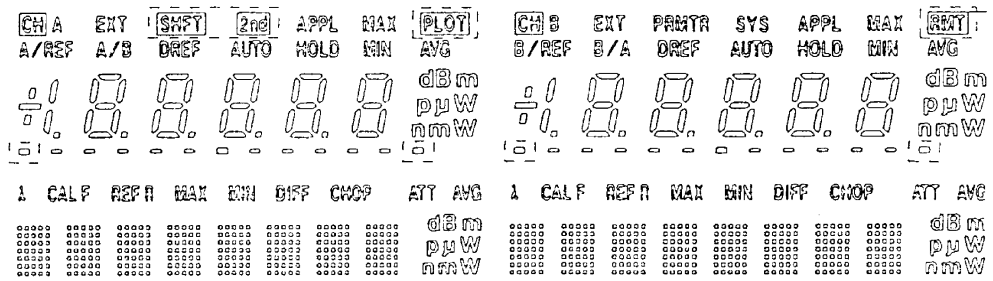


Figure 4-2 Indication of Display Panel

NOTE
If you continue the high intensity (by setting the "BRIGHT" system parameter to "4") for a long time, the intensity of fluorescent lamps may drop. To have a clear display and the long service life, reduce the display intensity.

Table 4-3 Explanation of Display Panel (1/2)

Indication	Explanation	Related Keys
7-segment display	Displays the measured value.	
CH A, CH B	The control channel lights.	CHAN
EXT	Lights when an external unit is connected to the channel and controlled.	CHAN
SHFT	Lights when the Parameter Setup mode is selected.	SHIFT
SYS	Lights during system parameter setup.	SYS
PRMTR	Lights during unit parameter setup.	PRMTR
APPL	Lights during application execution.	APPL
PLOT	Lights during output to the plotter.	
RMT	Lights during Remote control via GPIB interface.	
A/REF B/REF	Lights during relative measurement based on the reference set value.	A/B A/REF
A/B B/A	Lights during channel-to-channel comparison.	A/B A/REF
DREF	Lights during relative measurement based on the reference display value.	DREF
AUTO	Lights during automatic range switching mode.	RANGE
HOLD	Lights during manual range switching mode.	RANGE
MAX MIN	Lights during maximum and minimum value measurement.	MAX MIN
AVG	Lights during averaging measurement.	AVG

Table 4-3 Explanation of Display Panel (2/2)

Indication	Explanation
5 × 7-dot display	Displays the measuring conditions you have set.
λ	Lights during calibration wavelength display.
CALF	Lights during calibration coefficient display.
REF	Lights during reference value display.
MAX	Lights during maximum value display.
MIN	Lights during minimum value display.
DIFF	Lights during differential value display.
CHOP	Lights during CHOP frequency display.
ATT	Lights during optical attenuation display.
AVG	Lights during averaging count display.

4.2 OPM Unit (AQ2730) and Sensor (AQ2741 to 2743)

4.2.1 Explanation of Operation Section

Figure 4-3 shows the operation switch layout of the OPM unit, and Table 4-4 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

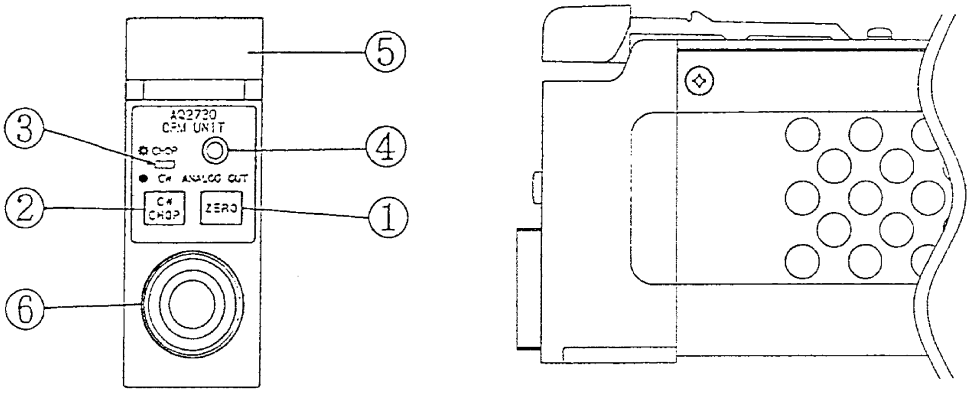


Figure 4-3 Operation Switch Layout of OPM Unit

Table 4-4 Name and Functions of OPM Unit Operation Switches

No.	Name	Display	Function
①	ZERO SET switch	ZERO	Resets the OPM unit.
②	CW/CHOP switch	CW CHOP	Switches the optical modulation mode. (Select the CHOP frequency from the AQ2140.)
③	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
④	Analog OUT terminal	[ANALOGOUT]	Outputs the linear voltage of a single range.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the OPM unit from the AQ2140.
⑥	Sensor connector		Each sensor can be connected to this port.

⚠ CAUTION
Always turn OFF the AQ2140 POWER switch and connect each sensor to the OPM unit or others.

4.2.2 Sensor Operation Section

Figure 4-4 shows the sensor operation section, and Table 4-5 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

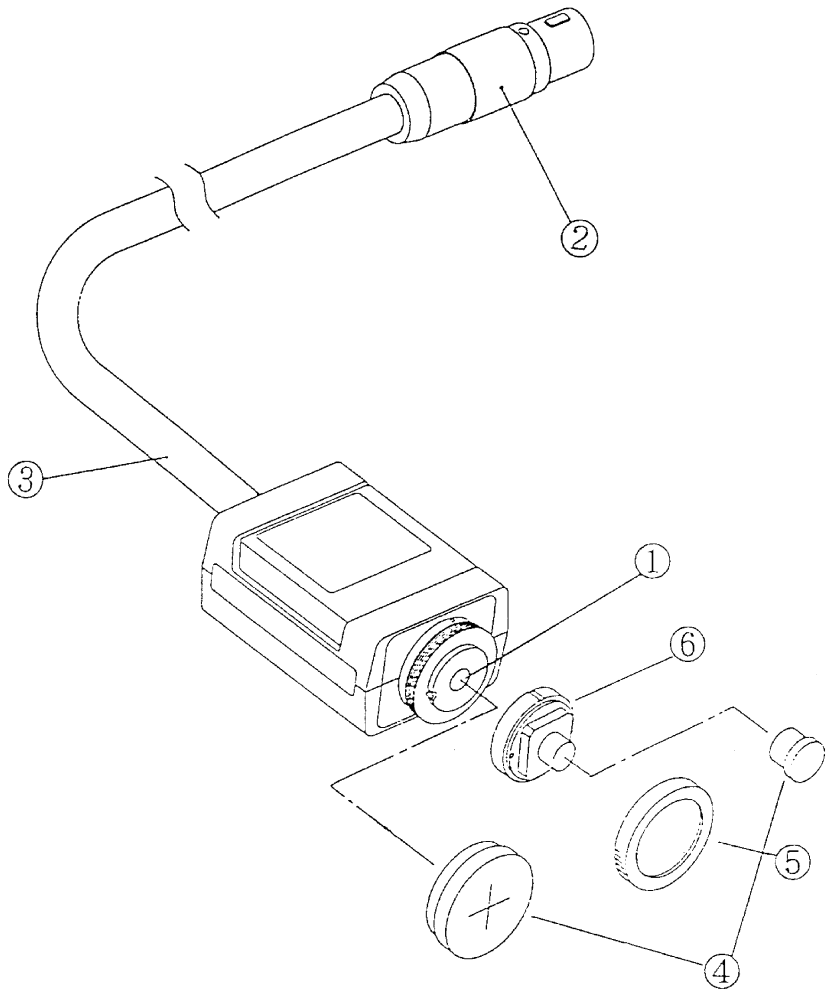


Figure 4-4 Sensor Operation Section

Table 4-5 Name and Functions of Sensor Operation Section

No.	Name	Function
①	Photosensor	Receives an optical light. The various connector adapters can be attached to it.
②	Connector	Plugs the sensor cable into the AQ2730 OPM unit.
③	Cable	Connects the sensor to the AQ2730 OPM unit.
④	Optical shield cap	Shields the sensor from the ambient light.
⑤	Stopper ring	Fixes the connector adapter in position.
⑥	Connector adapter (optional)	Connects an optical fiber cord having different type connector. (The adapter for FC connector is shown.)

4.3 Sensor Unit (AQ2731 to AQ2735)

4.3.1 Explanation of Operation Section

Figure 4-5 shows the operation switch layout of the sensor unit, and Table 4-6 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

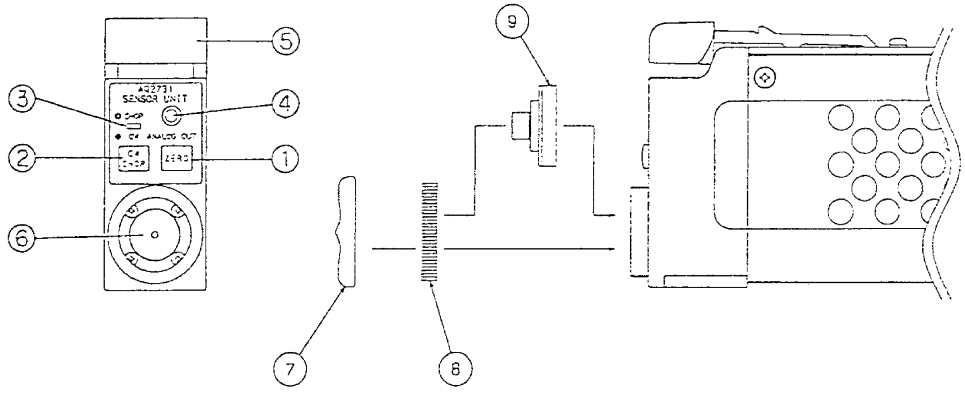


Figure 4-5 Operation Switch Layout of Sensor Unit

Table 4-6 Name and Functions of Sensor Unit Operation Switches

No.	Name	Display	Function
①	ZERO SET switch	ZERO	Resets the sensor unit.
②	CW/CHOP switch	CW CHOP	Switches the optical modulation mode. (Select the CHOP frequency from the AQ2140.)
③	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
④	Analog OUT terminal	[ANALOG OUT]	Outputs the linear voltage of a single range.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the sensor unit from the AQ2140.
⑥	Photosensor		Receives an optical light. The various connector adapters can be attached to it.
⑦	Dust cap		A dust protection cap
⑧	Stopper ring		Fixes the connector adapter in position.
⑨	Connector adapter (optional) (*1)		Connects an optical fiber cord having different type connector. (The adapter for FC connector is shown.)

*1 The AQ2732 to AQ2735 sensor units have the standard FC connector adapter.

4.4 Optical Source Unit (AQ4211, AQ4212, AQ4218 and AQ4221)

4.4.1 Explanation of Operation Section

Figure 4-6 shows the operation switch layout of the optical source unit, and Table 4-7 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

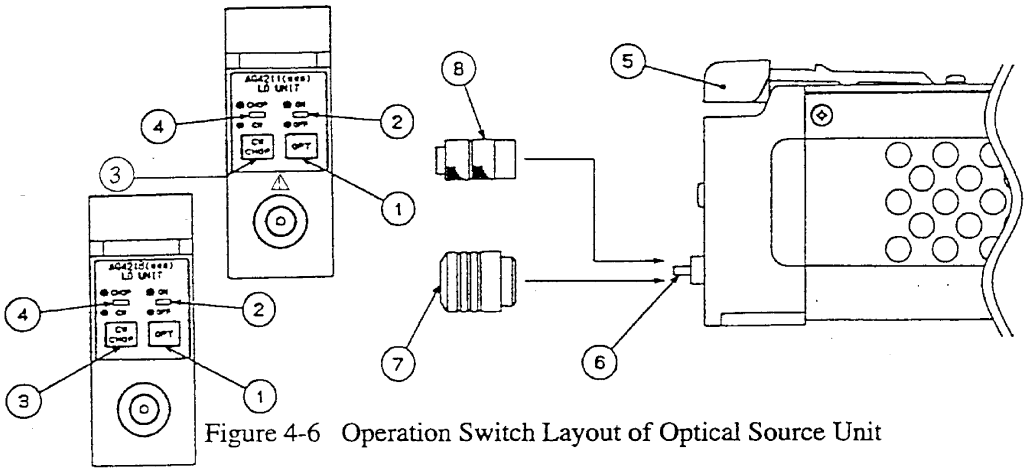


Figure 4-6 Operation Switch Layout of Optical Source Unit

Table 4-7 Name and Functions of Optical Source Unit Operation Switches

No.	Name	Display	Function
①	OPT switch	OPT	Turns the optical output ON or OFF.
②	OPT indicator lamp	[☼ ON] [● OFF]	Lights when an optical signal is output.
③	CW/CHOP switch	CW CHOP	Selects the CW or CHOP optical modulation mode. (Select the CHOP frequency from the AQ2140.)
④	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the optical source unit from the AQ2140.
⑥	Optical connector		This is the optical output port of the unit.
⑦	Connector protection cap		Protects the optical connector from ambient light and dusts.
⑧	Universal adapter (optional)		Connects an optical fiber cord having different type connector. (The adapter for FC connector is shown.)

4.5 LD Unit (AQ4213)

4.5.1 Explanation of Operation Section

Figure 4-7 shows the operation switch layout of the LD unit, and Table 4-8 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

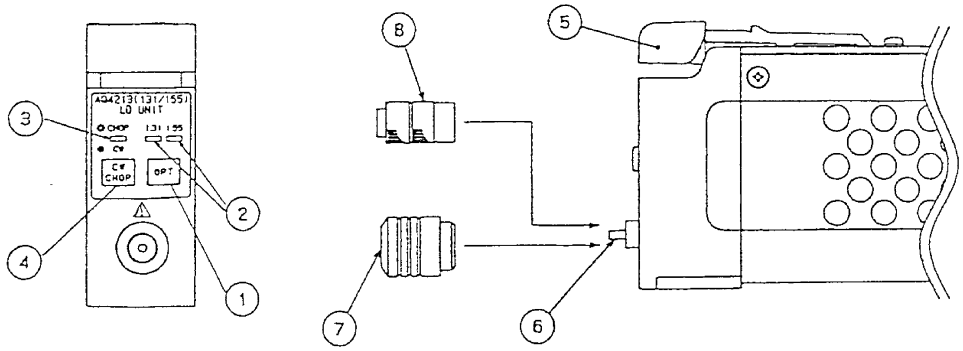


Figure 4-7 Operation Switch Layout of LD Unit

Table 4-8 Name and Functions of LD Unit Operation Switches

No.	Name	Display	Function
①	OPT switch	OPT	Turns the optical output ON or OFF.
②	OPT indicator lamp	[1.31 1.55]	Lights when an optical signal is output.
③	CW/CHOP switch	CW CHOP	Selects the CW or CHOP optical modulation mode. (Select the CHOP frequency from the AQ2140.)
④	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the LD unit from the AQ2140.
⑥	Optical connector		This is the optical output port of the LD unit.
⑦	Connector protection cap		Protects the optical connector from ambient light and dusts.
⑧	Universal adapter (optional)		Connects an optical fiber cord having different type connector. (The adapter for FC connector is shown.)

4.6 DFB-LD Unit (AQ4214)

4.6.1 Explanation of Operation Section

Figure 4-8 shows the operation switch layout of the DFB-LD unit, and Table 4-9 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

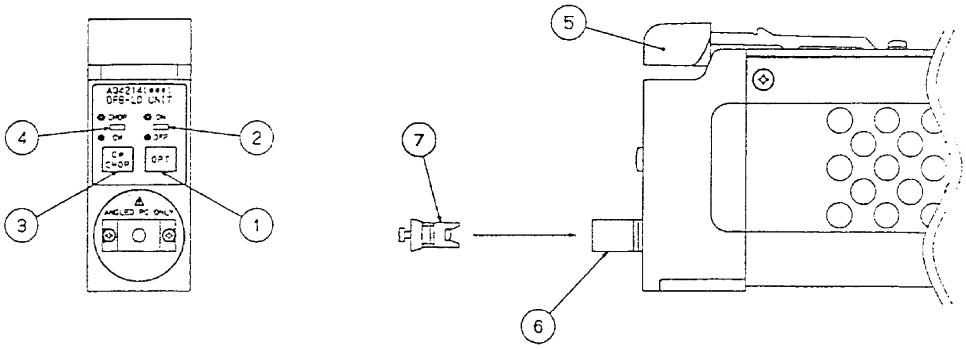


Figure 4-8 Operation Switch Layout of DFB-LD Unit

Table 4-9 Name and Functions of DFB-LD Unit Operation Switches

No.	Name	Display	Function
①	OPT switch	OPT	Turns the optical output ON or OFF.
②	OPT indicator lamp	[☼ ON] [● OFF]	Lights when an optical signal is output.
③	CW/CHOP switch	CW CHOP	Selects the CW or CHOP optical modulation mode. (Select the CHOP frequency from the AQ2140.)
④	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the DFB-LD unit from the AQ2140.
⑥	Optical output port		Connects an SC or APC connector cable.
⑦	Protection cap		Protects the optical output port from dusts.

4.7 LED Unit (AQ4215)

4.7.1 Explanation of Operation Section

Figure 4-9 shows the operation switch layout of the LED unit, and Table 4-10 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

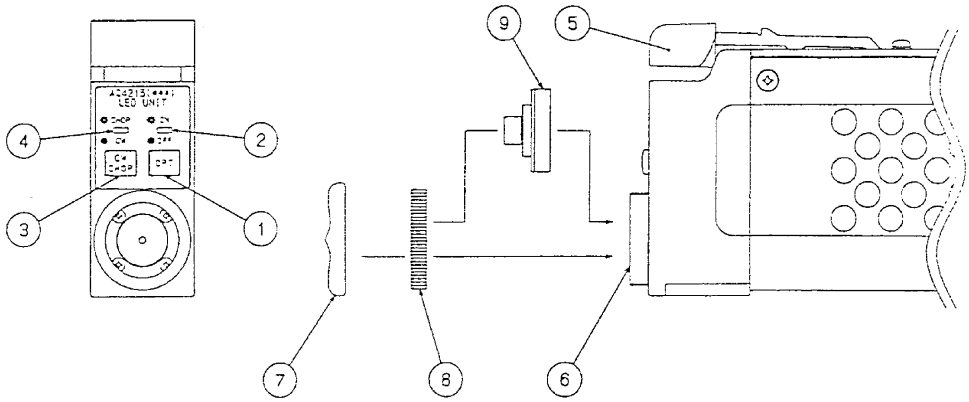


Figure 4-9 Operation Switch Layout of LED Unit

Table 4-10 Name and Functions of LED Unit Operation Switches

No.	Name	Display	Function
①	OPT switch	OPT	Turns the optical output ON or OFF.
②	OPT indicator lamp	[☼ ON] [● OFF]	Lights when an optical signal is output.
③	CW/CHOP switch	CW CHOP	Selects the CW or CHOP optical modulation mode. (Select the CHOP frequency from the AQ2140.)
④	CW/CHOP indicator lamp	[☼ CHOP] [● CW]	Lights when the CHOP optical modulation is selected.
⑤	Unit pull-out lever		Hold down this lever and you can pull out the LED unit from the AQ2140.
⑥	Optical output port		Outputs an optical signal from the LED unit.
⑦	Protection cap		Protects the optical output port from dusts.
⑧	Stopper ring		Fixes the connector adapter in position.
⑨	Connector adapter (optional)		Connects an optical fiber cord having different type connector. (The adapter for FC connector is shown.)

4.8 Return Loss Measurement Unit (AQ7310)

4.8.1 Explanation of Operation Section

Figure 4-10 shows the operation switch layout of the AQ7310 return loss measurement unit, and Table 4-11 lists the name and function of each operation component. The component numbers of the table correspond to the numbers shown in the figure.

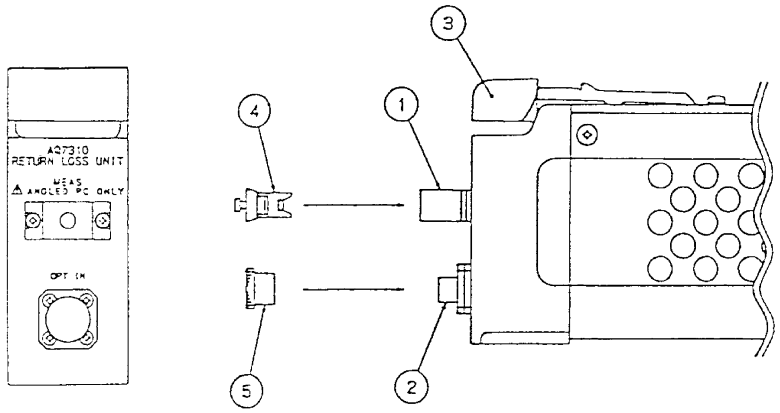


Figure 4-10 Operation Switch Layout of Return Loss Measurement Unit

Table 4-11 Name and Functions of Return Loss Measurement Unit Operation Switches

No.	Name	Display	Function
①	Master cord connection port	[MEAS]	Connects the standard master cord.
②	Optical input port	[OPT IN]	Receives an optical signal. Plug an SM fiber having the FC connector into this port.
③	Unit pull-out lever		Hold down this lever and you can pull out the return-loss measurement unit from the AQ2140.
④	Protection cap (for SC connector)		Protects the master cord connection port from dusts.
⑤	Protection cap (for FC connector)		Protects the optical input port from dusts.

5. System Operations

This chapter explains how to use your AQ2140.

5.1 Before Turning ON

(1) Make sure that the AQ2140 has been turned OFF ([POWER]) switch ③ must be [■ OFF].

(2) Check the correct fuse capacity at the AC voltage fuse socket.

(3) Check the source voltage of your AQ2140.

(4) Insert the desired Unit into slot ① of the unit storage of AQ2140.

⚠ CAUTION
Turn the multimeter power switch OFF ([■ OFF]) before mounting or dismounting the Unit to/from the Unit storage. Otherwise, the Unit will be damaged.

⚠ CAUTION
Do not connect an instrument or Unit that is NOT approved by Ando Electric to your AQ2140 Optical Multimeter. If done, both the connected instrument/Unit and AQ2140 may be damaged.

(5) Plug the power cord of your AQ2140 into the wall receptacle. If you have a two-pole socket, use the power adapter of accessory kit and ground the lead correctly.

(6) Make sure that the ambient conditions satisfy the requirements (see the system specifications). Keep your AQ2140 away from excessive dust.

(7) Place your AQ2140 on a stable and horizontal workbench. Take care not to restrict the air flow at the rear ventilation hole of AQ2140.

(8) Make sure that all units are securely connected to your AQ2140.

5.1.1 Cleaning of Optical Connectors

Before plugging an optical fiber cord into its connector, always wipe and clean the optical fiber connector and the unit connector port. The dusts and foreign materials may damage the used connectors and the internal optical parts of the unit.

(1) Cleaning of units

The NTT International's Cure-Top Cleaning Sticks are recommended to use for cleaning of the unit connector ports. (If the optical source unit has the universal adapter, remove the adapter and wipe and clean it using an absolute alcohol.) Figure 5-1 shows how to clean the optical connector ports.

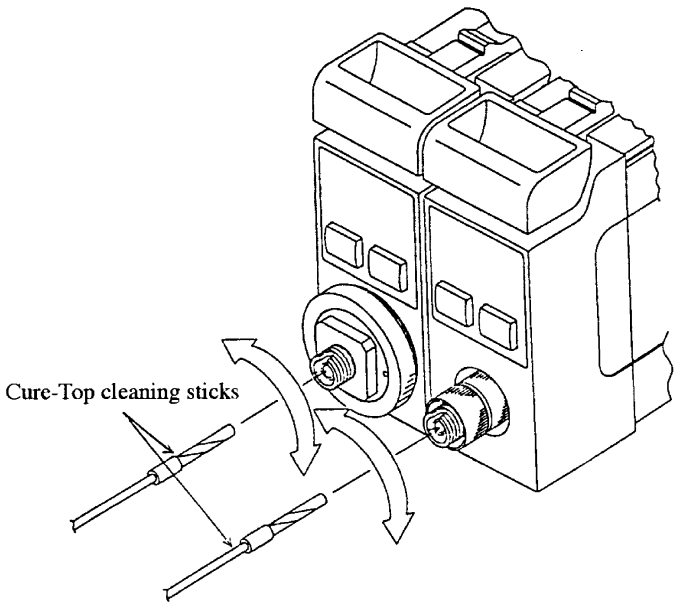


Figure 5-1 Cleaning of Optical Connector Ports

(2) Cleaning of optical connectors

Drop a small amount of absolute alcohol on a clean wiping paper, and wipe and clean the optical connector of the fiber. (Always use a clean wiping water during cleaning.)

NOTE
After the connector cleaning with the absolute alcohol, a foreign material may remain on the connector surface. Check the optical connector end for the dirt using a microscope.

5.1.2 Mounting/Dismounting the Blank Panel

The AQ2140 has a single blank panel to protect the unit storage section. If you do not mount any measuring unit on the AQ2140, always cover the storage section using the blank panel.

Figure 5-2 shows how to mount the blank panel on the AQ2140, and Figure 5-3 shows how to dismount the blank panel from it.

⚠ CAUTION
Take care not to drop any conductive metal in the unit storage section, or the AQ2140 will fail.

(1) Mounting the blank panel
Hook the blank panel top into the groove of unit storage section, and push the blank panel bottom part into the storage section.

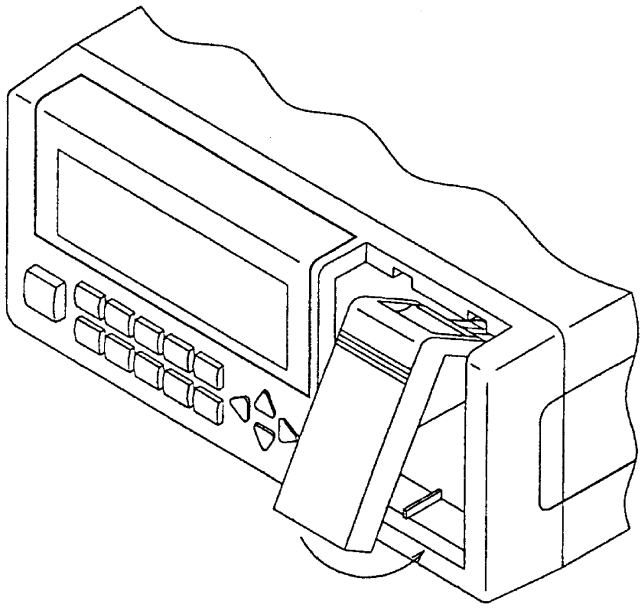


Figure 5-2 Mounting the Blank Panel

(2) Dismounting the blank panel
Hold down the blank panel top part, and pull it out to remove the panel.

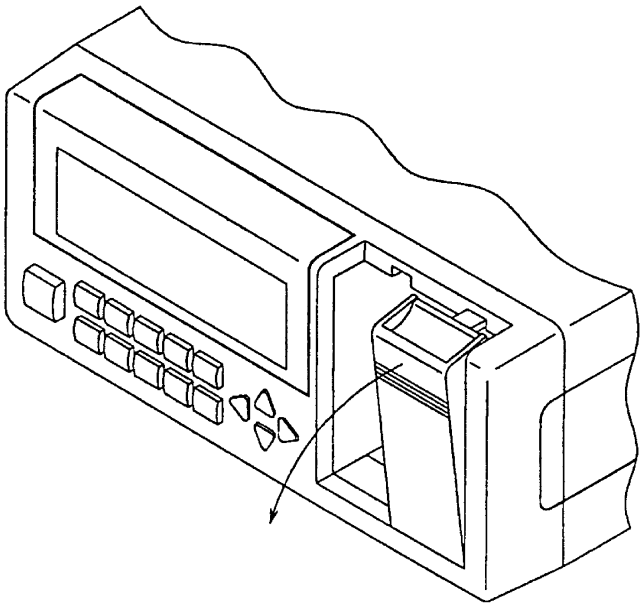


Figure 5-3 Dismounting the Blank Panel

5.1.3 Unit Mounting on the AQ2140

(1) Make sure that the AQ2140 power supply is turned OFF.

(2) Place the unit on the guide rail of the AQ2140 unit storage section, and fully insert the unit until its pull-out lever is clicked and lifted up.

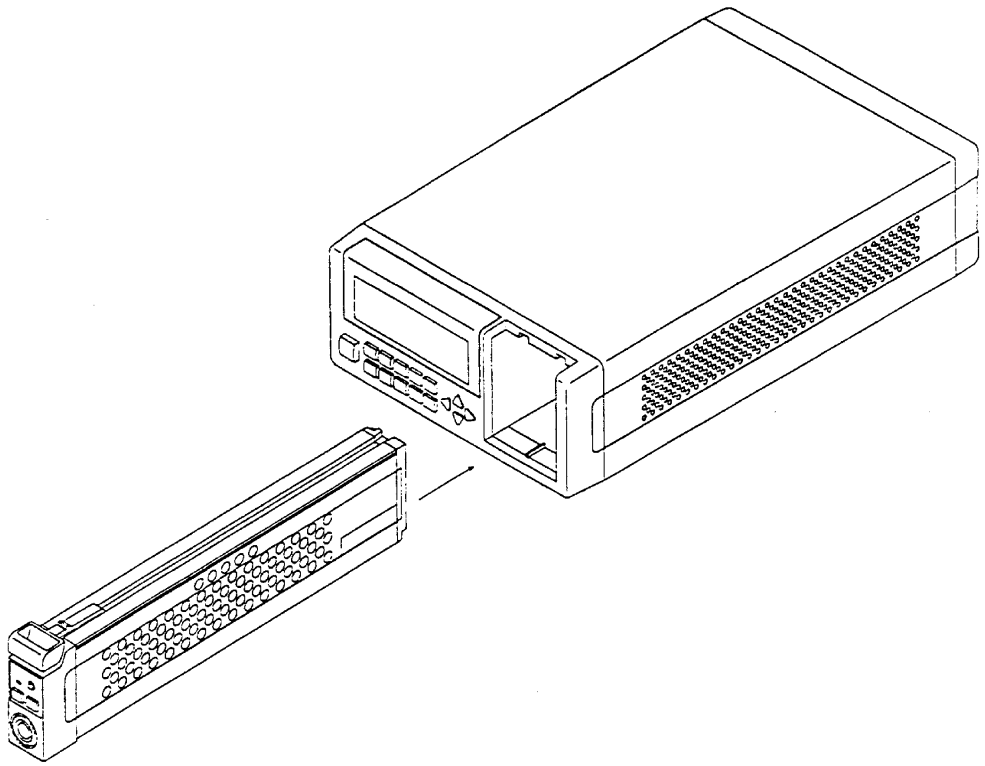


Figure 5-4 Unit Mounting

To remove the unit from the AQ2140, hold down the pull-out lever of the unit and pull out the unit toward you.

⚠ CAUTION
Turn the multimeter power switch OFF before mounting or dismounting the Unit to/from the AQ2140 Optical Multimeter. Otherwise, the Unit and Optical Multimeter will be damaged.

5.1.4 Sensor Connection (AQ2730 and AQ2741 to 2743)

Each sensor can be connected to the AQ2730 OPM unit.

(1) Make sure that the AQ2140 power supply is turned OFF.

(2) Mount the OPM unit by following the procedure of Section 5.1.2.

(3) Plug the sensor connector into the socket of OPM unit so that the connector red marker matches the socket red marker. Push the connector until it clicks.

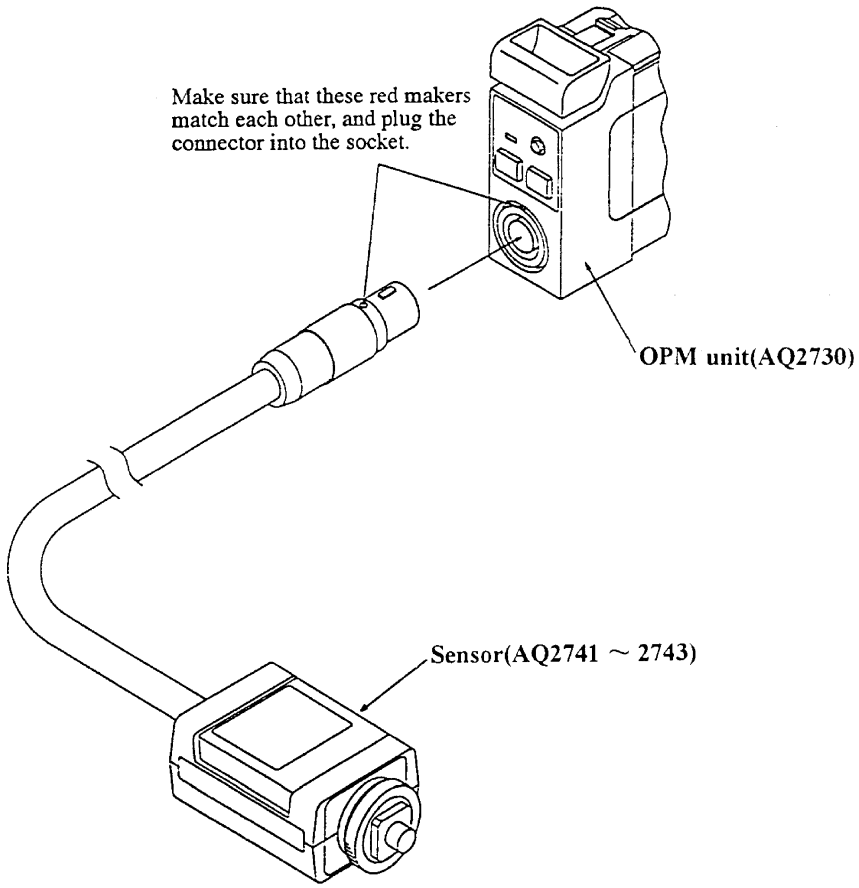


Figure 5-5 **Sensor Connection**

⚠ CAUTION
Turn the multimeter power switch OFF before mounting or dismounting the Sensor to/from the OPM Unit. Otherwise, the OPM Unit, Sensor, or Optical Multimeter will be damaged. Also, do not attach an undefined device or instrument to the Optical Multimeter and OPM unit, or they will be damaged.

5.1.5 Mounting the Shield Cap and Connector Adapter (AQ2741 to 2743)

When an appropriate type of connector adapter is attached to the photosensor unit, the optical signals emitted from the optical connector can be measured.

(1) Mounting the shield cap

Mount the shield cap on the sensor as shown in Figure 5-6. The positive (+) marking of the cap can be used for sensor positioning during space light measurement.

(2) Mounting the connector adapter

① Position the connector adapter so that its white band matches the photosensor port white band.

② Rotate and position the connector adapter so that the photosensor port guide pin enters the guide hole of the connector adapter.

③ After the positioning has ended, tighten the stopper ring to fix the connector adapter to the photosensor port.

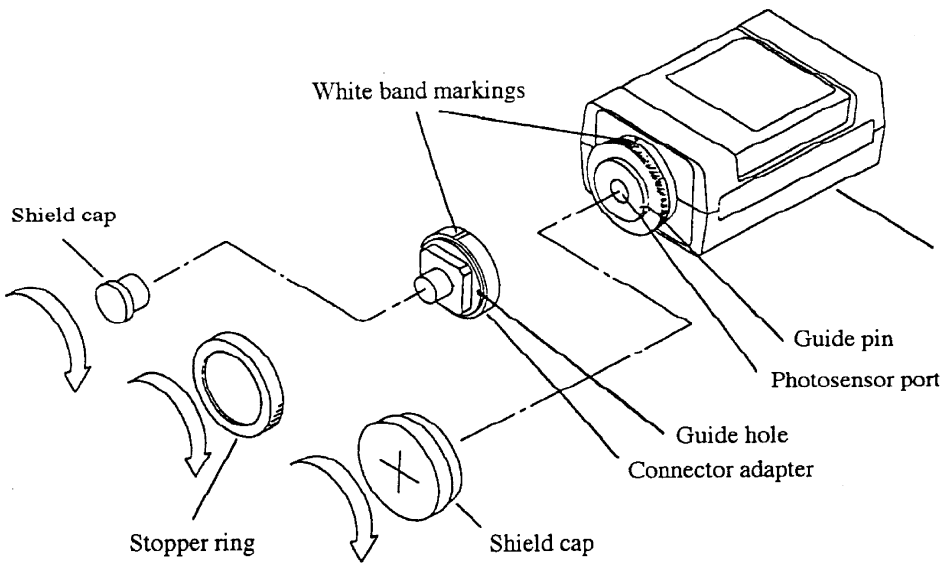


Figure 5-6 Mounting the Shield Cap and Connector Adapter

⚠ CAUTION

The connector adapter is fixed to the photosensor port with the highest machining accuracy. Wipe and clean the connector adapter joint section. If the dusts or foreign materials remain in the joint, the system performance may drop.

⚠ CAUTION
Handle the photosensor port carefully. If its glass surface is scratched or damaged, the system performance may not be satisfied.

NOTE
When you are not using the Optical Multimeter, always cover the connector adapter with the shield cap against the dusts.

5.1.6 Mounting the AQ2731 to AQ2735 or AQ4215 Connector Adapter

When an appropriate type of connector adapter is attached to the Sensor Unit, the optical signals emitted from the optical connector can be measured.

(1) Position the connector adapter so that its white band matches the white band of the Sensor Unit.

(2) Rotate and position the connector adapter so that the Sensor Unit guide pin enters the guide hole of the connector adapter.

(3) After the positioning has ended, tighten the stopper ring to fix the connector adapter to the Sensor Unit.

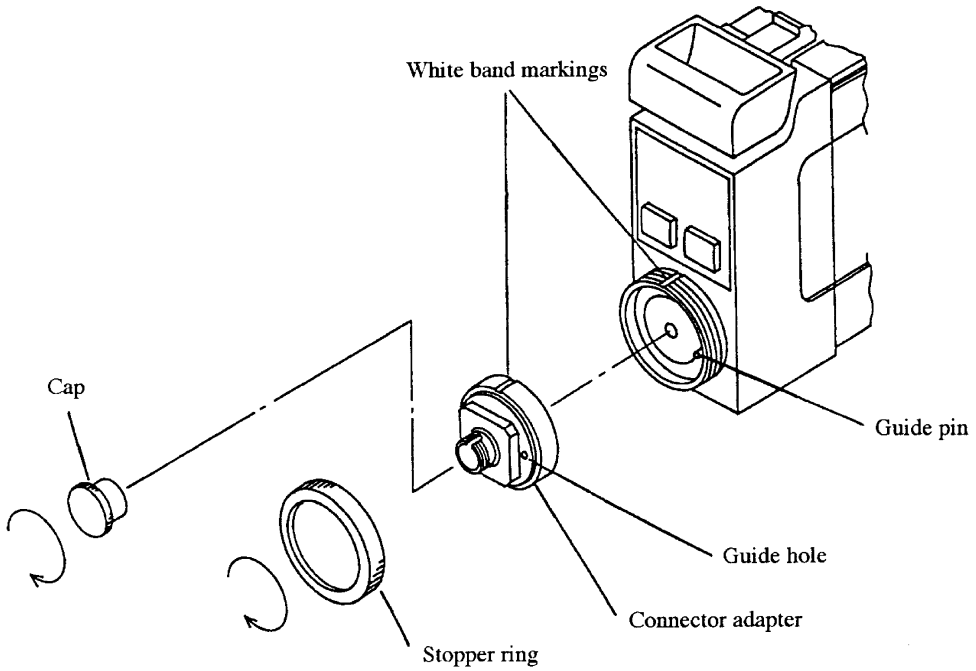


Figure 5-7 Mounting the Connector Adapter

⚠ **CAUTION** on AQ2731 to AQ2735 Units
If the connector adapter is removed from the Sensor Unit, the measurement accuracy of the specifications may not be satisfied. We recommend to recalibrate the Sensor Unit when replacing the connector adapter.

⚠ **CAUTION** on AQ2731 to AQ2735 Units
The system can satisfy its specifications only when the connector adapter and Sensor Unit have the same part number. Otherwise, the system specifications may not be satisfied.

⚠ **CAUTION** on AQ2731 to AQ2735 Units
Handle the photosensor port carefully. If its glass surface is scratched or damaged, the system performance may drop.

⚠ **CAUTION**
The connector adapter is fixed to the Sensor Unit with the highest machining accuracy. Wipe and clean the connector adapter joint section. If the dusts or foreign materials remain in the joint, the system performance may drop.

NOTE
When you are not using the Optical Multimeter, always cover the connector adapter with the shield cap against the dusts.

5.1.7 Mounting the AQ4211 to 4213, AQ4218 or AQ4221 Universal Adapter

When an appropriate type of universal adapter (optional) is attached to the Sensor Unit, the various optical connector cables can be plugged into the Sensor Unit.

⚠ CAUTION

Take care not to scratch the optical connector end surface when handling it. The scratches may drop the signal transmission reliability. (When connecting the optical fibers, follow the operation notes of Section 3.3.)

(1) Make sure that the optical output is turned OFF.

(2) Wipe and clean the optical connector end surface of the Sensor Unit with an alcohol or others.

(3) Take care not to scratch the optical connector end, and mount the universal adapter.

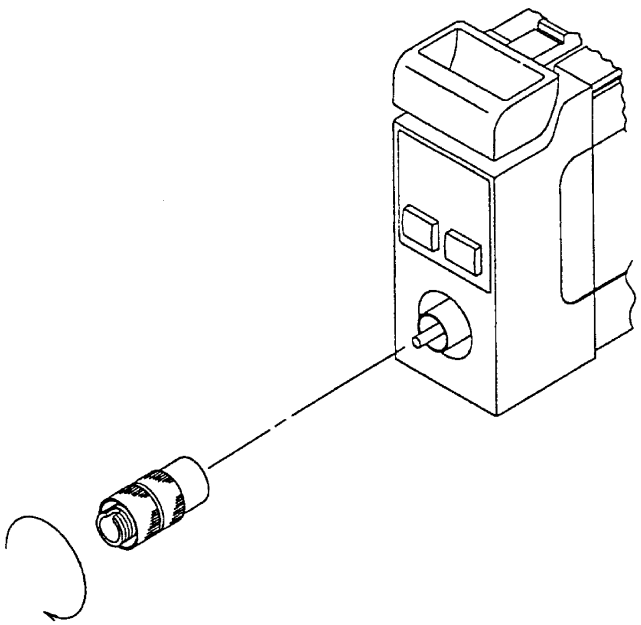


Figure 5-8 Mounting the Universal Adapter

NOTE

The optical connector has the positioning pin, and the universal adapter has the positioning groove. If you are hard to mount the universal adapter, make sure that the positioning pin of the optical connector ferule matches the groove of the universal adapter.

5.1.8 Connecting the AQ4214 Optical Fiber

⚠ CAUTION
Only an SC or APC cable can be plugged into the optical output port of the DFB-LD unit. Do not plug any other cable into it.

⚠ CAUTION
If the ferule end of the DFB-LD unit optical output is scratched, the signal transmission stability may be reduced. (When connecting the optical fibers, follow the operation notes of Section 3.4.)

(1) Make sure that the optical output is turned OFF.

(2) Wipe and clean the SC or APC connector ferule end using an alcohol or others.

(3) Clean the ferule end of the DFB-LD unit and optical output port. We recommend to use the NTT International's Kure-Top cleaning sticks.

(4) Plug the optical fiber into the optical output port of the Optical Multimeter. Take care not to scratch the ferule end and not to contaminate it with dusts.

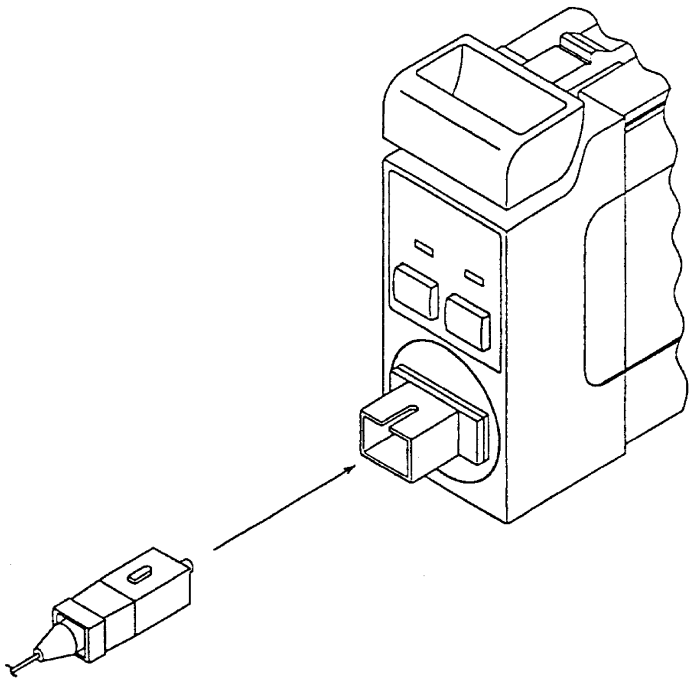


Figure 5-9 Connecting the Optical Fiber

5.1.9 Connecting the AQ7310 Optical Fiber

⚠ CAUTION
Only an SC or APC cable can be plugged into the master cord socket of the Return-Loss Measurement Unit. Do not plug any other cable into it.

⚠ CAUTION
If the master cord socket or optical input ferule end of the Return-Loss Measurement Unit is scratched, the signal transmission stability may be reduced.

NOTE
When you are not using the Return-Loss Measurement Unit, cover the master cord socket and optical input port with protection caps against dusts.

(1) Make sure that the optical output of the LD source is turned OFF.

(2) Wipe and clean the SC or APC connector ferule end using an alcohol or others.

(3) Clean the ferule end of the Return-Loss Measurement Unit, optical input port, and master cord socket. We recommend to use the NTT International's Kure-Top cleaning sticks.

(4) Plug the LD source optical fiber (having the SMF or FC type connector) into the optical input port of the Optical Multimeter. Take care not to scratch the ferule end and not to contaminate it with dusts.

(5) Plug the AQ7310 master cord into the master cord socket of the Return-Loss Measurement Unit. Take care not to scratch the ferule end and not to contaminate it with dusts.

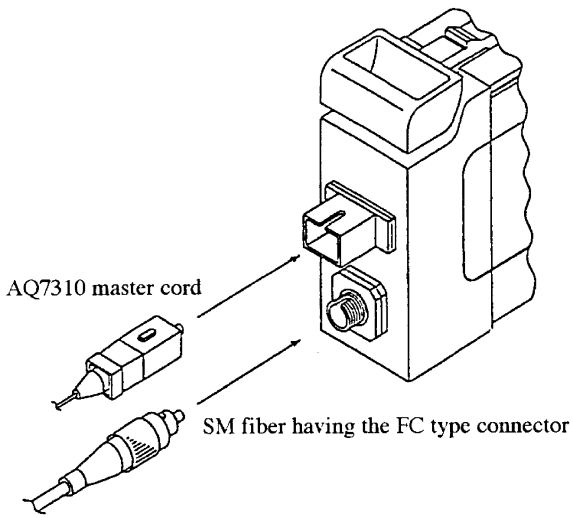


Figure 5-10 Connecting the Optical Fiber

5.1.10 Wiring of Analog OUT plug

Although the Optical Multimeter has the Analog OUT plug, it is not wired yet.
The user needs to wire the cables before using the plug.
Figure 5-11 shows the Analog OUT plug structure.

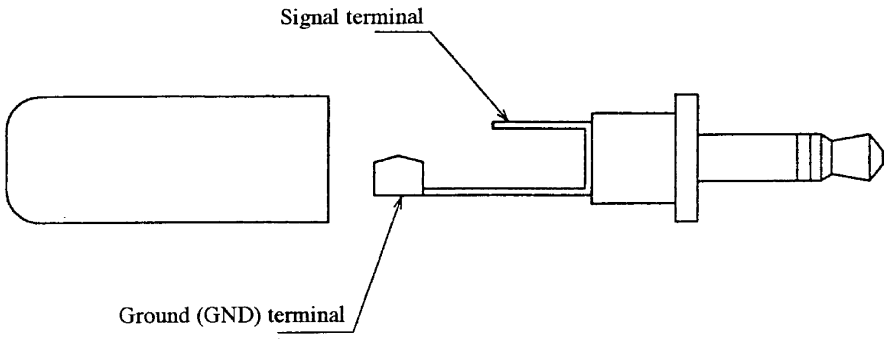


Figure 5-11 Structure of Analog OUT Plug

5.2 Operation Checkout

This section explains the power-on sequence and initial system operations.

(1) Checkout of display panel, memory test, and connected Units
Connect the Unit(s) you wish to use, and turn the power switch ON ([ON]). The 5 × 7-dot display will light one after the other, and all lamps will light (see Section 4.2 (→ 4-10)) for checkout of display panel, memory test, and connected Units.
If they do not light, the display panel has failed. If the memory or connected Unit has failed, an error message (See Table 5.6 (→ 5-56)) appears.

(2) Initial operations
Figures 5-12 (a) to 5-12 (c) show the initial screen of your AQ2140 after the unit checkout. Numerical values of these figures are only reference.

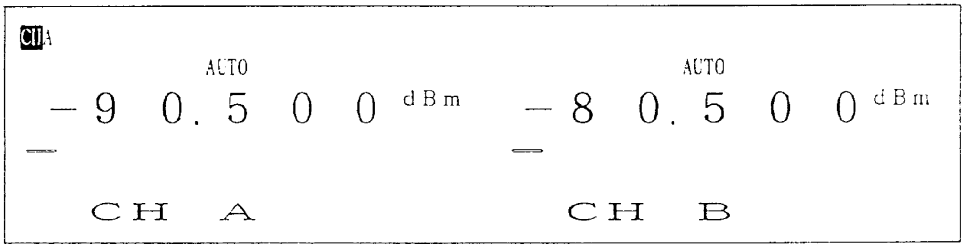


Figure 5-12 (a) Initial Screen 1 (Sensor for Channel A, and Sensor for Channel B)

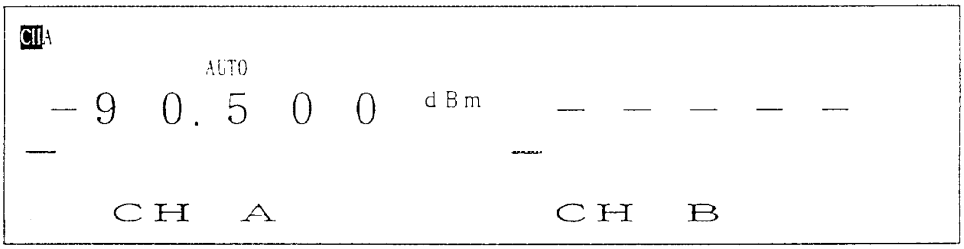


Figure 5-12 (b) Initial Screen 2
(Sensor for Channel A, and Light Source for Channel B)

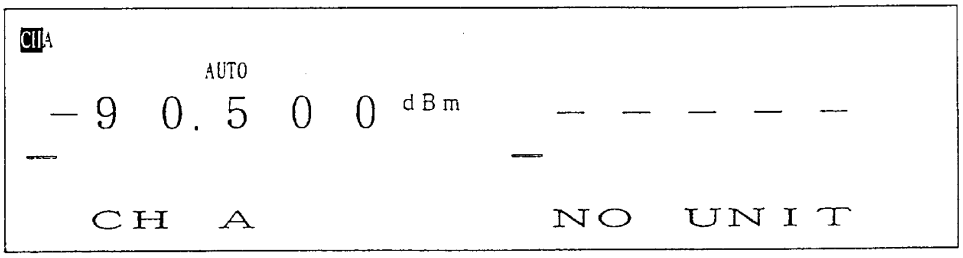


Figure 5-12 (c) Initial Screen 3 (Sensor for Channel A, but no unit for Channel B)

(3) To allow highly reliable and wide dynamic range measurement, wait approximately one hour (heat-up) after power ON.

(4) Before using the Sensor Unit, shield the photosensor from the ambient light and zero-adjust it (by Zero Set functions).

(5) Turn the power switch OFF when you do not use.
When you do not use your AQ2140, turn the power switch OFF. Wait at least five seconds before the next power ON.

(6) How to initialize the set values?
To initialize all parameters to their initial status, hold down the [SHIFT] key and turn the power switch ON.

⚠ DANGER
If an overheat or an electrical shock is found during measurement, turn the power switch OFF immediately ([■ OFF]) and call the service.

5.3 Operations during Measurement Mode

This section explains the operations and display of the AQ2140 in the Measurement Mode using typical examples.

Unless otherwise noted, you must use the operations and display on the Initial screen (→ 5-15). Also, these examples assume that the Sensor Unit is attached to Channel A and the Optical Source Unit is attached to Channel B.

During Measurement mode, you can modify the 5 × 7-dot display using the ◁ or ▷ MODIFY key. Also, the selecting blinking value can be changed using the △ or ▽ MODIFY key. Press the [ENTER] key to enter your selection.

To return all parameters to their initial status (called the "initialization"), hold down the [SHIFT] key and turn the POWER switch ON.

NOTE
A value you have modified using the [MODIFY] key is made valid only when you press the [ENTER] key. If you do not press the [ENTER] key for your selection and if you have changed to another measurement mode or parameter setup mode, the parameters you have set are lost.

5.3.1 System parameter setup

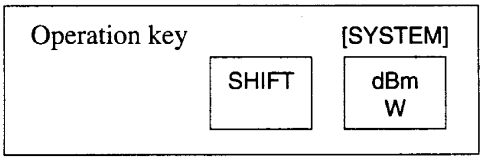


Table 5-1 defines the system parameters that you can set from your AQ2140.

Table 5-1 System Parameters

On-screen display	Parameter	Setup Range	Initial Setup
ADRS	GPIB address	0 to 30	19
TONE	Beep tone	16 tones (1 to 16)	8
VOLUME	Beep volume	5 volume levels (0 to 4)	4
BRIGHT	Display brightness	4 brightness levels (1 to 4)	3
INT	Measurement interval	10 (20), 50, or 200 msec	100 msec

The measurement interval is set to 10 msec minimum if a single Sensor Unit is connected. It is set to 20 msec minimum if two Sensor Units are connected.

If you press the [SHIFT] and [SYSTEM] keys simultaneously, the AQ2140 shows the screen of Figure 5-13.

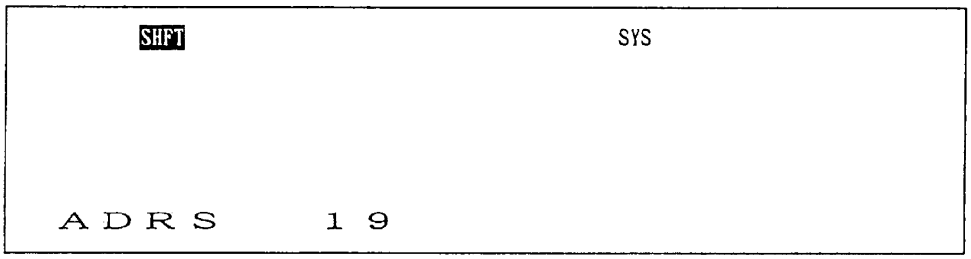


Figure 5-13 System Parameter Setup Screen

You can select a system parameter by pressing the [SYSTEM] key on the screen of Figure 5-13. Select a parameter you wish to modify, enter the desired value using the [MODIFY] key, and press the [ENTER] key for setup.

5.3.2 Unit program setup

Operation key		[PRMTR]	[LOAD]	[SAVE]
	SHIFT	DREF	MAX MIN	BLKG

(1) Sensor unit parameters

Table 5-2 lists the Sensor Unit parameters.

Table 5-2 Sensor Unit Parameters

On-screen display	Parameter	Setup Range	Initial Setup
CAL F	Calibration value	±199.999 dB	0 dB
REF	Reference value	±199.999 dBm	0 dBm
CHOP f	CHOP frequency	270 Hz, 1 kHz, or 2 kHz	270 Hz
AVG	Averaging count	2, 5, 10, 20, 50, 100, or 200 times	10

If the unit is in CW mode, it continues even when you modify the CHOP frequency in this mode. To modify the unit operation, use the CW CHOP key on that unit.

If you press the SHIFT and [PRMTR] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-14.

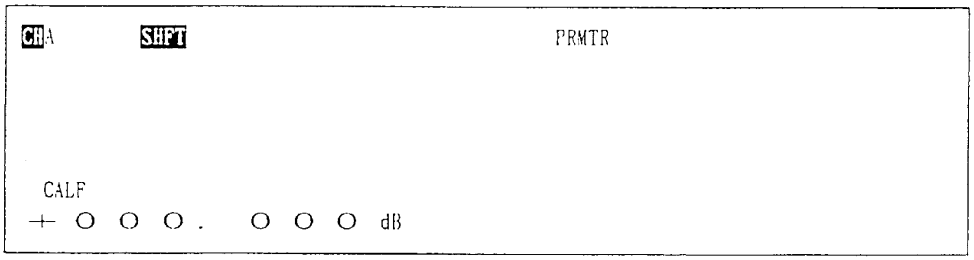


Figure 5-14 Sensor Parameter Setup Screen

You can select a sensor parameter by pressing the [PRMTR] key on the screen of Figure 5-14. Select a parameter you wish to modify, enter the desired value using the [MODIFY] key, and press the ENTER key for setup.

(2) Parameters for Optical Source Unit

Table 5-3 lists the parameters of the Optical Source Unit.

Table 5-3 Parameters of Optical Source Unit

On-screen display	Parameter	Setup Range	Initial Setup
ATT	Optical attenuation	6.0 dB (at 0.1-dB step)	0 dB
CHOP f	CHOP frequency	270 Hz, 1 kHz, or 2 kHz	270 Hz

If the unit is in CW mode, it continues even when you modify the CHOP frequency in this mode. To modify the unit operation, use the [CW CHOP] key on that unit.

If you press the [SHIFT] and [PRMTR] keys simultaneously when controlling the Unit of channel B, the AQ2140 shows the screen of Figure 5-15.

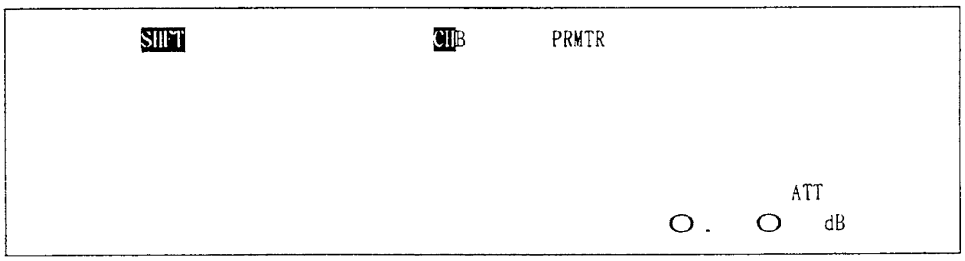


Figure 5-15 Parameter Setup Screen of Optical Source Unit

You can select a sensor parameter by pressing the [PRMTR] key on the screen of Figure 5-15. Select a parameter you wish to modify, enter the desired value using the [MODIFY] key, and press the [ENTER] key for setup.

(3) Parameter storage and recalling

Each channel of the AQ2140 has 10 parameter tables from 0 to 9. The parameter tables relevant to the sensors comprise the contents shown in Table 5-2. And, the parameter tables relevant to the calibration wavelengths (→ 5-22), type of the absolute value measurements (→ 5-36) and light sources consist of the contents shown in Table 5-3. The parameter table 0 contains the initial settings (note, however, that reference wavelength of each sensor is employed as the sensor calibration wavelength), and tables 1 to 9 are prepared for containing user's settings.

When saving a parameter table after entering the unit parameter and other, display the unit parameter once. Then, press the [SAVE] key. Press the MODIFY key then to display the table number of the table to be save, then press [ENTER] key to validate your entry.

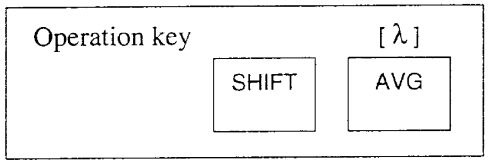
When recalling a parameter table, display the unit parameter once as you did in saving the table. Then, press the [LOAD] key being followed by the MODIFY key to display a desired table number. Now you can recall the table by pressing the [ENTER] key.

If you recall the light source relevant parameters to the sensor unit or OPM unit (sensor), settings specified for the recalled parameters are initialized. It holds true too when the sensor or OPM unit relevant parameters are recalled to the light source.

Note that if you load a non-saved parameter table (except parameter table "0"), the sensor calibration wavelength will be set to "850 nm".

5.3.3 Calibration wavelength setup

The calibration wavelength is a parameter unique to the Sensor Unit.



If you press the [SHIFT] and [λ] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-16.

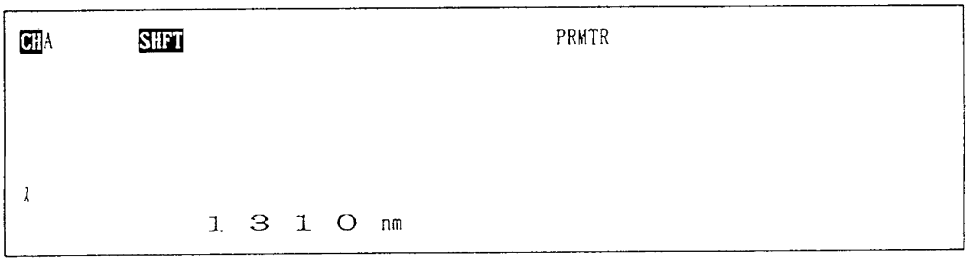
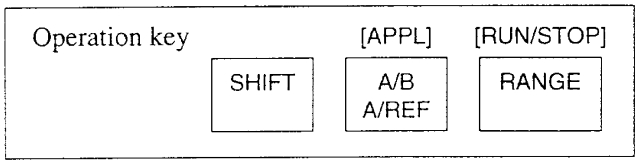


Figure 5-16 Calibration Wavelength Setup Screen

You can change the typical wavelength by pressing the [λ] key on the screen of Figure 5-16.
To set a smaller wavelength, display the desired one using the [MODIFY] key and press the [ENTER] key.
The wavelength operating range that can be set varies depending on each unit.

5.3.4 Application startup

The application is valid when the Sensor Unit is controlled by the control channel.



The AQ2140 can execute the following five types of application:

1) Data storage (STOR)
2) Plotting (GRPH)
3) Alignment (ALIGN)
4) Return-loss measurement unit (RETURN LOSS)
5) Recall storage data (SHOW)

If you press the [SHIFT] and [APPL] keys successively when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-17.

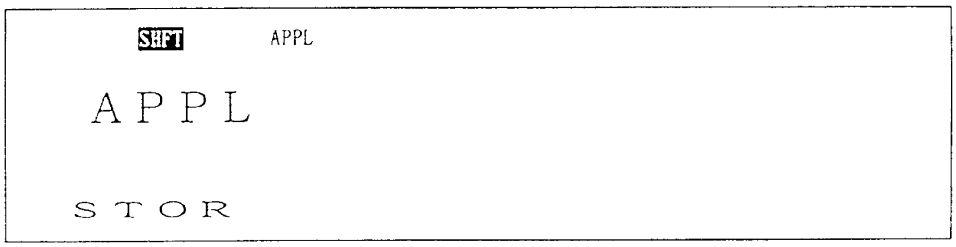


Figure 5-17 Application Selection Screen

You can change the application to execute by pressing the [APPL] key on the screen of Figure 5-17.
To start the application, display it and press the [ENTER] key.

(1) Data storage (STOR)

This application stores the measured data in memory of the AQ2140.
Up to 1000 data sets can be stored in memory for each of channels A and B. You can generate a graph of the measured data and output it by combination of plotting application (explained later).

Select "STOR" on the application screen (→ 5-23) and press the [ENTER] key.
The following Channel Selection screen will appear.

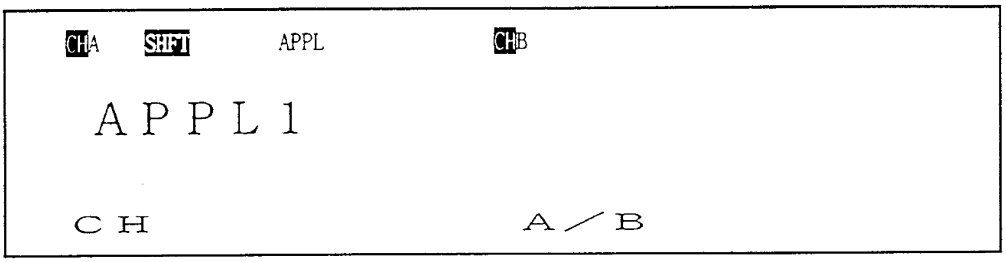


Figure 5–18 Channel Selection Screen 1

You can select channel A, channel B, or both channels simultaneously.
The available channel blinks in the following order each time you press the ◁ or ▷ MODIFY key (you cannot select a channel having no data).

- For the channel-to-channel measurement (A/B or B/A):
  When A/B is selected ····· A and B ←→ B.
  When B/A is selected ····· A and B ←→ A.
  When A/B and B/A are selected ····· A and B alone.
- When the channel-to-channel measurement is not executed:
  A ←→ B ←→ A and B.

You cannot select a channel having no data.
Select the desired channel (by blinking it) and press the [ENTER] key.
The screen of Figure 5-19 will appear (this example selects both channels A and B simultaneously).

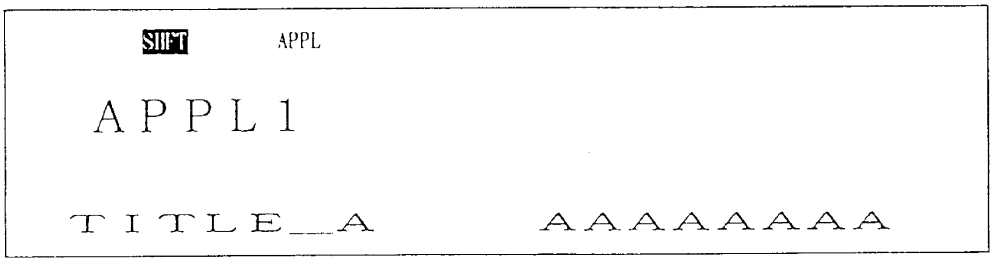


Figure 5-19 Title Input Screen

Enter a data tile in the 5 × 7-dot display area of the screen of Figure 5-19.
Display the desired letters using the [MODIFY] key, select all letters, and press the [ENTER] key. When you have selected both channels, the Title Input screen appears for channel B.
The title name is initially set to "AAAAAAAA" and "BBBBBBBB".
After title data input, the measurement time input screen of Figure 5-20 appears.

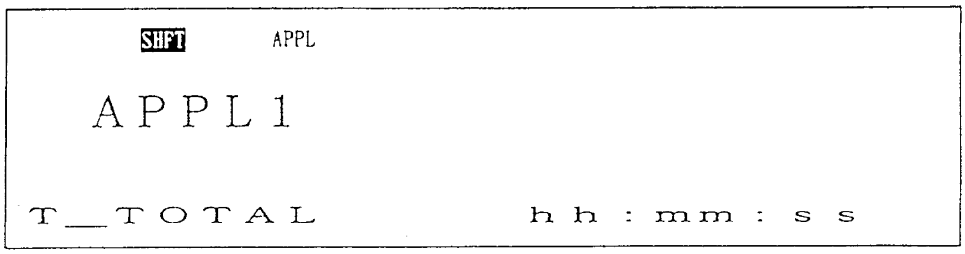


Figure 5-20 Measurement Time Input Screen

On the screen of Figure 5-20, enter the measurement time in the right 5 × 7-dot display area. Display the desired measurement time using the [MODIFY] key, and press the [ENTER] key for setup.
The measurement time is initially set to "00:01:40".
Example: If the measurement interval is 100 msec:
100 msec × 1000 = 100 sec
= "00:01:40" is displayed.

NOTE

You can set a single "data storage time" and a single "measurement interval" only (regardless of channel selection). If you store data of both channels, the data is sampled in the almost same timing (with an error of approximately 10 msec).

After you have entered the measurement time, the AQ2140 enters the idle status.
Press the [RUN/STOP] key to start measurement.
The remaining time is indicated on the 5 × 7-dot display area.
When the measurement has ended, the beep sounds (the beep volume and tone depend on your system parameter setup).
To stop the current application, press the [SHIFT] key.
The Application Selection screen (→ 5-23) will reappear.
Also, you can stop the measurement by pressing the [RUN/STOP] key.
In this case, the "END Y/N?" prompt message appears before measurement stop.
You can recall the storage data in the following ways:

- Plotter output : See Paragraph (2) "Plotting (GRPH)."
- Data recall : See Paragraph (5) "Recall storage data (SHOW)."

- GPIB output : See Section 5.9 "GPIB."

NOTES

1. When data is being stored (that is, when the data storage started by the [RUN] key still continues), the Optical Multimeter accepts the [RUN/STOP] key only.
2. When data of a single channel is being stored, you cannot start the data storage of another channel.
3. When data of a single channel is stored separately, the data of another channel is held in memory.
4. Do not turn the POWER switch OFF during data storage. If done, the data and parameters being stored may be destroyed.
5. Following describes number of storable data:
   - Up to 1000 pieces of data per channel are storable.
   - When the data storage time is set to 10 seconds and 100 ms is employed for the measurement interval, number of data storable is 100. When the data storage time is set to 60 seconds and 10 ms is employed for the measurement interval, number of data storage is 1000. Storage interval, in this case, is 60 ms (60 seconds/1000).
6. If a specified averaging count (→ 5-18) is not reached for the currently turned on averaging measurement, you cannot change the measurement time using the [RUN] key. In this case, the measurement value and measurement time on the screen will blink.
7. When you implement the data storage after selecting the channel-to-channel measurement (A/B or B/A), data of A of A/B or B/A is stored on CH A and data of B of A/B or B/A is stored on CH B.
   Thus, note that when the channel-to-channel measurement (A/B or B/A) is turned on, data on both CH A and CH B are overwritten.
8. If a different averaging count (AVG) is specified for CH A and CH B in the channel-to-channel measurement (A/B or B/A), correct measurement is not available because measurement data acquisition timing between CH A and CH B are not synchronized. You must specify the same averaging count for both CH A and CH B.

(2) Plotting (GRPH)

This application generates a graph of memory data in any format and outputs it to a plotter.

The supported plotter is the Hewlett Packard's HP7475A or equivalent.

On the Application Selection screen (→ 5-23), display "GRPH" and press the [ENTER] key. The Channel Selection screen of Figure 5-21 will appear.

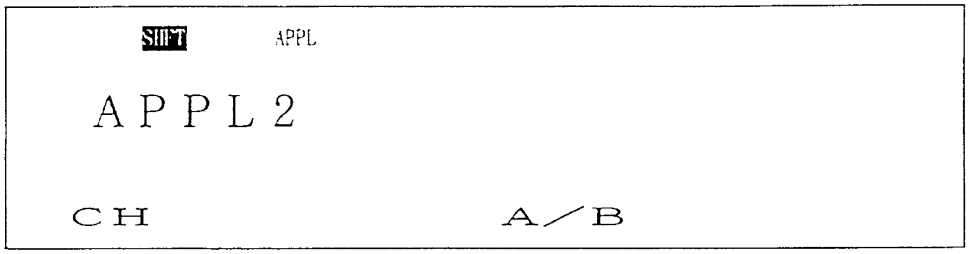


Figure 5-21 Channel Selection Screen 2

You can select the data to be plotted out in the following manner.
Pressing the ◁ or ▷ MODIFY key sequentially blinks the channels or type of data you can select. (You cannot select a channel having no data nor the both channels at the same time.)

A ⟷ B ⟷ A (A/B) ⟷ B (B/A)

A ..... CH A data.

B..... CH B data.

A (A/B)..... Channel-to-channel measurement data (relative data on CH A using CH B as the reference).

B (B/A) ..... Channel-to-channel measurement data (relative data on CH B using CH A as the reference).

A (A/B) and B (B/A) is available for your selection when number of data stored on them is the same.

Select the desired channel or data type (by blinking it) and press the [ENTER] key. The screen of Figure 5-22 will appear (this example selects channel A).

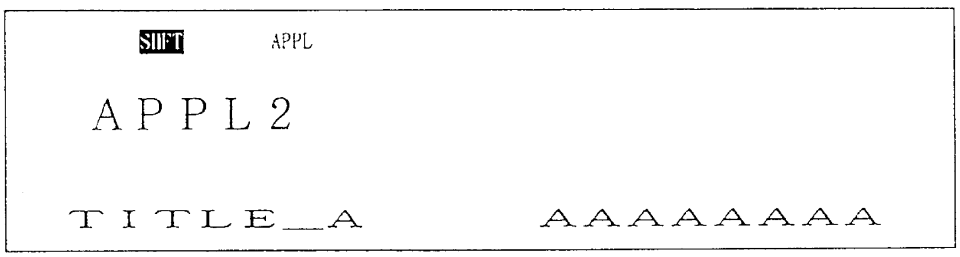


Figure 5-22 Title Input Screen 2

Enter a data tile in the 5 × 7-dot display area of the screen of Figure 5-22. Display the desired letters using the [MODIFY] key, select all letters, and press the [ENTER] key. The same title name is set as the title name used during data storage.

After title data input, the plotting format setup screen appears.
When you select the Auto Scale mode, the X- and Y-axis scales are set automatically.
To manually set these axis scales, do not select the Auto Scale mode.
To manually set the output format, set the parameters of Table 5-4 by following the on-screen prompts. The previously set parameters are initially displayed (see the table below for parameter initialization).

Table 5-4 Plotting Format Parameters

On-screen display	Parameter	Setup Range	Initial Setup
X_Start	Plot start time	0 to (T_Total - 10 sec)	0 sec
X_End	Plot end time	X_Start to T_Total	T_Total
Y/DIX	Y-axis scale interval	0.001 0.002, 0.005, 0.010, 0.020, 0.050, 0.100, 0.200, 0.500, 1.000, 2.000, 5.000, 10.000, 20.000, 50.000	1.000
	Y-axis unit	dB, mW, μW, nW, pW	dB

After you have completed the plotting format setup, the AQ2140 enters the standby mode. Press the [RUN/STOP] key to start plotting. Once plotting has started, the AQ2140 rejects any of control operations you specify.

NOTES

The initial value of X-Start and X-End change depending on the data storage time.
The X-axis scale is set to zero (0) when plotting has started.
The minimum difference between the plot start and end times is 10 seconds.

(X_End - X_Start) ³ 10 sec

Note on unit of Y-axis
When plotting a set of data being stored in "dB", conversion of the unit (in the range of mW, μW, nW or pW) is available only to those units having values larger than the maximum value of the data contained in the plotting range.
For instance, when the maximum value of the data in the plotting range is –30 dBm, the units available for the plotting are mW or μW alone.

Figure 5-23 gives a plotter output example.

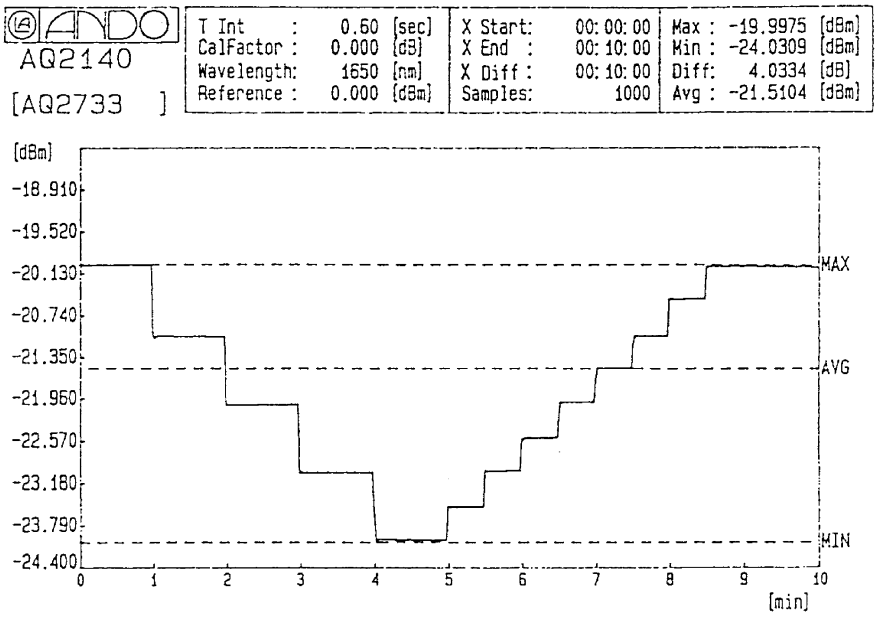


Figure 5-23 Plotter Output Example (in Auto Scale)

In the channel-to-channel measurement, the value at start of the storage appears in "xxxx" portion of the plotter output "Reference: xxxx".

After the plotting has completed, the AQ2140 returns to the normal measurement mode.

Figure 5-24 gives an output example when you manually set the output format.
This example uses the same data of Figure 5-23 (→ 5-29).
However, as only a part of total measurement time is sampled, the data count ("Samples"), maximum value ("Max"), minimum value ("Min"), difference ("Diff"), and average ("Avg") differ from those of Figure 5-23.

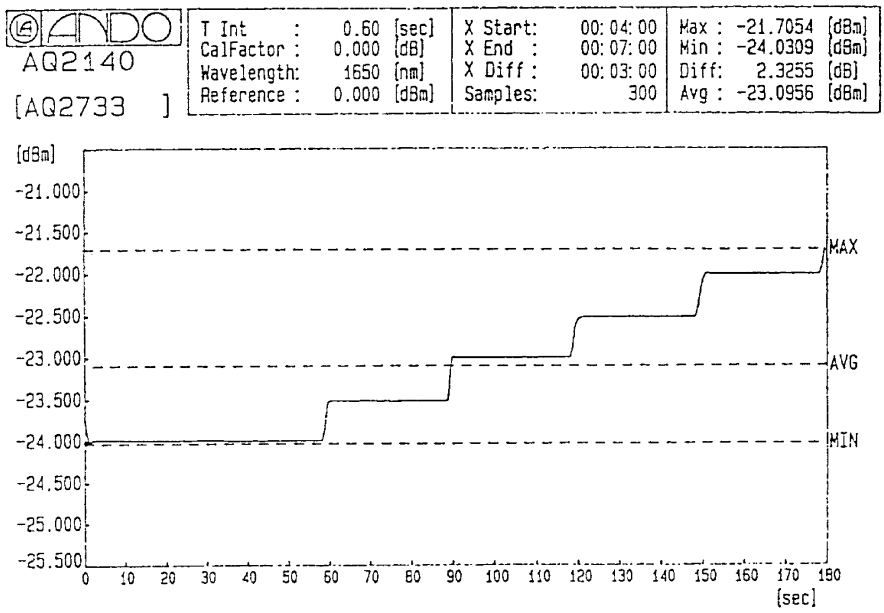


Figure 5-24 Plotter Output Example (in Manual Scale Mode)

After the plotting has completed, the AQ2140 returns to the normal measurement mode.
To cancel the currently running application, press the [SHIFT] key.
The initial Application Selection screen (→ 5-23) will reappear.
(You cannot stop the application when data is being plotted out.)
If no plotter is connected to your AQ2140, the "PLOT ERR" message is displayed.
In such case, press the [RUN/STOP] key to return to the measurement mode.

NOTE

To use a plotter, set the DIP switches of the plotter to the "LISTEN ONLY" mode.
For other setup, refer to the plotter operation manual.
When the controller such as personal computer is connected, the plotter is not operable. Before operating the plotter, the controller must be disconnected.

(3) Alignment (ALIGN)

This application uses the 5 × 7-dot display as a bar graph and shows the measured data variation in real-time mode. The control channel of the measurement mode has the higher priority. During two-channel control, channel A has the higher priority. (You cannot run the application on the two channels simultaneously.)

On the Application Selection screen (→ 5-23), display "ALIGN" and press the [ENTER] key. select channel A or B, and the upper limit input screen of Figure 5-25 will appear.

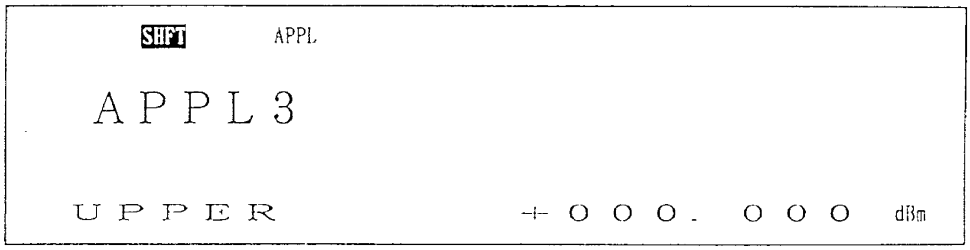


Figure 5-25 Upper Limit Input Screen

On the screen of Figure 5-25, you can modify the upper limit shown at the right of 5 × 7-dot display. Display the desired value using the [MODIFY] key, and press the [ENTER] key.

After the upper limit input, you can enter the lower limit. Enter it in the similar way for the upper limit input. You can enter the lower limit that is equal to the upper limit subtracted by 1 dB or more.
The lower limit is not equal to the upper limit subtracted by 1 dB or more.

After you have set the lower limit, the AQ2140 enters the standby mode.
Press the [RUN/STOP] key to start alignment.

To cancel the currently running application, press the [SHIFT] key.
The initial Application Selection screen (→ 5-23) will reappear.
Also, you can stop the alignment by pressing the [RUN/STOP] key.
In this case, the "END Y/N?" prompt message appears before alignment stop.

NOTE
To set the UPPER and LOWER limits that exceed the power range, use the AUTO range.

(4) Return-loss measurement unit (RETURN LOSS)

The Return-Loss Measurement Unit is detailed in Section 5.7.3 (→ 5-46).

(5) Recall storage data (SHOW)

This application redisplays (or recalls) the data which has been stored in memory by the "STOR" (Data Storage) application.

Display the "SHOW" on the Application Selection screen (→ 5-23), and press the [ENTER] key. The Channel Selection screen of Figure 5-26 will appear.

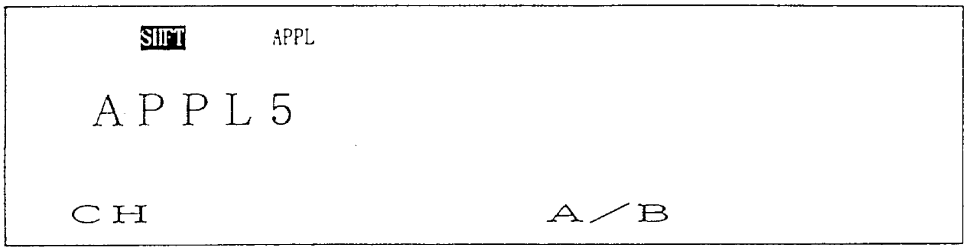


Figure 5-26 Upper Limit Input Screen

You can select channel A, channel B, or both channels simultaneously.
The available channel blinks in the following order each time you press the ◁ or ▷ MODIFY key (you cannot select a channel having no data).

A ←→ B ←→A & B

Select the desired channel (by blinking it) and press the [ENTER] key. The screen of Figure 5-27 will appear (this example selects both channels A and B simultaneously).

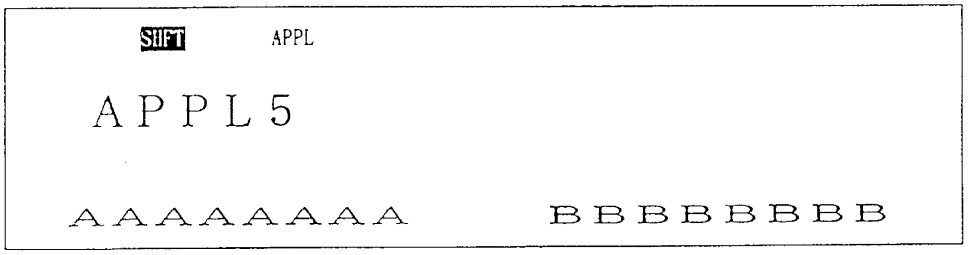


Figure 5-27 Title Input Screen

Titles "AAAAAAAA" and "BBBBBBBB" (shown on the 5 × 7-dot display) are those you have entered by the STOR application.

From the screen of Fig. 5-27, the storage data is sequentially displayed in the following order each time you press the ◁ or ▷ MODIFY key.

TITLE → T_Total → AVG → MAX → MIN → DIFF → Separate data → ...

Figure 5-28 gives an example of separate data display screen.

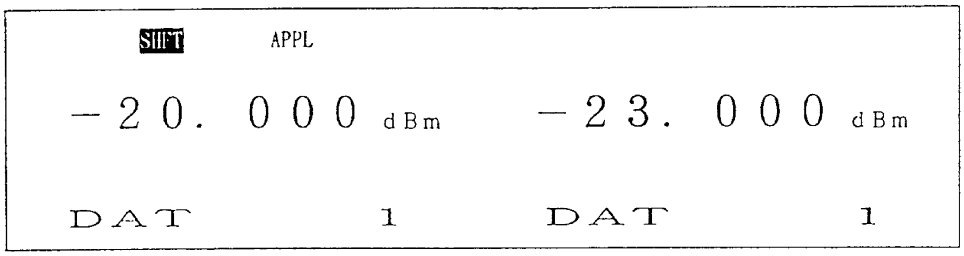


Figure 5-28 Upper Limit Input Screen

When the separate data of Figure 5-28 is being displayed and when you press the △ or ▽ MODIFY key, the previous or subsequent "STOR" data is displayed sequentially.

DAT1 → DAT2 → DAT3 → ... → DAT999 → DAT1000 → DAT1 → ...

To terminate the SHOW application, press the [SHIFT] or [RUN/STOP] key. The initial Application Selection screen (→ 5-23) will reappear.

5.4 Operations in Measurement Mode

This section explains the operations and display of the AQ2140 including some case studies.
Unless otherwise noted, you must use the operations and display on the Initial screen (→ 5-15).
Also, these examples assume that the Sensor Units are attached to channels A and B.
During Measurement mode, you can modify the 5 × 7-dot display using the ◁ or ▷ MODIFY key.

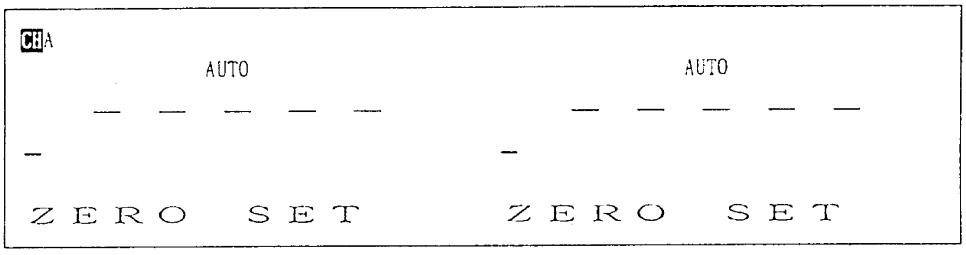
5.4.1 Zero Set

Operation key (Unit)	ZERO

The AQ2140 Optical Multimeter supports the Zero Adjustment (called the "Zero Set") function to clear an electric offset of the circuits. The Zero Set key is mounted on the Sensor Unit (but not mounted on the AQ2140 itself).

(1) Shield the AQ2140 photosensor port using a shield cap or others.
(2) Press the ZERO key on the Sensor Unit, and the Zero Set will be executed. It usually takes 30 seconds. If you press the ZERO key again during zero adjustment, the Zero Set is canceled and the Multimeter returns to its normal measurement mode.
(3) After the Zero Set has completed, the Multimeter returns to the normal measurement mode.

When you press the ZERO key of channel A or B on the Sensor Unit, the AQ2140 shows the screen of Figure 5-29.



<The "ZERO SET" letters blink.>

Figure 5-29 Zero Set Screen

If you turn the AQ2140 power off once, then turn it on again after executing the zero set, the zero set value will be cleared. Thus, when power has been turned on again, you must implement the zero set.

NOTE

If the AQ2140 photosensor port is poor shielded and if the [ZERO] key is pressed, the Zero Set is NOT executed but the error message (→ 5-56) is displayed approximately three seconds. Then, the AQ2140 returns to its normal measurement mode. If such zero adjustment is made, an error may increase during absolute value measurement.

NOTE

An electrical offset of sensors and internal circuits may change depending on the ambient temperature and power conductive time. This value is defined as the noise level of each sensor in the specifications of Table 1-3. If you measure an optical level below -40 dBm or at the highest accuracy, for example, you must execute the Zero Set immediately before the measurement.

NOTE

The AQ2743 sensors having the built-in electronics cooling elements require some heat-up time. If they are used, you need to wait up to five minutes after power-on. If you execute the Zero Set during heat-up, an error occurs. In such case, reexecute the Zero Set after the heat-up time has passed.

NOTE

When using the AQ2743 sensor for measurement in the high sensitivity range (such as –50 or –60 dBm range), do not move the photosensor section and cables of the sensor. If moved, the noise level may change. In such case, execute the Zero Set again.

NOTE

The electrical offset of the AQ2140 may change due to the changed ambient temperature. If it has occurred, wait until the ambient temperature becomes stable and execute the Zero Set.

NOTE

If the measurement range is changed from the high power range (such as +10 or 0 dBm range) to the high sensitivity range (such as –50 or –60 dBm range) during the CW mode, the noise level may increase but it is not abnormal. Wait until the noise level becomes stable and execute the Zero Set again. The noise level variation can be checked on the AQ2140 display or by the signal at the Analog OUT terminal.

NOTE

To start the CHOP optical signal measurement, set the modulation frequency to be measured and execute the Zero Set.

5.4.2 Switching of optical modulation mode

Operation key (Unit)	CW CHOP

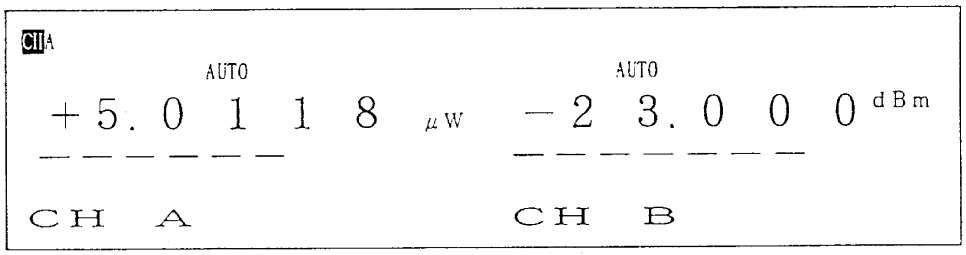
The optical modulation mode switch key is mounted on the Sensor Unit (but not mounted on the AQ2140 itself). To switch the optical modulation mode, press the CW CHOP key. When you select the CW optical modulation mode, the LED indicator goes out on the front panel of Sensor Unit. When you select the CHOP optical modulation mode, the LED indicator lights.

5.4.3 Absolute value measurement

Operation key [SYSTEM]	dBm W

The AQ2140 Optical Multimeter has the initial screen (initializing) showing the absolute value measurement in dBm unit. To select the absolute value measurement in W unit, just press the dBm W key. To return to the absolute value measurement in dBm unit, press the dBm W key again.

When you press the dBm W key when controlling channel A, the AQ2140 shows the screen of Figure 5-30.



<Display example: When the -23 dBm signals are entered in both channels.>

Figure 5-30 Absolute Value Measurement Screen

5.4.4 Relative value measurement

Operation key	[PRMTR]	[APPL]
	DREF	A/B A/REF

Release key	[SYSTEM]	[PRMTR]	[APPL]
	dBm W	DREF	A/B A/REF

The AQ2140 supports three types of relative value measurement.

(1) Display Reference measurement:
Allows relative measurement based on the measured values as reference data.

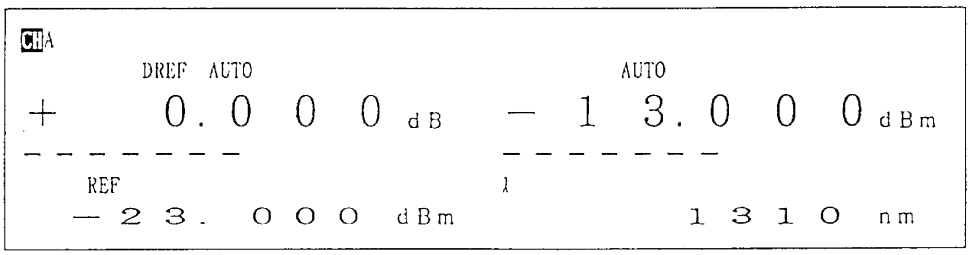
(2) Channel-to-Channel Comparison:
Allows comparison measurement with another channel.

(3) Reference measurement:
Allows relative measurement based on the set values as reference data.
(For entry of set values, see Section 5.3.2.) (→5-19)

If you press the [DREF] key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-31 (a).

The reference value is updated each time the [DREF] key is pressed.

To release it, press the [dBm W] or [A/B A/REF] key. The respective measurement mode will be selected.
The "REF" value of 5 × 7-dot display shows the measured value when this key is pressed.

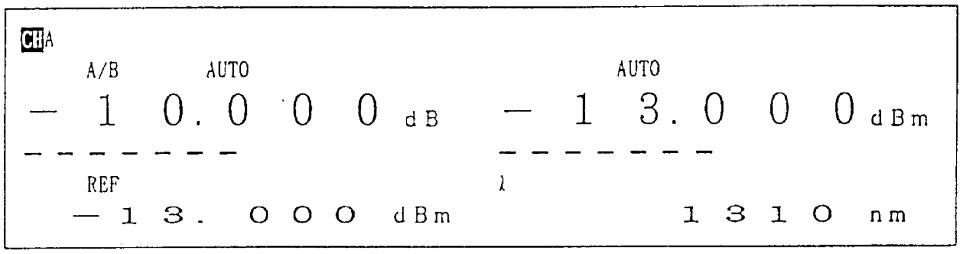


<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-31 (a) Display Reference Measurement Screen

When a reference value is too large or small to be contained in the display range, the 7-segment indicator shows the maximum or minimum value displayable in blinking.

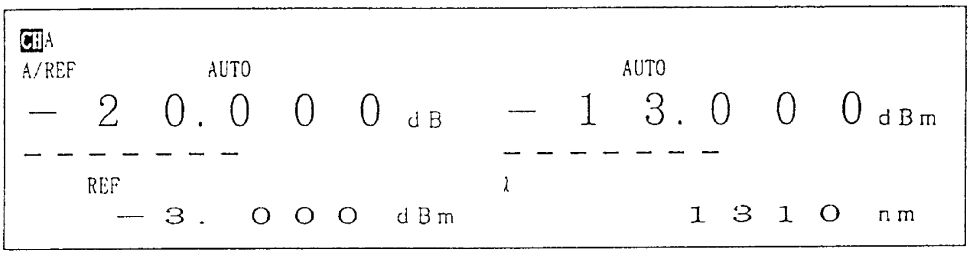
If you press the A/B A/REF key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-31 (b).
To release it, press the dBm W or DREF key. The respective measurement mode will be selected.
The "REF" value of 5 × 7-dot display shows the measured value of channel B.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-31 (b) Channel Comparison Measurement Screen

If you press the A/B A/REF key on the screen of Figure 5-31 (b), the AQ2140 shows the screen of Figure 5-31 (c).
You can return to the screen of Figure 5-31 (b) by pressing the A/B A/REF key again.
To release it, press the dBm W or DREF key. The respective measurement mode will be selected.
The "REF" value of 5 × 7-dot display shows your set values (see Section 5.3.2). (→5-19)



<When -3 dBm is set on channel A.>
<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-31 (c) Reference Measurement Screen

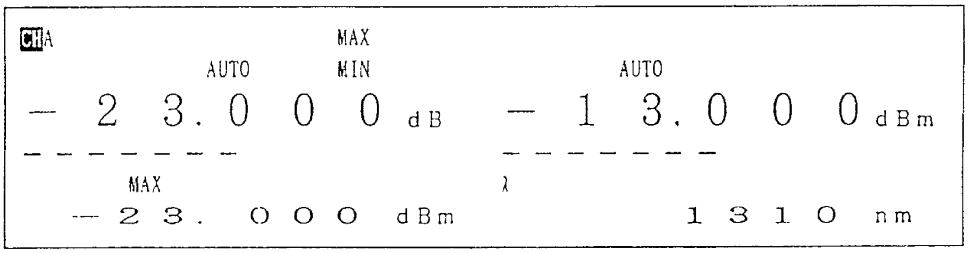
5.4.5 Maximum and minimum value measurement

Operation key	[LOAD]
	MAX MIN

Release key	[SYSTEM]	[PRMTR]	[APPL]
	dBm W	DREF	A/B A/REF

During maximum and minimum value measurement, the 5 × 7-dot display shows the maximum value, minimum value, and differential value of the 7-segment display.
The information of the 7-segment display remains unchanged.

If you press the [MAX MIN] key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-32.
The maximum and minimum values are reset each time the [MAX MIN] key is pressed.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-32 Maximum and Minimum Value Measurement Screen

You can modify the MAX, MIN and DIFF values of the 5 × 7-dot display using the ◁ or ▷ MODIFY keys.

5.4.6 Averaging measurement

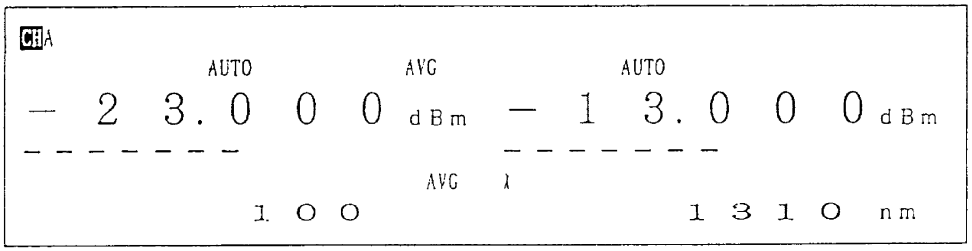
Operation key [λ]
AVG

The AQ2140 uses the sequential addition averaging method. (*1)

To start averaging measurement, press the [AVG] key.
To release it, just press the [AVG] key again.

If you press the [AVG] key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-33. If the averaging count (→ 5-19) is less than your set count, the 7-segment display flashes.

The 5 × 7-dot display shows the averaging count you have set.



<If 100 averaging times are set for channel A>
<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-33 Averaging Measurement Screen

When the averaging measurement is turned on, pressing the [SHIFT] key cancels this measurement mode once. Thus, in this case, if you press the [SHIFT] key again, the sequential additional averaging is resumed, thereby causing the 7-segment indicator to blinking display.

*1 The measured values are sequentially added, and the result is averaged at the certain measurement interval (→ 5-18).
If the averaging count is less than the set count, the measured values up to this point are averaged and displayed.

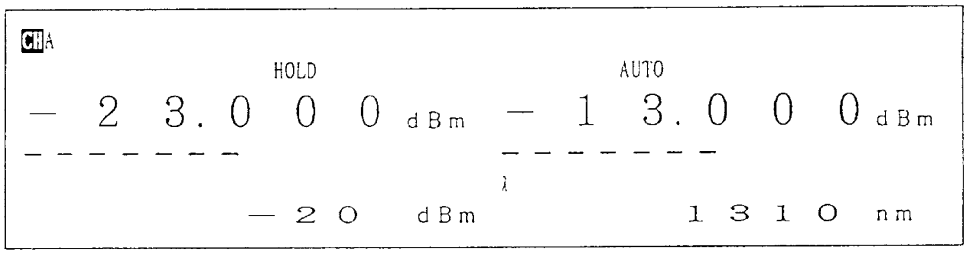
5.4.7 Changing the measurement range

Operation key [RUN/STOP]

RANGE △ ▽

The AQ2140 automatically selects a measurement range based on the incident light.
To manually change the measurement range, press the RANGE key to fix the measurement range.
Then, increase or decrease the range using the △ and ▽ MODIFY keys.

If you press the RANGE key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-34.
Press the RANGE key again to return to the automatic range selection mode.
The 5 × 7-dot display shows the measurement range.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-34 Changing the Measurement Range

If an incident light is out of measurement range during fixed measurement range, the upper limit or lower limit value flashes on the 7-segment display.
During automatic measurement range selection, the same result occurs if the incident light is outside of the power range that is set for each sensor unit.

5.5 Measurement of Sensor Unit, OPM Unit and Sensor

When the Sensor Unit is attached to the AQ2140 Optical Multimeter for optical power measurement, all sensor functions (except for CW/CHOP switching) can be controlled from the AQ2140 (using its key switches). For control details, see Section 5.4 "Operations in Measurement Mode."

⚠ CAUTION

Must keep the input of optical power to sensor and sensor unit within the regulation value. The photosensor may be damaged if optical power beyond regulation value is added.
Precision of the measurement can not be guaranteed if photosensor is damaged.

⚠ CAUTION

Make sure that optical fiber is not pushed inward from the ferrule edge when using the bare fiber adapter.
Further more, be alert for the stress to the fiber when using. Do not pull the optical fiber.

⚠ CAUTION

When using AQ2735 sensor unit, do not attach or detach the optical connector with high optical power (Approx. +20dBm or more) on. It may damage the photosensor and damage may ruin the precision for measurement.
Considering safety, attach and detach the optical connector in the state of "unlit".

NOTE

The AQ2140 requires approximately one hour of heat-up after power-on for high density and low level signal measurement.

NOTE

Set the correct CHOP frequency. If an incorrect frequency is set for CHOP optical signal measurement, no error information is given but the incorrect measurement result may be shown.

NOTE

The CHOP measurement results contains the calibration value of each measurement range and CHOP frequency.
Therefore, the result data may slightly differ from the analog bar display.

NOTE

If the sensor ambient temperature is too high during the low-level CHOP optical signal measurement, a measurement error may occur.
Avoid the high temperature during the low-level CHOP optical signal measurement.

5.6 Optical Output Setup (of Optical Source Unit)

All sensor functions (except for optical output on/off switching and CW/CHOP switching) can be controlled from the AQ2140.
For control details, see Section 5.4 "Operations in Measurement Mode."

NOTE
The AQ2140 requires approximately one hour of heat-up after power-on for high density signal measurement.

NOTE
Use an SPC polished optical fiber for high density measurement by the AQ2140. If an optical fiber having the 40 dB or less reflection attenuation is used, the measurement stability may be dropped. Also, measure the optical signals in the fixed temperature environment.

5.7 Measurement Procedures (of Return-Loss Measurement Unit)

5.7.1 Instruments and tools required for measurement

Table 5-5 Instruments and Tools required for Measurement

	Instrument/Tool	Summary
Mainframe	AQ2140 Optical Multimeter	Optical multimeter itself
Units	AQ7310 Optical Return-Loss Measurement Unit	Optical Return-loss measurement unit
	AQ4211 (131) LD Unit (*1)	1310-nm LD optical source unit
	AQ4211 (155) LD Unit (*1)	1550-nm LD optical source unit
	AQ4213 (131/155) LD Unit (*1)	1310/1550-nm LD optical source unit
Optical fiber cord having master connector (optional)	AQ7310 (FC) Master Cord	SC/APC FC master connector with high-reflection attenuation (50 dB or higher)
	AQ7310 (SC) Master Cord	SC/APC SC master connector with high-reflection attenuation (50 dB or higher)
	AQ7310 (Open) Master Cord	SC/APC open connector (*2)
Others	Connector adapter	Connects the master cord to the fiber being measured.
	2-meter long SM fiber having FC/PC at both ends	Connects the optical source to the AQ2140 optical input.
	The matching oil	Used for no-reflection termination.

*1 An external optical source can also be used. However, if a source unit other than the AQ4211 or AQ4213 unit (or equivalent one) is used, the specifications defined on Table 1-5 (→ 1-14) is not guaranteed.
If the Return-Loss Measurement Unit and an LD unit other than the specified one are attached to the AQ2140 Optical Multimeter, an error is shown on the AQ2140 display.

*2 The customer needs to terminate the open end of the master connector by soldering. To measure the reflection attenuation of a connector whose Fresnel reflection cannot be measured (due to the skew polishing or others), prepare two AQ7310 open master cords.
Solder one of them and use it as the master cord, and use the other one for the Fresnel reflection reference measurement.

5.7.2 Measurement System Configuration

Figures 5-35 (a) and 5-35 (b) show the configuration of measurement system.
The system consists of the AQ7310 Optical Return-Loss Measurement Unit and:

① AQ2140 Optical Multimeter having the AQ4211 (131), AQ4211 (155) and/or AQ4213 (131/155) LD units, or

② An external optical source unit.

① The system consisting of the AQ2140 Optical Multimeter only

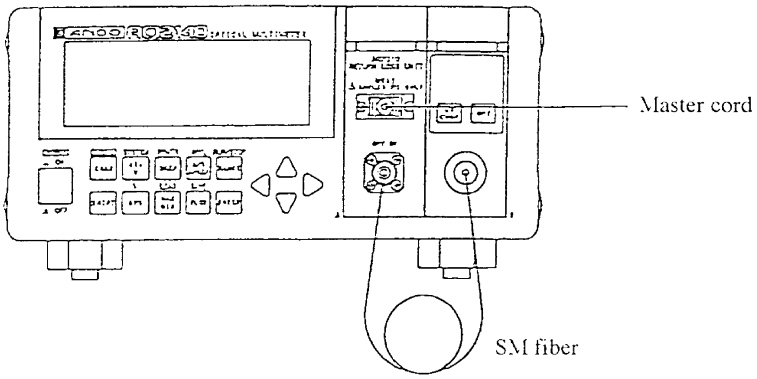


Figure 5-35 (a) Measurement System Configuration 1

② The system consisting of the AQ2140 Optical Multimeter and an external LD Optical Source

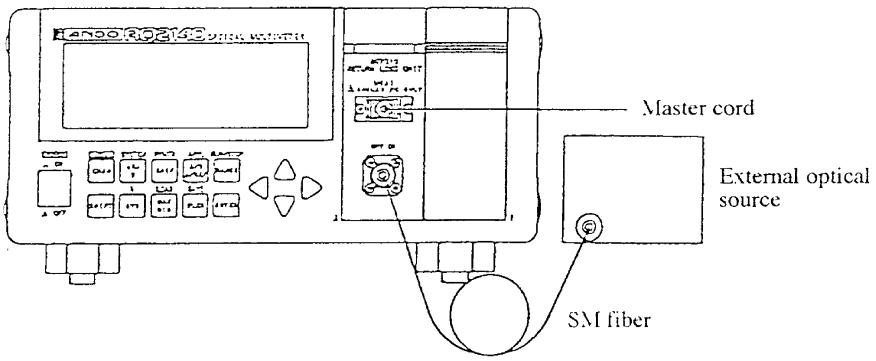


Figure 5-35 (b) Measurement System Configuration 2

The LD optical source is connected to the optical input port of the AQ7310 Return-Loss Measurement Unit by the SM fiber.
Also, the master cord is plugged into the AQ7310 master cord input port.
Use the AQ4211, AQ4213 or an equivalent external optical source unit.

5.7.3 Measurement procedure

(1) System startup

Attach the AQ7310 Return-Loss Measurement Unit to the AQ2140 Optical Multimeter, and turn their POWER switch ON. The screen of Figure 5-36 will appear. (The Unit can be attached to channel A or B. However, the optical source unit or another unit MUST NOT be attached to the remaining channel.)

① Starting the measurement

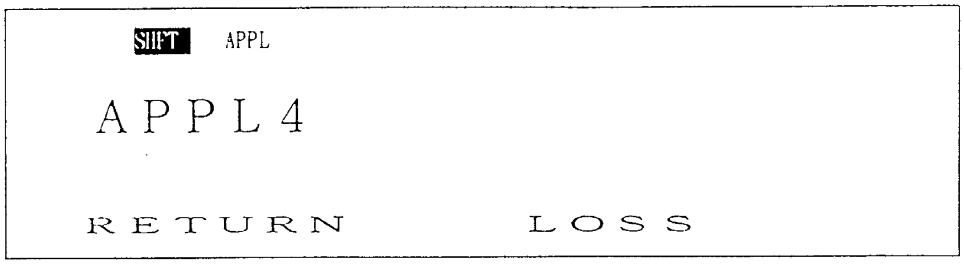


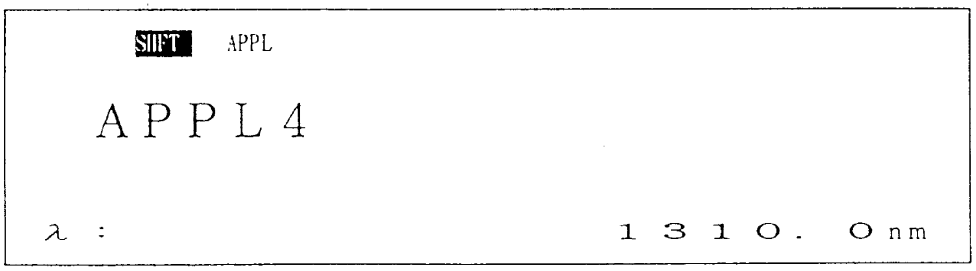
Figure 5-36 Startup Messages

If an LD unit is attached to a single channel, the LD unit is automatically set to the CHOP (270 Hz) mode.
As the optical output is turned OFF, press the [OPT] key on the LD unit to turn it ON. When the optical output is turned ON, its LED lights.
To assure the stable signal measurement, preheat both the AQ2140 Optical Multimeter and the LD unit for one hour (by keeping ON the optical output of LD unit).
When an external light source is used, select the CHOP (270 Hz) before turning on the optical output.

(2) Measuring the wavelength

Press the [ENTER] key, and the screens of Figures 5-37 (a) to 5-37 (c) will appear in sequence.

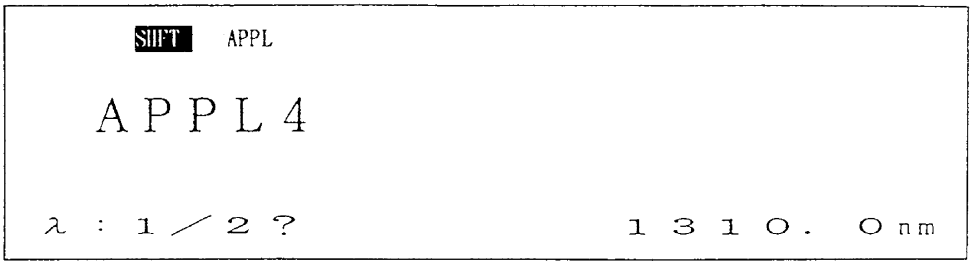
②-1 If an LD optical source (having a single wavelength) is attached to a single channel



<Display example: AQ7310 is attached to channel A, and AQ4211 (131) is attached to channel B.>

Figure 5-37 (a) Wavelength Setup Screen 1

②-2 If an LD optical source (having two wavelengths) is attached to a single channel



<Display example: AQ7310 is attached to channel A, and AQ4213 (131/155) is attached to channel B.>

Figure 5-37 (b) Wavelength Setup Screen 2

Select the wavelength depending on the wavelength of LD optical source using the ◁ or ▷ MODIFY key.

②-3 If an external LD optical source is used

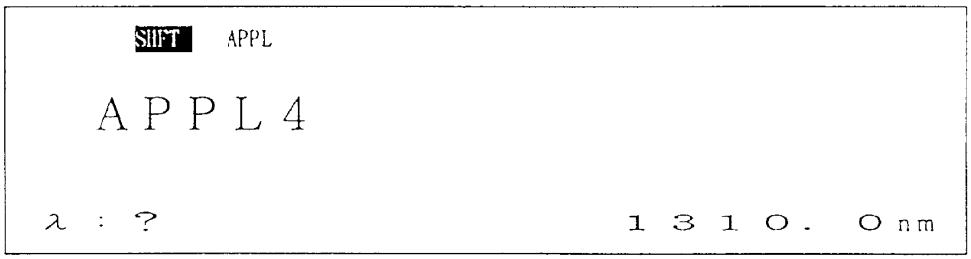


Figure 5-37 (c) Wavelength Setup Screen 3

Set the wavelength depending on the wavelength of external LD optical source.
Increase or decrease the wavelength value using the △ or ▽ MODIFY key.
Change the digit using the ◁ or ▷ MODIFY key.
The wavelength can be set within the range of 1280 to 1600 nm.

(3) Measuring the reference reflection

Press the ENTER key, and the screen of Figure 5-38 will appear.

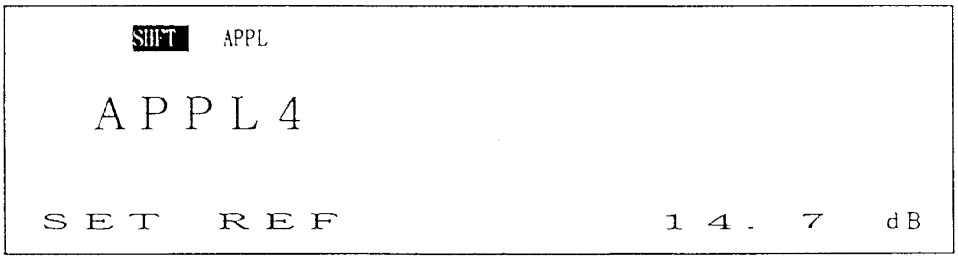
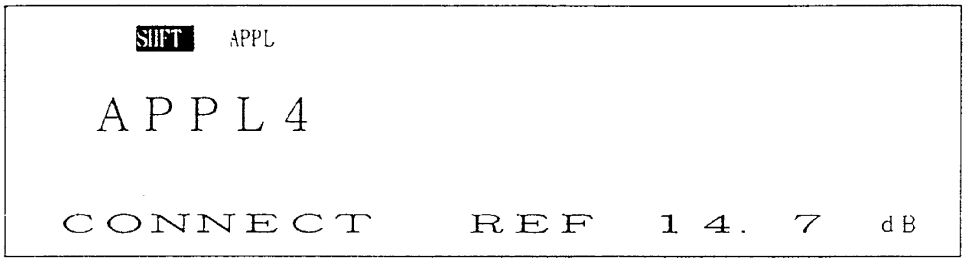


Figure 5-38 Reference Reflection Setup

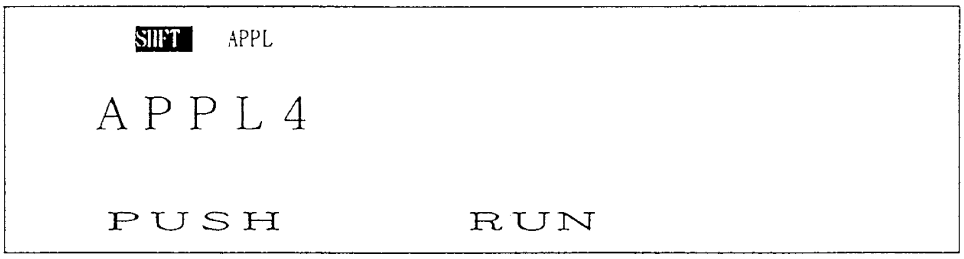
Select the Fresnel Reference Reflection or the Full Reference Reflection mode. Enter 14.7 dB for the Fresnel Reference Reflection, or enter 0.2 dB for the Full Reference Reflection using the △ or▽ MODIFY key.

(4) Checking the reference reflection setup
Press the [ENTER] key, and the screen of Figure 5-39 will appear.

④-1 If 14.7 dB are set for the reference reflection



④-2



④-3

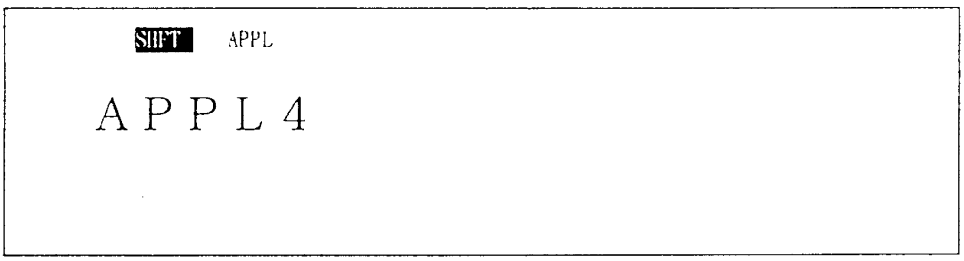


Figure 5-39 Checkout of Reference Reflection Setup

Screens ④-1 to ④-3 repeat sequentially at interval of approximately two seconds until you press the [RUN] key.
Before pressing the [RUN] key, make sure that the SM fiber from the LD source (with optical output ON) is plugged into the optical input port of Return-Loss Measurement Unit.
Also, make sure that the master cord for the AQ7310 is plugged into the master cord input port of Return-Loss Measurement Unit (→ 5-50).

(5) System and parameter setup

If you press the [APPL] key during Steps (1) to (4) above, you can return to initial screen ①. Press the [SYSTEM] key to set up the system, or press the [PRMTR] key to set up the parameters.

⑤-1 System setup

Press the [SYSTEM] key, and the screen of Figure 5-40 will appear.

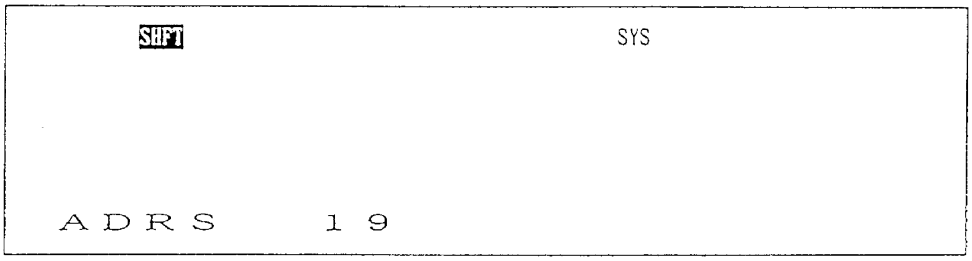


Figure 5-40 System Setup Screen

For the system setup details, see Section 5.3 "Operations during Measurement Mode" (→ 5-17).

⑤-2 Parameter setup

You can change the averaging count by parameter setup.
Press the [PRMTR] key, and the screen of Figure 5-41 will appear.
Modify the averaging count (to 2, 5, 10, 20, 50, 100 or 200 times) using the △ or ▽ MODIFY key. Press the [ENTER] key for setup.
To return to initial screen ①, press the [APPL] key.

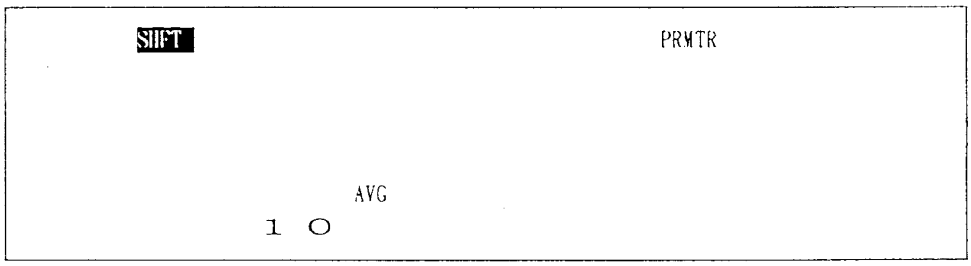


Figure 5-41 Parameter Setup Screen

(6) Measuring the reference reflection

Before pressing the [RUN] key, check the following points.

When you press the [RUN] key in Step ④, the reference reflection measurement starts.

⑥-1 Fresnel reflection (14.7 dB)

Make sure that the AQ7310 master cord (having the same type of master connector as the DUT) has been plugged into the master cord input port of Return-Loss Measurement Unit. Wipe and clean the ferule of master cord end with an alcohol or others. Also, take care not to enter an incident light into the port. Figure 5-42 shows the measurement system.

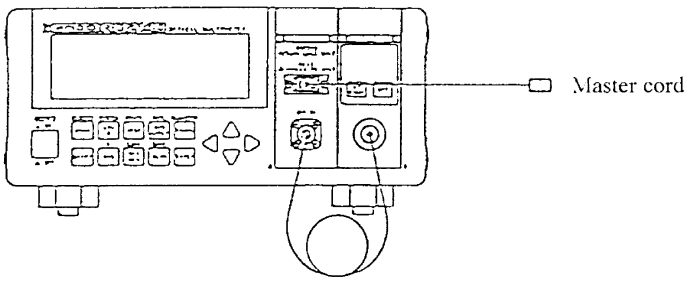


Figure 5-42 Fresnel Reflection Measurement System

⑥-2 Full reflection (0.2 dB)

Make sure that the AQ7310 master cord has been plugged into the master cord input port of Return-Loss Measurement Unit. Also, make sure that the full reflection measurement master cord has been plugged into the master connector via the adapter. Figure 5-43 shows the measurement system.

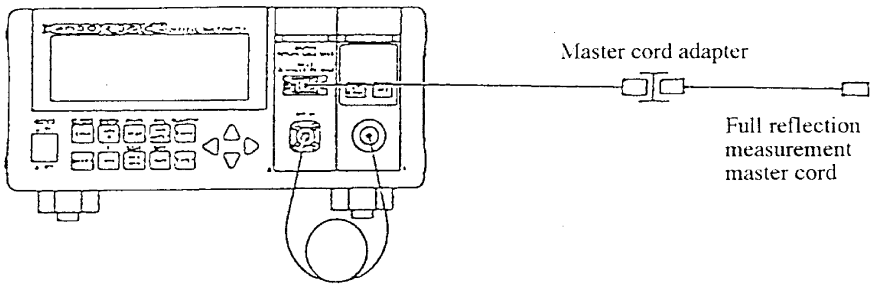


Figure 5-43 Full Reflection Measurement System

When the reference reflection measurement has completed, the screen of Figure 5-44 appears.

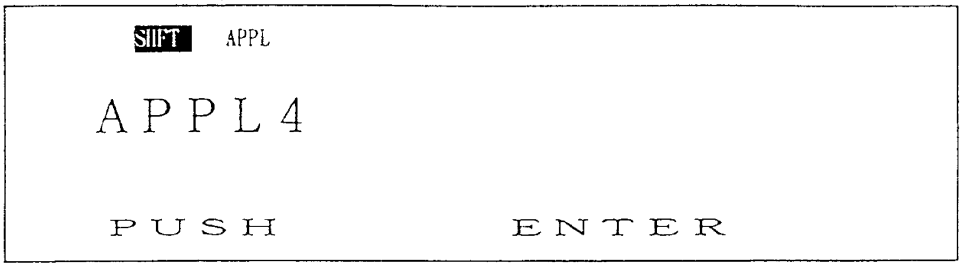
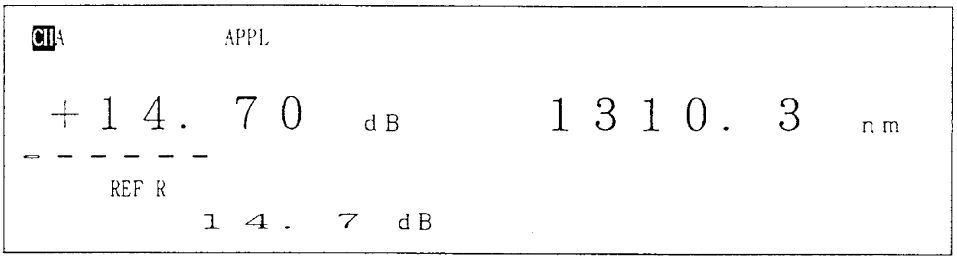


Figure 5-44 Completion of Reference Reflection Measurement

(7) Checking the reference reflection measurement
Press the [ENTER] key in Step ⑥, and the screen of Figures 5-45 and 5-46 will appear.

⑦-1 Fresnel reference reflection measurement

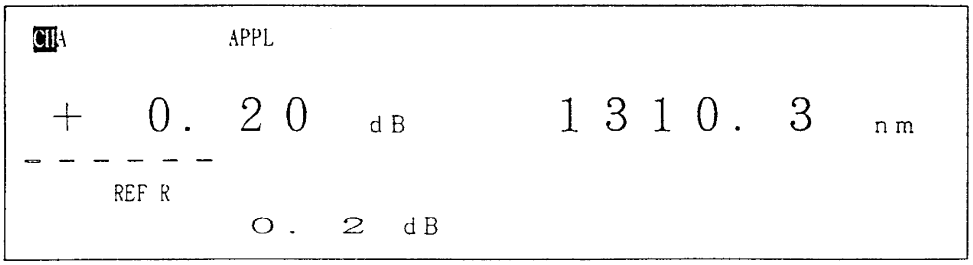


<Display example: If AQ7310 is attached to channel A, and if AQ4211 (131) is attached to channel B. >

Figure 5-45 Fresnel Reflection Measurement Screen

Message "REF R 14.7 dB" at the bottom indicates the Fresnel reference reflection (at 14.7 dB). The value shown at top is the measured value of reflection attenuation. Approximately 14.7 dB is shown in this example. If it is outside of 14.7 ± 0.02 dB, press the [A/B A/REF] key and make sure that the reflection attenuation enters within 14.7 ± 0.02 dB.

⑦-2 Full reference reflection measurement



<Display example: If AQ7310 is attached to channel A, and if AQ4211 (131) is attached to channel B. >

Figure 5-46 Full Reflection Measurement Screen

Message "REF R 0.2 dB" at the bottom indicates the full reference reflection (at 0.2 dB). The value shown at top is the measured value of reflection attenuation.
Approximately 0.2 dB is shown in this example.
If it is outside of 0.2 ± 0.02 dB, press the [A/B A/REF] key and make sure that the reflection attenuation enters within 0.2 ± 0.02 dB.

NOTE

The [A/B A/REF] key can be used for reference reflection measurement for the AQ7310 Optical Return-Loss Measurement Unit.

If the reflection attenuation does not enter within 0.2 ±0.02 dB even when you repeat pressing the [A/B A/REF] key, the LD optical source may be unstable or the optical fiber connector and plug may be contaminated by dusts or others.

Make sure that the AQ4211, AQ4213 or equivalent LD optical source is used.
Also, wipe and clean the fiber contacts with an alcohol or others.
If the reflection attenuation does not enter within 0.2 ± 0.02, the Return-Loss Measurement Unit may have failed. Call the service.

(8) DUT setup

After the reference reflection measurement has completed and if the reference value (14.7 dB for Fresnel reference reflection or 0.2 dB for full reference reflection) roughly matches the measured value, plug the master cord into the device under test (DUT).

⑧-1 Fresnel reference reflection

Plug the DUT signal cable into the mater connector of AQ7310 master cord input port (via the adapter). Terminate the other end of DUT signal cable to make no reflection. Figure 5-47 shows the DUT setup.

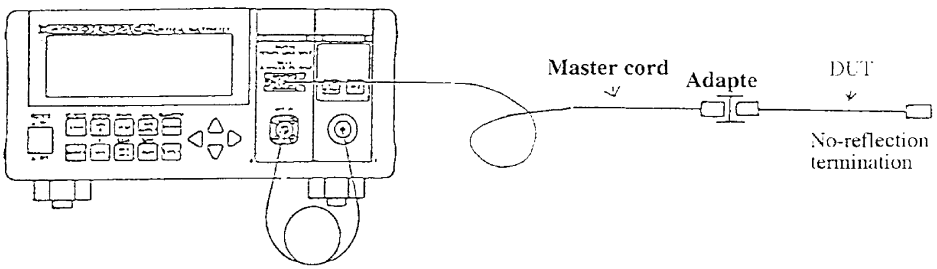


Figure 5-47 DUT Setup

⑧-2 Full reference reflection

Unplug the AQ7310 master cord from the master cord input port of Return-Loss Measurement Unit. Also, unplug the full reflection master cord.
(If the same type of DUT connector and master cord connector are used, unplug the full reflection master cord only.)
Connect the cables as shown in Figure 5-43.

(9) Measuring the reflection attenuation

After the DUT setup of Step (8) has completed, the reflection attenuation is shown on the screen.

(10) Key operations during measurement

You can use the following keys during reflection attenuation measurement.

- [DREF] key : Shows the Display Reference.
- [MAX MIN] : Shows the maximum value, minimum value, and the difference between them. The maximum value is shown at the bottom of the screen. You can switch the value display using the △ or ▷ MODIFY key.
- [AVG] key : Turns the averaging ON or OFF with the averaging count set by the parameter.
- [BLKG] key : Changes the display digits. Up to one to three decimal digits can be changed by each press.
- [dBm W] key : Releases the Display Reference and MAX/MIN setup.

⚠ CAUTION
The [A/B A/REF] key is used for the reference reflection measurement. Do not press it during reflection attenuation measurement.

⑩-1 System and parameter setup

When you press the [SHIFT] key during measurement of reflection attenuation, you can return to initial screen ① (→ 5-46).

Press the [SYSTEM] key to set the system, and press the [PRMTR] key to set the parameters.

When you press the [SHIFT] key again, you can return to the reflection attenuation measurement screen.

⚠ CAUTION
1. When the sensor unit or OPM unit is connected following the optical return loss measurement, the display format ([BLKG]) used in the measurement will be employed for displaying the first value obtained from the sensor or OPM unit. For example, when the format "xx.xx" has been employed in the optical loss measurement, the first measurement will be indicated with the same format.
2. When frequency of the light reflected by a DUT is not identical with that of CHOP (270 Hz) or when the light reflected by a DUT contains large volume of optical noise, Err 13 (→ 5-56) may be warned. Thus, before starting the operation, make sure that frequency of the light reflected by a DUT coincides with that of CHOP (270 Hz).

5.8 Error Messages

If your operating conditions are incorrect, the AQ2140 displays error messages that are listed on Table 5-6. If it has occurred, locate the error cause and take an appropriate action. For the GPIB error codes and formats, see Section 5.9 "GPIB."

NOTE
If light with a different frequency is entered to the AQ2140 while CHOP light measurement is taking place, "ERR13" (on the display) or "ERROR 7" (GP-IB error code) is displayed. Depending type of the incident light, however, above error information may not be indicated. Before starting your measurement, make sure that frequency of the incident light is identical with that of CHOP.

Table 5-6 Error Messages

No.	Error Code	GPIB Code	Explanation	Actions Taken
1	ERR01		RAM error of AQ2140	Call the service to repair your AQ2140.
2	ERR02		Expired service life of backup battery	Replace the backup battery with a new one. Consult to our agency. Press the [ENTER] key to release the error display and restart the Multimeter. (However, the data CANNOT be backed up.)
3	ERR03		Unit RAM error	Call the service to repair the unit.
4	ERR04		Disconnected sensor(s)	Connect the sensor(s) to the AQ2140 securely.
5	ERR05		Unit mounting error	An illegal unit has been connected to the AQ2140. Check the unit.
6	ERR06		A recalled (loaded) wavelength is outside the sensor operating range.	The parameter data being saved is inappropriate. You need to specify the conditions including wavelengths anew.
7	ERR11		Unit other than the light source was removed when operating.	Turn the AQ2140 power switch OFF first, then turn it ON again.
8		2	An invalid program code was received.	Check the program code.
9		3	The result has exceeded the display limit.	Check the REF and DREF values.
10		4	Wavelength measurement exceeding the unit limit was attempted.	Check the unit wavelength range.
11	ERR12	5	Abnormal end of Zero Set	Check the shield of sensor inputs and execute Zero Set again.
12		6	Too many codes were received. 129 bytes or longer including the delimiters (CR and LF).	
13	ERR13	7	The input frequency does not match the specified CHOP frequency.	Set the correct optical modulation frequency (mode).
14		8	There is a conflict between the type of unit used (sensor or light source) and output data setup (5-78).	Conduct modification on the target channel of control or the output data setup so that the conflict may be eliminated.

5.9 Control via GPIB Interface (IEEE-488.1 Standards)

Your AQ2140 has the built-in GPIB interface to control each parameter setup, parameter modification, and data transmission and reception via the GPIB interface bus.
The AQ2140 uses an IEEE-488 standard, receptacle-type connector for signal interfacing.

⚠ CAUTION
Turn the ([POWER]) switch [■ OFF] before connecting or disconnecting the GPIB interface cable.

⚠ CAUTION
When you turns the power switch ON, the AQ2140 executes the lamp test and memory test. During this time (approximately 10 seconds), the AQ2140 cannot accept the GPIB program codes.

⚠ CAUTION
Select the Measurement mode for GPIB control. If you select the setup mode, a malfunctioning can result. Note that if you change a setting manually while control from the GP-IB is turned on, the modification may not be recognized.

5.9.1 Interface functions

Table 5-7 GPIB Interface Functions

Function	Explanation
SH1	Source handshaking full functions
AH1	Acceptor handshaking full functions
T7	Talker function
L4	Listener function
SR1	Service request
RL1	Remote/local control
PP0	No parallel polling
DC1	Device clear
DT1	Device trigger
C0	No control functions
E1	Open collector driver

5.9.2 Explanation of basic functions

(1) GPIB address

You can change the GPIB address of your AQ2140 in the Parameter Setup mode (→ 5-18). The new address is valid immediately after you have changed it.
The setup address is kept by the battery. However, when the backup battery has expired or when the backup data is erased, the address data is lost and the GPIB address is reset to the initial setup.
The initial GPIB address is "19".

(2) Local mode

When you control your AQ2140 from its operation keys, the Multimeter is in the Local mode. During this time, all operation keys are valid.

(3) Remote mode

When you control your AQ2140 from another controller via the GPIB interface bus, the Multimeter is in the Remote mode. During this time, all operation keys (except [LOCAL] key) are invalid.
During Remote mode, the RMT lamp continues to light at the right upper end of the screen.

(4) LLO (Local Lockout)

When receiving the "LLO" universal command during Remote mode, the AQ2140 enters the LLO mode. During this time, all operation keys (including the [LOCAL] key) are invalid. To release this mode, use the REN (Remote Enable) command.

(5) DCL (Device Clear)

When receiving the "DCL" universal command or "SDC" address command during Remote mode, the AQ2140 initializes the parameters listed on Table 5-6.

⚠ CAUTION

Device clear will be rejected when the Zero Set is turned on. The controller may stop handshaking if various commands, program codes or others are executed immediately after DCL command. To prevent it, set a 100 msec waiting immediately after the DCL.

(6) GET (Group Trigger)

When receiving the "GET" address command during Remote mode, the AQ2140 starts a single-time measurement.

(7) The operating range supported in Remote mode

The AQ2140 supports the remote operations which are similar to those available in the manual operations. For details, see Section 5.9.3 "Program codes." (→ 5-60)

(8) Send/receive buffer

The AQ2140 has a 128-byte (including the control codes such as CR and LF as well as ",") send/receive buffer.

Table 5-8 Parameters Initialized by Device Clear

Parameter	Initial value	Application
Service request	Full masking	
Measurement unit	dBm	Sensor
Range setup	Auto range	Sensor
Averaging	Off	Sensor or Return loss
Display resolution	1/1000	Sensor or Return loss
Measurement interval	100 msec	Sensor or Return loss
Calibration value	0.000 dB	Sensor
Reference value	0.000 dBm	Sensor
Optical modulation mode	CW	Sensor or Light Source
Optical output	Off	Light Source
Optical attenuation	0.0 dB	Light Source
Measurement	Continuous measurement	Sensor
Output data setup	Measurement data	

5.9.3 Program codes

The GPIB program codes of the AQ2140 Optical Multimeter are listed on Table 5-9.
However, some of them does not function for some unit types and measurement parameters used.
When using the AQ2141 Optical Multimeter Expansion Unit, refer to its instruction manual.

⚠ CAUTION
As the AQ2140 performance has been increased, the program codes developed for the conventional AQ-2105B and other models have been partially modified. Take care the code modification when reusing the program of the conventional models.

Table 5-9 GPIB Program Codes (1/5)

*1 Control Channel: Display setup
*2 Scope: I=Sensor unit, II=Optical source unit, III=Common

Function	Explanation	Program Code	Control Channel (*1)	Scope (*2)	Note
Service request	Full mask Separate mask	I0 I1 to I9, IA to IF	Not required	–	1
Channel and DUT setup	A and B A B	C0 or C3 C1 C2	–	III	3
Unit	W dBm Display reference measurement (DREF)	FA FB FC	Required	I	
Relative measurement	Comparison between display units A/B Comparison between display units B/A Reference measurement A/REF Reference measurement B/REF	FD1 FD2 or FD FF1 FF2	Not required	I	
Display resolution	1/1000 1/100 1/10	B0 B1 B2	Required	I	16
Measure-ment	Single time measurement Continuous measurement	S or GET Trigger F	Required	I	11
MAX/MIN measurement	Clear of maximum/minimum measurement Start of maximum/minimum measurement	H0 H1	Required	I	4
Channel display	The channel is displayed on the 5 × 7 dots indicator unit.	CH	Required	III	
Measure-ment interval	10 msec 20 msec 50 msec 100 msec 200 msec	TA7 TA8 TA9 TAA TAB	Not required	–	8

Table 5-9 GPIB Program Codes (2/5)

*1 Control Channel: Display setup

*2 Scope: I=Sensor unit, II=Optical source unit, III=Common

Function	Explanation	Program Code	Control Channel (*1)	Scope (*2)	Note
Range setup	AUTO	RA	Required	I	5
	+30 dBm (1 W)	RC			
	+20 dBm (100 mW)	RD			
	+10 dBm (10 mW)	RE			
	+ 0 dBm (1 mW)	RF			
	−10 dBm (100 μW)	RG			
	−20 dBm (10 μW)	RH			
	−30 dBm (1 μW)	RI			
	−40 dBm (100 nW)	RJ			
	−50 dBm (10 nW)	RK			
	−60 dBm (1 nW)	RL			
	−70 dBm (100 pW)	RM			
	−80 dBm (10 pW)	RN			
	Hold the present range.	RO			
		RZ			
Averaging (AVG)	1 (OFF)	AA	Required	I	7
	2	AB			
	5	AC			
	10	AD			
	20	AE			
	50	AF			
	100	AG			
	200	AH			
Zero Set	ON (Single zero adjustment)	Z	Required	I	6
Optical modulation mode	CW	MO0 or C	Required	III	
	270 Hz	MO1 or P			
	1 kHz	MO2			
	2 kHz	MO3			
Reference value (REF)	dBm= ± × × × . × × ×	R± × × × . × × × DB	Required	I	12
	W= × . × × ×	R+ × . × × × W			13
	mW= × × × . × × ×	R+ × × × . × × × MW			
	μW= × × × . × × ×	R+ × × × . × × × UW			
	nW= × × × . × × ×	R+ × × × . × × × NW			
	pW= × × × . × × ×	R+ × × × . × × PW			
Calibration wavelength (λ)	WL= × × × × nm	W × × × ×	Required	I	

Table 5-9 GPIB Program Codes (3/5)

*1 Control Channel: Display setup

*2 Scope: I=Sensor unit, II=Optical source unit, III=Common

Function	Explanation	Program Code	Control Channel (*1)	Scope (*2)	Note
Calibration value (CAL F)	dB= ±×××.×××	D±×××.×××	Required	I	13
Calibration coefficient	K= ×.××E±×	K= ×.××E±×	Required	I	12 13
Beep tone	1 to 16 tones	TO××	Not required	–	
Beep volume	0 to 4 levels	VO××	Not required	–	
Display brightness	1 to 4 levels	BR××	Not required	–	
Output data setup (sensor)	Measurement data A&B Measurement data A Measurement data B Parameter A Parameter B Reference value A&B Reference value A Reference value B MAX/MIN value A&B MAX/MIN value A MAX/MIN value B Difference between maximum and minimum values A&B A B	OD0 or OD3 OD1 OD2 OS1 OS2 FR0 or FR3 FR1 FR2 HD0/MAX/MIN HD1/MAX/MIN HD2/MAX/MIN HD0/DIFF or HD3/DIFF HD1/DIFF HD2/DIFF	Not required	I	10
Delimiter setup for data output	[CR]+[LF]+EOI (Default), or EOI only	CMD/DELIM0 CMD/DELIM1	Not required	III	17
Optical output	OFF ON	O0 O1	Required	II	
Optical attenuation (ATT)	0.0 to 6.0 dB ATT Clear (=ALT0.0)	ATL ×.× ATC	Required	II	
Optical source selection (for dual sources)	λ = 1 λ = 2 λ = 1 and 2	WL1 WL2 WL3	Required	II	
Output data setup (optical source)	Parameter A Parameter B	LSS1 LSS2	Not required	II	

Table 5-9 GPIB Program Codes (4/5)

*1 Control Channel: Display setup

*2 Scope: I=Sensor unit, II=Optical source unit, III=Common

Function	Explanation	Program Code	Control Channel (*1)	Scope (*2)	Note
Setup of data storage title	"x" represents the DUT. (1=A, 2=B) "□□□□□□□□" represents the title (up to eight alphanumeric characters).	OMx/TITLE/ □□□□□□□□	Not required	I	
Storage time setup	hh: Hours (0 to 99) mm: Minutes (0 to 59) ss: Seconds (0 to 59)	OM/TIME/hhmmss	Not required	I	
Start of data storage	"x" represents the DUT. (0=A&B, 1=A, 2=B)	OMx/START	Not required	I	9
Forcible termination of data storage		OM/STOP	Not required	I	9
MAX/MIN value of storage data	"x" represents the DUT. 0=A&B 1=A 2=B	OMx/MAX/MIN	Not required	I	
Difference between the maximum and minimum values of storage data		OMx/DIFF	Not required	I	
Get the average of storage data		OMx/AVG	Not required	I	
Get the title of storage data		OMx/TITLE	Not required	I	14 15
Get the time of data storage		OMx/TIME	Not required	I	14 15
Get the total count of storage data		OMx/NUM	Not required	I	14 15

Table 5-9 GPIB Program Codes (5/5)

*1 Control Channel: Display setup

*2 Scope: I=Sensor unit, II=Optical source unit, III=Common

Function	Explanation	Program Code	Control Channel (*1)	Scope (*2)	Note
Get the storage data	"x" represents the DUT. (1=A, 2=B) "ΔΔΔΔ" is the start address to be retrieved. "□□□□" is the end address to be retrieved. (Example: Specify as "OM1/1/10" for acquiring data between the 1st point and 10th point on CH A.)	OMx/ΔΔΔΔ/□□□□/	Not required	I	14
Get the calibration wavelength of storage data	"x" represents the DUT. (0:A&B, 1:A, 2:B)	OMx/WL	Not required	I	14 15

NOTE 1: An "SRQ" (Service Request) occurs during the following:

① TEST ERROR
The Zero Set (zero-adjustment) has failed.

② TEST END
The Zero Set (zero-adjustment) has terminated normally.
When the data storage is interrupted.

③ ERROR
An error (Refer to the GP-IB error code field in Table 5-6) has occurred.

④ DATA READY
The data is ready to send after the OD command reception.

The SRQ status byte (STB) has the following format:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
×	RQS	×	×	Test Error	Test End	Error	Data Ready

- RQS
  Bits 0 to 3 go high (logical 1) when masked, and to high (logical 1) when set.
- Error
  Set to logical 1 when Zero Set has failed.
- Test End
  Set to logical 1 when Zero Set has terminated normally.
  Or, set to logical 1 when the data storage is ended or interrupted.
- Program Error
  Set to logical 1 when an error (Refer to the GP-IB error code field in Table 5-6) has occurred.
- Data Ready
  Set to logical 1 when the data is ready to send.

The service request function can be masked for each cause. The binary value of program codes 1 to 9 and A to F correspond to STB bits 3 to 0. The logical 1 bit is valid, but the logical 0 bit is invalid.
During continuous measurement (GP-IB program code: F), DATA READY must be masked.

Example: Program code I5
Decimal value "5" is equal to binary value "0101". Bit 2 and bit 0 are valid, but bit 3 and bit 1 are invalid.
Therefore, when a Test End or a Data Ready occurs, a service request is issued to the controller. However, when a Test Error or an Error occurs, no service request is issued to the controller.

Example: Program code IF
Decimal value "F" is equal to binary value "1111". All bits are valid. When TEST ERROR (bit 3) or TEST END (bit 2) is warned, the service request is issued only one time. When ERROR (bit 1) is warned, the service request is issued one time minimum and continued until the cause is eliminated. When the service request is issued, the controller reads the status byte and it is cleared.
In the case of Program code I0, no service request is issued. The bit information, however, is unstable when the controller reads the status byte.

When the mask conditions of service request are changed, the status byte is cleared.
If a service request is issued to the controller, this request is canceled.

Example: If a service request is set by program code I1 and if a Data Ready has occurred:
Bit 0 and bit 6 are set to logical 1, and a service request is issued to the controller. If this service request is ignored and if program code I2 is set, bit 0 and bit 6 are cleared. Therefore, the STB is set to 0 and the service request is canceled simultaneously.

NOTE 3: Your channel setup is held until the nest setup. You need not repeat to set for the same channel. However, you must set the channel when changing to another channel.

NOTE 4: If an "H1" code is received again during MAX or MIN measurement, the specified MAX/MIN value is reset. When the MAX/MIN data output command ("HDx/MAX/MIN") is received, the MAX/MIN data is sent to the controller and the MAX/MIN value is reset.
If the MAX/MIN data output command is received although the MAX/MIN measurement is not executed, the "W" unit and "000.000" data are sent.
The output data format of MAX/MIN values is the same as the two-channel data output of OD command. The first data is the maximum value and the second data is the minimum value. Both data of the output channel are identical.

Example: If the HD1/MIX/MIN program code is used:
Both data of the output channel are "A". The first data indicates the maximum value of channel A, and the second data indicates the minimum value of channel A.

NOTE 5: The range setup usually takes approximately 500 msec.
Also, the measurement may be unstable immediately after this setup.
To prevent such problems, perform a dummy measurement using "S" code or others at least one time after range setup.
Then, start the normal measurement.

NOTE 6: If Zero Set Error occurs when bit 1 of the service request is not masked, this request will be continued for approximately 3 seconds.
When you have executed the zero set connecting two or more sensor units to the AQ2141 optical multi-meter expansion frame, SRQ to be sent at the end of the zero set will be transmitted when all the currently turned on zero sets are completed.

NOTE 7: The averaging processing uses the sequential addition averaging method (→ 5-9).
Therefore, the measured data immediately after the averaging has turned ON are not averaged sufficiently.

NOTE 8: If two sensor units are connected to your AQ2140, the minimum measurement interval is set to 20 msec. Therefore, the "TA7" setup is made invalid.
If only a single Sensor Unit is connected to the AQ2140, the minimum measurement interval is set to 10 msec and the "TA8" setup is made invalid.
If a sensor unit is mounted on the AQ2141 Optical Multimeter Expansion Frame when it is used, the measurement interval is fixed to 200 msec.

NOTE 9: Use the following basic rules for GPIB data storage.

1. After you have entered the "OMx/START" command, wait one or more second before entering the GPIB disable command (such as "END" in BASIC).
2. If the "OM1/START" command is received when channel A is in STOR mode, the data storage (STOR) of channel A is repeated from the beginning.
3. When data of channel A is separately stored, the storage data of channel B is kept in memory.
   Note, however, that in the channel-to-channel measurement (A/B or B/A), data on CH A and CH B are overwritten.
4. If the "OM1/START" command is received when both channels A and B are in STOR mode, the data storage (STOR) of both channels is forcibly terminated.
5. When data is being stored (that is, when the sufficient storage time is not passed after issue of "OMx/START" command), no command except for "OMx/START" or "OM/STOP" is accepted.

NOTE 10: Data acquirable with the commands "FR0", "FR1", "FR2" and "FR3" are as shown below. For description of each measurement, refer to page 5-37.

- When the relative value measurement is not turned on, the reference value (REF) of the unit parameter is acquired.
- When the display reference measurement is not turned on, the reference value of this measurement is acquired.
- When the channel-to-channel measurement is not turned on, measurement value on another channel, which is to be used as the reference value, is acquired.
- When the reference measurement is turned on, the reference value (REF) of the unit parameter is acquired.

NOTE 11: After every measurement done by use of the "S", "GET", "Trigger" command or device trigger, it is required to enter the PC data once immediately after issuing a command (see the sample program). If this operation is ignored, malfunctioning can result.

(Sample program)

When Controller 9816 by HP is used:

```
10 OUTPUT 719; "S"        ; One mesurement, address = 19
20 ENTER 719 ; Inp$       ; Data input
30 END
```

NOTE 12: When specifying a reference value (REF) or calibration factor (CAL F), a value not exactly identical with the entered value may be set up. It results from error in the value conversion process.
An example: If you enter "R+9.99 MW", "9.9899 mW" will be set as the resulting reference value (REF).

NOTE 13: Depending on the values specified for the reference value (REF), calibration value (CAL F) and calibration factor (CAL F), a measurement may not be contained in the displayable range. In this case, data entered to the controller is recognized as error data (ERROR 3) (→ 5-78).

NOTE 14: When data is sent after this program has been entered, the data setup before entering the program is restored. For instance, if you send "TITLE data" after entering "OM1/TITLE", setup of "OD1" (for example) being used before entering the program will be restored.

NOTE 15: If another program code for the output data setup is entered after entering this program and before sending the data, currently specified output data setup will be canceled.
For example, If you enter "C1" after entering "OM1/TITLE", "OD1" will be restored when "OD1" is the setup being used prior to entry of the program.

NOTE 16: Each of "B0", "B1" and "B2" commands displays value in the following manner depending on the unit selected.

	When dBm or dB is selected	When W and unit are not specified
B0	1/1000	6 digits including a decimal point.
B1	1/100	5 digits including a decimal point.
B2	1/10	4 digits including a decimal point.

NOTE 17: If "EOI alone" is selected for the delimiter, correct GP-IB operation may not be implemented depending on the controller's control timing. This error is more probable when the controller checks "EOI" only after obtaining data. On the contrary, there won't be problem when the controller checks "EOI" before obtaining data.

5.9.4 Precaution on programming

1. Observe the following precautions when inputting measured data to your controller (PC, etc.).
   If ranges are switched during measurement using the auto range (RA) function, overshooting or undershooting may occur immediately after switching. Note that measurement errors become larger if overshot or undershot data are input before being converged.
   For accurate measurement, read the range switching information (refer to statuses in "Output formats") when inputting measured data, wait for a while if the ranges are being switched ("R" status) and re-enter data. Although a typical waiting period is between 1.2 to 1.5 seconds, checking is recommended since the time differs depending on the equipment used.
   By setting a waiting time appropriate for the program being created, the shortest measurement time for your system can be achieved.

(Sample program)

When Controller 9816 by HP is used:

```
10 OUTPUT 719; "OD1"              ; Requests Ach measured data.
20 ENTER 719; Inp$                ; Data input, address = 19
30 IF Inp$ [2, 2] ="R" THEN       ; If ranges are being switched,
40    WAIT 1, 2                   ;Wait for 1.2 sec.
50    ENTER 719 ; Inp$            ;Data input
60 END IF                         ;
70 Data = VAL (Inp$ [7, 14])      ; Data determined
80 END
```

5.9.5 Programming rules

a. The program codes can be sent with together when connected to each other by a comma (,).
When, however, the program codes for the optical modulation mode ("MO0", "MO1", "MO2", "MO3", "C" or "P") and the program code for the range setup ("RZ") are connected with ",", "RZ" may not function.

b. The total number of characters except blanks (but including CR, LF and ",") is 128 characters.

c. Delimiter from the controller side is CR + LF + [EOI], CR + LF, LF or [EOI].
Delimiter from the AQ2140 is CR + LF + [EOI] or [EOI] alone (you can select either of them using CMD/DELIM0 or CMD/DELIM1).

d. The channel setup is held until the next setup.

e. Unnecessary zeros (0s) may be omitted in the numerical input section of codes (such as "× ×. × × ×").
Example: For "D+001.000DB" input:
Simply enter "D+1DB".

f. Calibration wavelength "W × × × ×" cannot exceed the range set by the specifications.

g. The correction values can be entered within the following ranges:
−199.999 dB to +199.999 dB (or dBm)
0.010 pW to 1.000 W

h. If you use a digit longer than that used for the program codes shown in Table 5-9, the value you specified may not be set up.
For example, when R±xxx.xxxDB is indicated in Table 5-9:
R+10.0008DB is not correct.
R+10.000DB is correct.

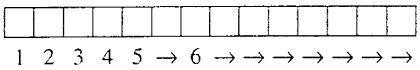
I. In the optical return loss measurement, normal operation of the GP-IB is available only from the measurement data display screen (see Figures 5-45 and 5-46).

5.9.6 Output formats

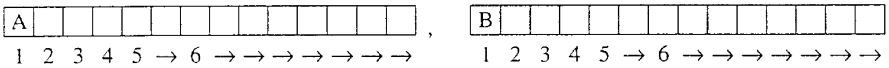
The output data ends with the CR, LF+[EOI], or [EOI] control code.

(1) If the output data is OD, FR, OMx/ΔΔΔΔ/❑❑❑❑ OMx/AVG, OMx/DIFF, HDx/DIFF:

Single-channel data output format



Two-channel data output format



In case of OMx/ΔΔΔΔ/❑❑❑❑ commandm, specified data is output continuously, being divided by ".".

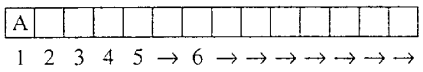
Table 5-10 GPIB Data Output Formats (1/4)

1	Output channel	A: Channel A B: Channel B
2	Status	Z: During Zero Set I: Within the range U: Under range O: Over range R: During range change C: Reference value (during FR command)
3	Function information	1: W 2: W-REF (or W-DREF) 3: W-A/B (or W-B/A) A: dBm B: dBm-REF (or dBm- DREF) C: dBm-A/B (or dBm-B/A)
4	Measurement unit	O: W P: mW Q: μW R: nW S: pW U: dBm V: dB W: No measurement unit
5	Range information	Same as the program code
6	Data	Signed 8-digit output (Independent of the program codes "B0", "B1" or "B2".)

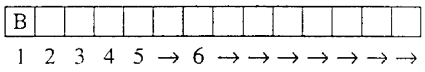
(2) If the output data is HDx, OMx/MAX/MIN command :

Single-channel data output format

MAX value

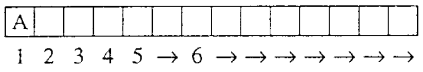


MIN value

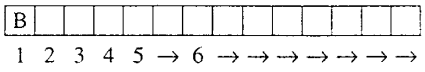


Two-channel data output format

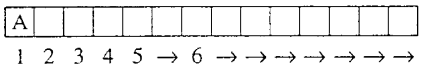
MAX value(Channel A)



MIN value(Channel A)



MAX value(Channel B)



MIN value(Channel B)

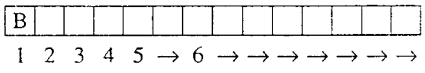


Table 5-10 GPIB Data Output Formats (2/4)

1	Output channel	A: Channel A B: Channel B
2	Status	Z: During Zero Set I: Within the range U: Under range O: Over range R: During range change
3	Function information	1: W 2: W-REF (or W-DREF) 3: W-A/B (or W-B/A) A: dBm B: dBm-REF (or dBm- DREF) C: dBm-A/B (or dBm-B/A)
4	Measurement unit	O: W P: mW Q: μW R: nW S: pW U: dBm V: dB W: No measurement unit
5	Range information	Same as the program code
6	Data	Signed 8-digit output

(3) If the output data is OS command:

Data output format

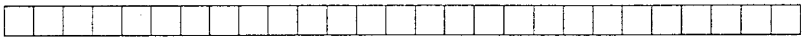


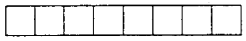
Table 5-10 GPIB Data Output Formats (3/4)

1	Output channel	A: Channel A B: Channel B
2	Channel specified	Same as the program code
3	Optical signal format	C: CW P: 270 Hz Q: 1 kHz R: 2 kHz
4	Function information	F1: W F2: W-REF (or W-DREF) F3: W-A/B (or W-B/A) FA: dBm FB: dBm-REF (or dBm- DREF) FC: dBm-A/B (or dBm-B/A)
5	Averaging	Same as the program code
6	Calibration wavelength	Same as above
7	Correction value	Same as above
8	Measurement interval	Same as above
9	Range information	Same as above

(4) If the output data is OMz/TITLE command:

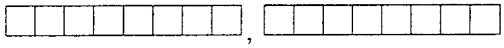
Single-channel data output format

Title



Two-channel data output format

Title (CH A) Tittle (CH B)



Sequentially displayed from the top.

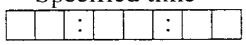
Example: When the title is "AB", "AB _ _ _ _ _ _"

"_" is a space.

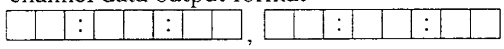
(5) If the output data is MOx/TIME command

Single-channel data output format

Specified time



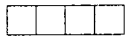
Two-channel data output format



(6) If the output data is OMx/NUM command

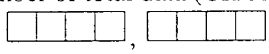
Single-channel data output format

Number of total data



Two-channel data output format

Number of total data (CH A) Number of total data (CH B)

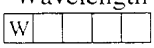


When, however, when up to 4 characters are permitted and "100" is specified for number of total data, the number of outgoing data is "100" for single-channel and it will be "100, 100" for 2-channel.

(7) If the output data is OMx/WL command

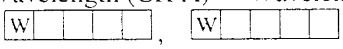
Single-channel data output format

Wavelength



Two-channel data output format

Wavelength (CH A) Wavelength (CH B)



It becomes "W900" when up to 5 characters are permitted including and "900" is specified for number of total data.

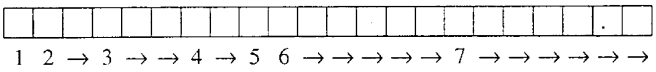
(8) If the output data is LSS command:

Data output format:

① If the dual optical sources are not used

② If the dual optical sources are used and if λ=1 is only selected

③ If the dual optical sources are used and if λ=2 is only selected



④ Data output format if the dual optical sources are used and if both λ=1 and λ=2 are selected

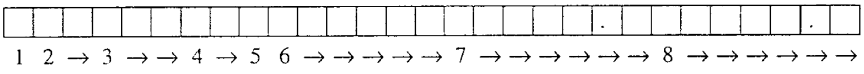
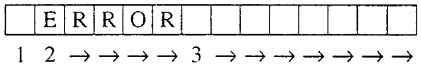


Table 5-10 GPIB Data Output Formats (4/4)

1	Output channel	A: Channel A B: Channel B C or others: External channels
2	Channel specified	Same as the program code
3	Optical source type	LDS: Single LD source LDD: Dual LD sources LES: LED source
4	Optical source ON/OFF setup	Same as the program code
5	Optical signal format	C: CW P: 270 Hz Q: 1 kHz R: 2 kHz
6	Optical attenuation	Same as the program code
7	Optical emission wavelength	W × × × × . × In case 2, it indicates the "λ=1" wavelength. In case 3, it indicates the "λ=2" wavelength. In case 4, it indicates the "λ=1" wavelength.
8	Optical emission wavelength (in case 4 only)	W × × × × . × In case 4, it indicates the "λ=2" wavelength.

(9) Error format

Single-channel data output format



Two-channel data output format

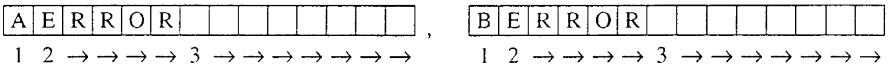


Table 5-11 GPIB Error Output Format

1	Output channel	A: Channel A B: Channel B C or others: External channels
2	Status	Error
3	Error information	2: An inoperable program code was received. 3: A value exceeding the display limit was detected. 4: The wavelength exceeding the unit operating range was set. 5: The zero-adjustment (Zero Set) has failed. 6: Too many codes were received. 7: The optical modulation mode is incorrect. 8: When the AC2141 is connected, if there is any conflict between the output data setup (→ 5-63) and the unit type used (sensor or light source), the error 8 will be warned. An example: If "OD1" is received and CH A is specified as the light source by "U" command, for instance, the error 8 will be warned. For description of the commands including "U", refer to the AQ2141 Instruction Manual.

If duplicate errors have occurred, an error message similar to the following one is output:

"AERROR00000123"

If error 2 or 6 has occurred, no channel number is displayed.
When, however, an error is duplicated with another error as shown in above, they will be output simultaneously in the output format having the channel number of another error.

The error 8 does not duplicate with another error. Error data of the error 8 is output after other errors have been eliminated.

This error data is cleared as a correct command is received.

5.9.7 Sample program

The following gives an sample program to perform a single-time measurement and display the measured data on the controller.

Example: The Hewlett Packard's HP9836 controller is used, two sensors are connected to the AQ2140 Optical Multimeter, and the GPIB address is set to "19".

```
10  DIM A$ [30]
20  ABORT 7
30  OUTPUT 719;"OD0, S"
40  ENTER 719;A$,
50  PRINT A$,
60  LOCAL 7
70  END
```

6. Structure and Circuits of Sensor Unit

This chapter outlines the basic circuit configuration and structure of the AQ2140.

6.1 Main System (AQ2140)

6.1.1 Circuit Configuration

Figure 6-1 gives a circuit block diagram of the AQ2140.
The AQ2140 controls the key operations and GPIB command transmission to the unit(s). Also, it receives digital data from the Sensor Unit(s), processes them by various arithmetic operations, and displays them on the fluorescent lamp display.

(1) Control section
Your key operations and GPIB commands are converted into the format that each unit can recognize within the AQ2140. The converted data is sent to the respective Units via the serial bus. The Light Source Unit converts the optical output by following the commands issued by the AQ2140. The Sensor Unit converts the incident light into digital data by following the control command issued by the AQ2140. Then, the Sensor Unit converts them into the format that the AQ2140 can recognize, and sends them to the AQ2140 via the serial bus.

(2) Display section
The display section receives the measured data from the Sensor Unit(s), and displays the status information of the AQ2140 and each unit via the display circuit.

6.1.2 System Structure

The appearance of the AQ2140 is shown on drawings ASD-62333.

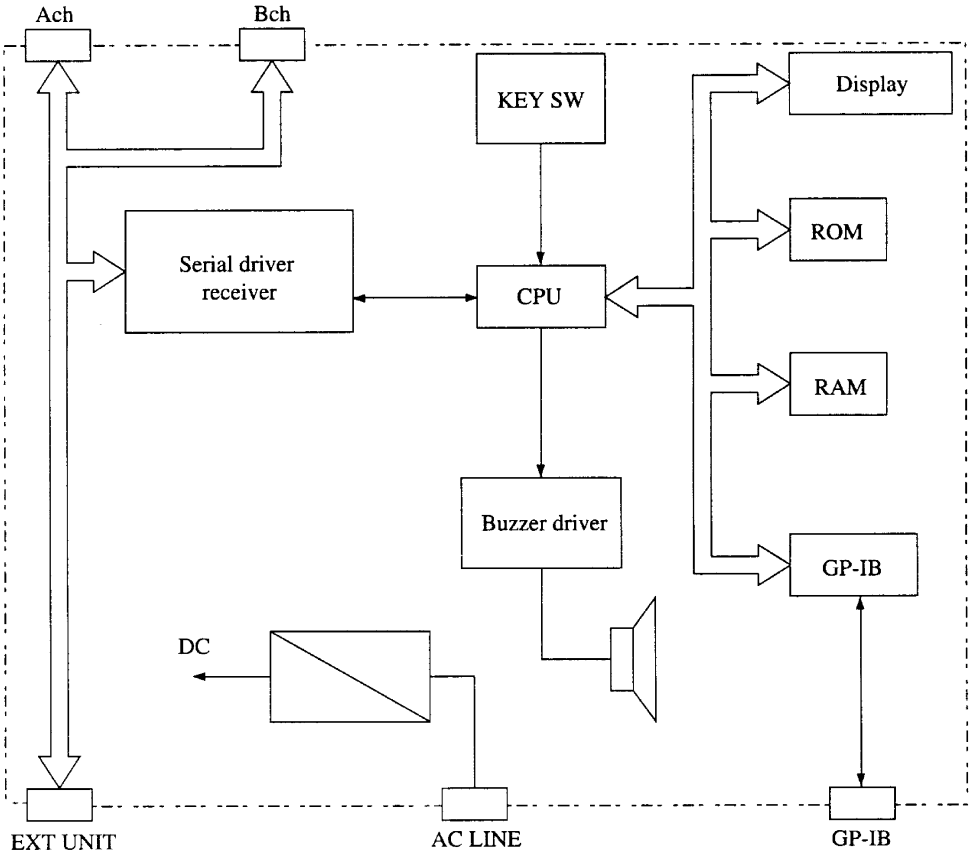


Figure 6-1 Circuit Configuration of AQ2140

6.2 OPM Unit (AQ2730) and Sensor (AQ2741 to 2743)

6.2.1 Circuit

Block diagram of the OPM unit are given in Figure 6-2 and Figure 6-3.
This OPM unit is operated by the key function or commands from the AQ2140.

(1) Sensor
This sensor is consisted of the PD module, EEPROM and volume control. The PD module employs Si photo diode, Ge photo diode or Ge photo diode with the built-in Peltier element to generate electric signals in proportion to the incident light applied to it.
This sensor has the built-in EEPROM for correcting its wavelength sensitivity. It also carries the volume control for adjusting the absolute value.

(2) Variable gain amplifier section
Consisting of the operational amplifier, active LPF, active BPF and wave detector circuit, this amplifier switches the gain according to level of the incident power.

(3) Zero set section
This unit negates the electric offset in the circuit by the output from the D/A conversion circuit. Executing the zero set using the [ZERO] key determines the output level from the D/A conversion circuit, and the value determined is maintained until the next zero set is executed.

(4) Control section
A signal amplified on the variable gain amplifier section is converted to digital signal on the A/D conversion circuit, processed with various arithmetic operations (logarithmic conversion and various other corrections) then sent to the AQ2140 through the serial I/O port.

6.2.2 System Structure

External view of this OPM unit is given in the sketch of the sensor and OPM unit (optional). External view of the AQ2741, AQ2742 and AQ2743 is given in the sketch of the AQ2730 OPM unit sensor (optional).

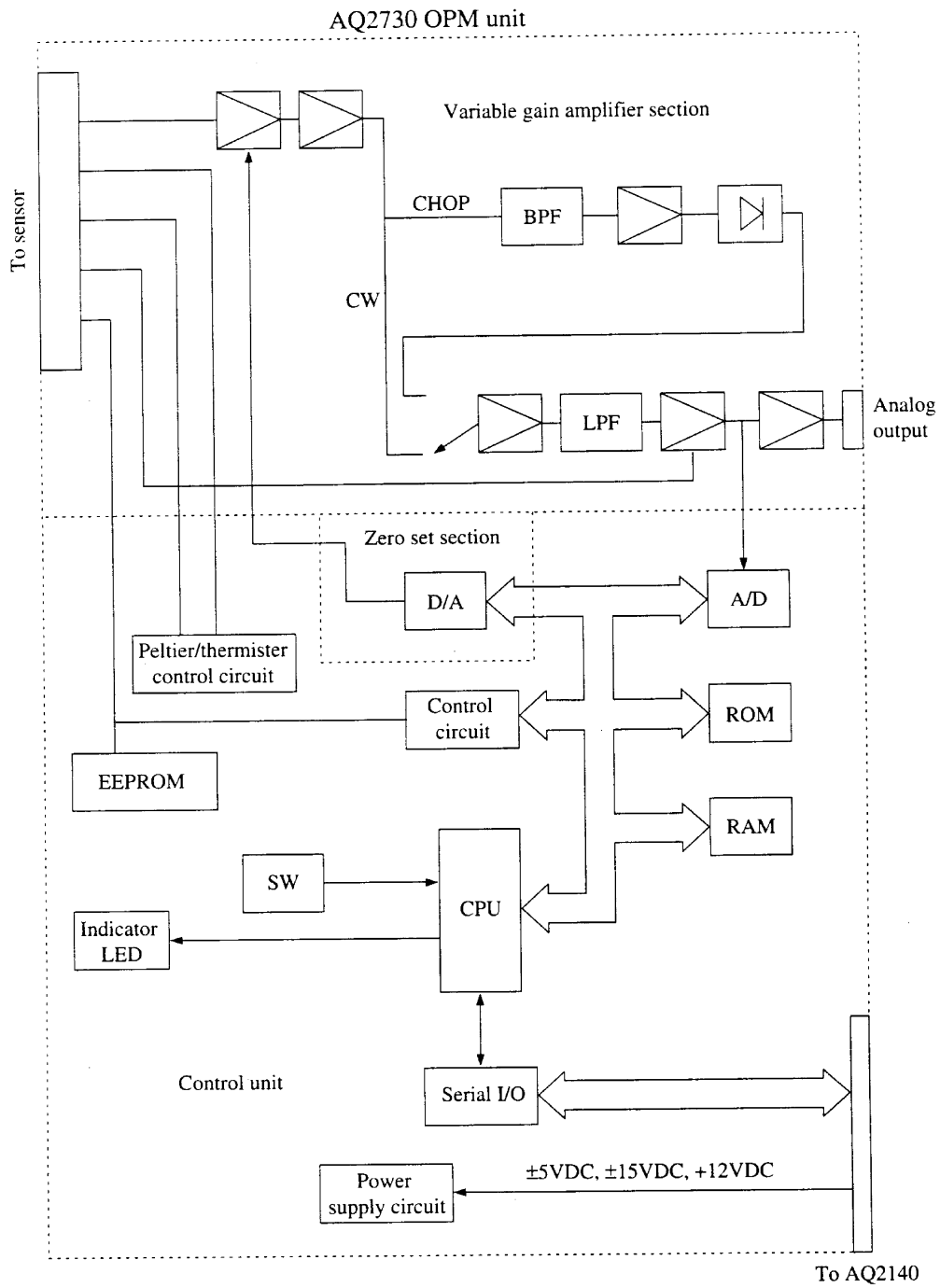


Figure 6-2 OPM Unit (AQ2730) Circuit Configuration

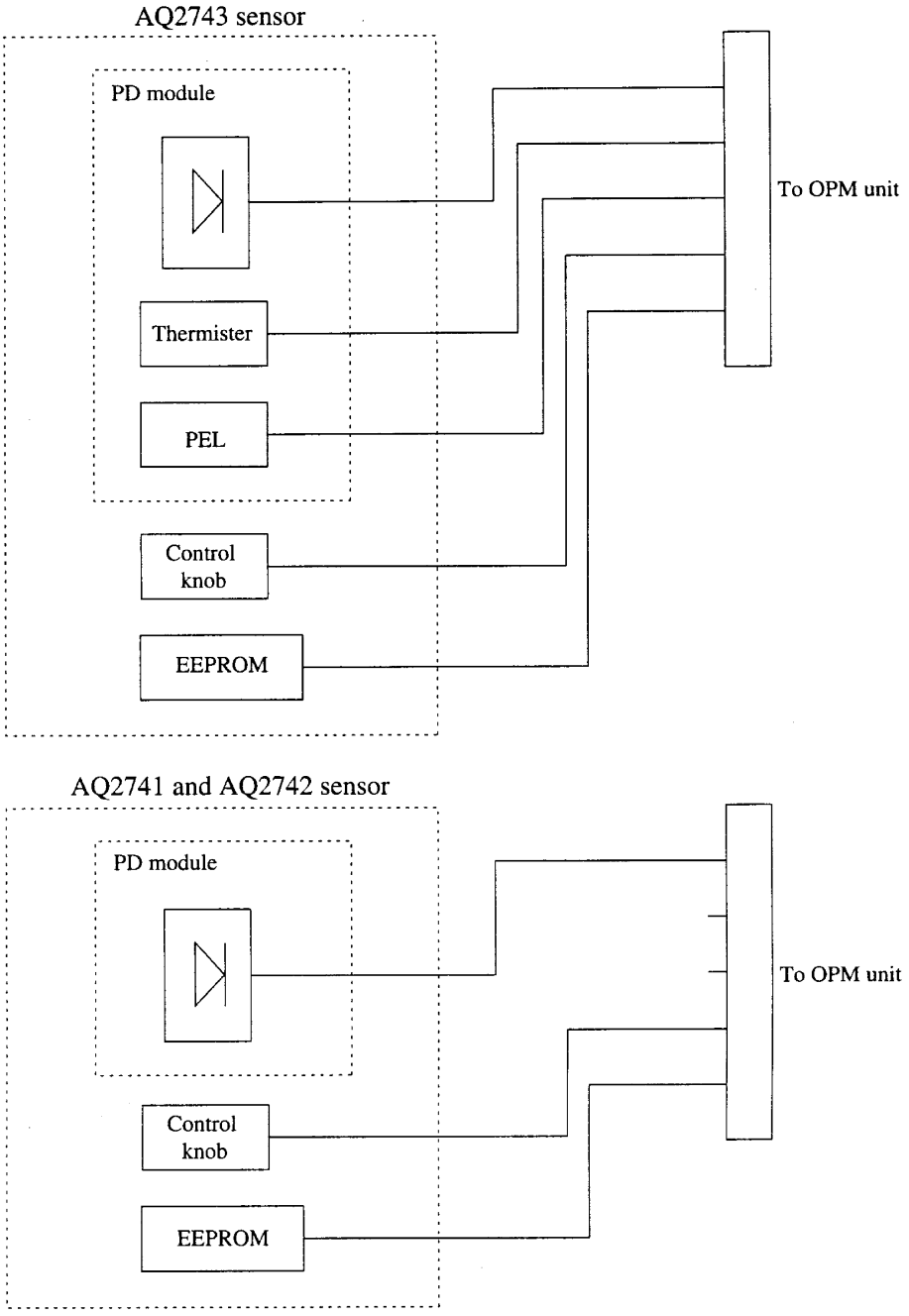


Figure 6-3 Sensor (AQ2741 to AQ2743) Circuit Configuration

6.3 Sensor Unit (AQ2731)

6.3.1 Circuit Configuration

Figure 6-4 shows the block diagram of this sensor unit.
This sensor unit is operated by the key function or commands from the AQ2140.

(1) PD module
Si photo diode on the sensor enables to generate electric signals in proportion to the incident light applied to it.

(2) Variable gain amplifier section
Being consisted of the operational amplifier, active LPF, active BPF and wave detector circuit, the amplifier switches the gain according to level of the incident power.

(3) Zero set section
This unit negates the electric offset in the circuit by the output from the D/A conversion circuit.
Executing the zero set using the [ZERO] key determines the output level from the D/A conversion circuit, and the value determined is maintained until next zero set is executed.

(4) Control section
A signal amplified on the variable gain amplifier is converted to digital signal on the A/D conversion circuit, processed with various arithmetic operations (logarithmic conversion and various other corrections) then sent to the AQ2140 through the serial I/O port.

6.3.2 System Structure

External view of the sensor unit is given in the sketch of the sensor and OPM unit (optional).

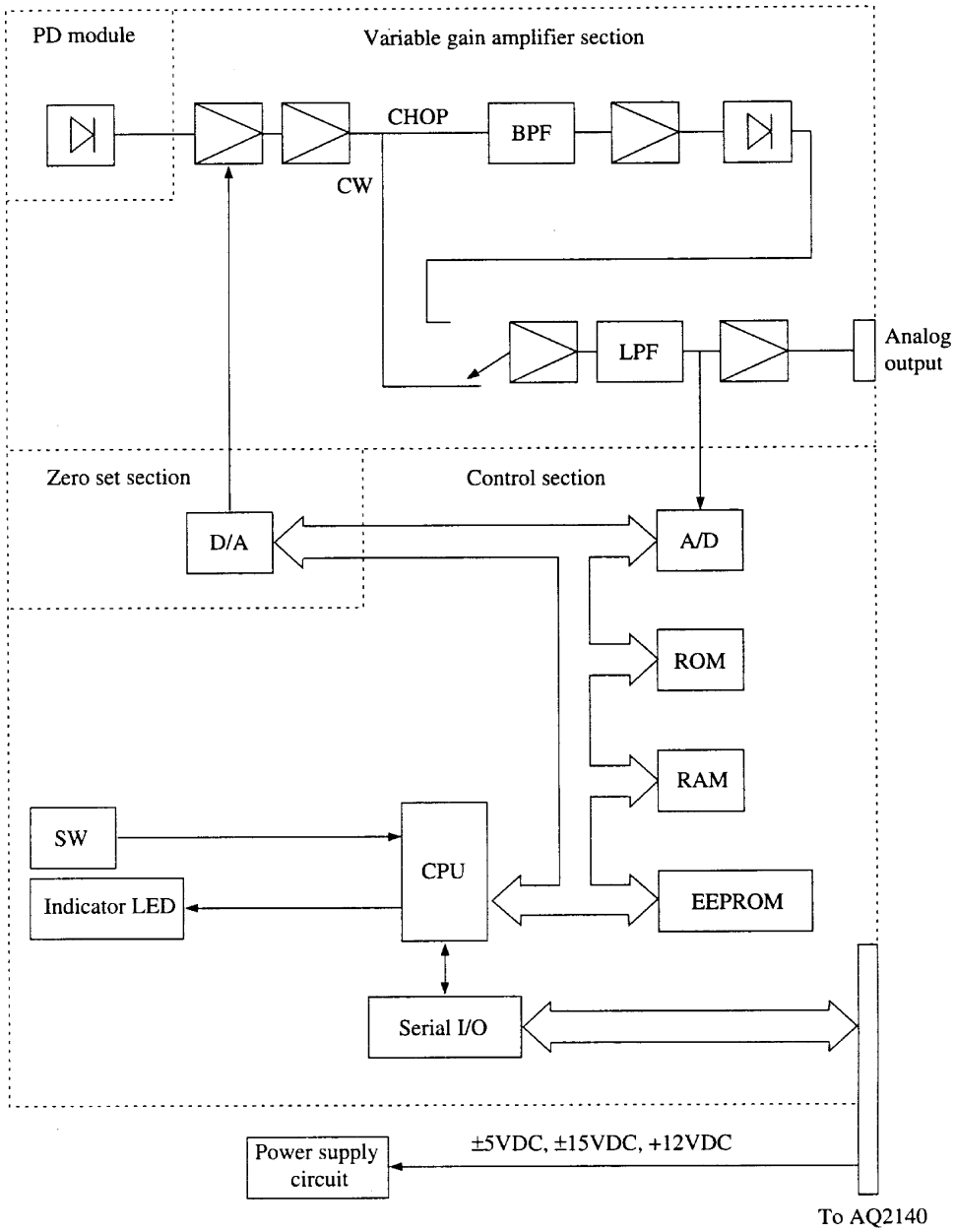


Figure 6-4 Sensor Unit (AQ2731) Circuit Configuration

6.4 Sensor Unit (AQ2732)

6.4.1 Circuit Configuration

Block diagram of this sensor unit is given in Figure 6-5.
This sensor unit is operated by the key function or commands from the AQ2140.

(1) PD module
InGaAS photo diode on the sensor enables to output electric signals in proportion to the incident light applied to it.

(2) Variable gain amplifier section
Being consisted with the operational amplifier, active LPF, active BPF and wave detector circuit, the amplifier switches the gain according to level of the incident power.

(3) Zero set section
This unit negates the electric offset in the circuit by the output from the D/A conversion circuit.
Executing the zero set using the [ZERO] key determines the output from the D/A conversion circuit, and the value determined is maintained until the next zero set is executed.

(4) Control section
A signal amplified on the variable gain amplifier section is converted to digital signal on the A/D conversion circuit, processed with various arithmetic operations (logarithmic conversion and various other corrections) then sent to the AQ2140 through the serial I/O port.

6.4.2 System Structure

External view of this sensor unit is given in the sketch of the sensor and OPM unit (optional).

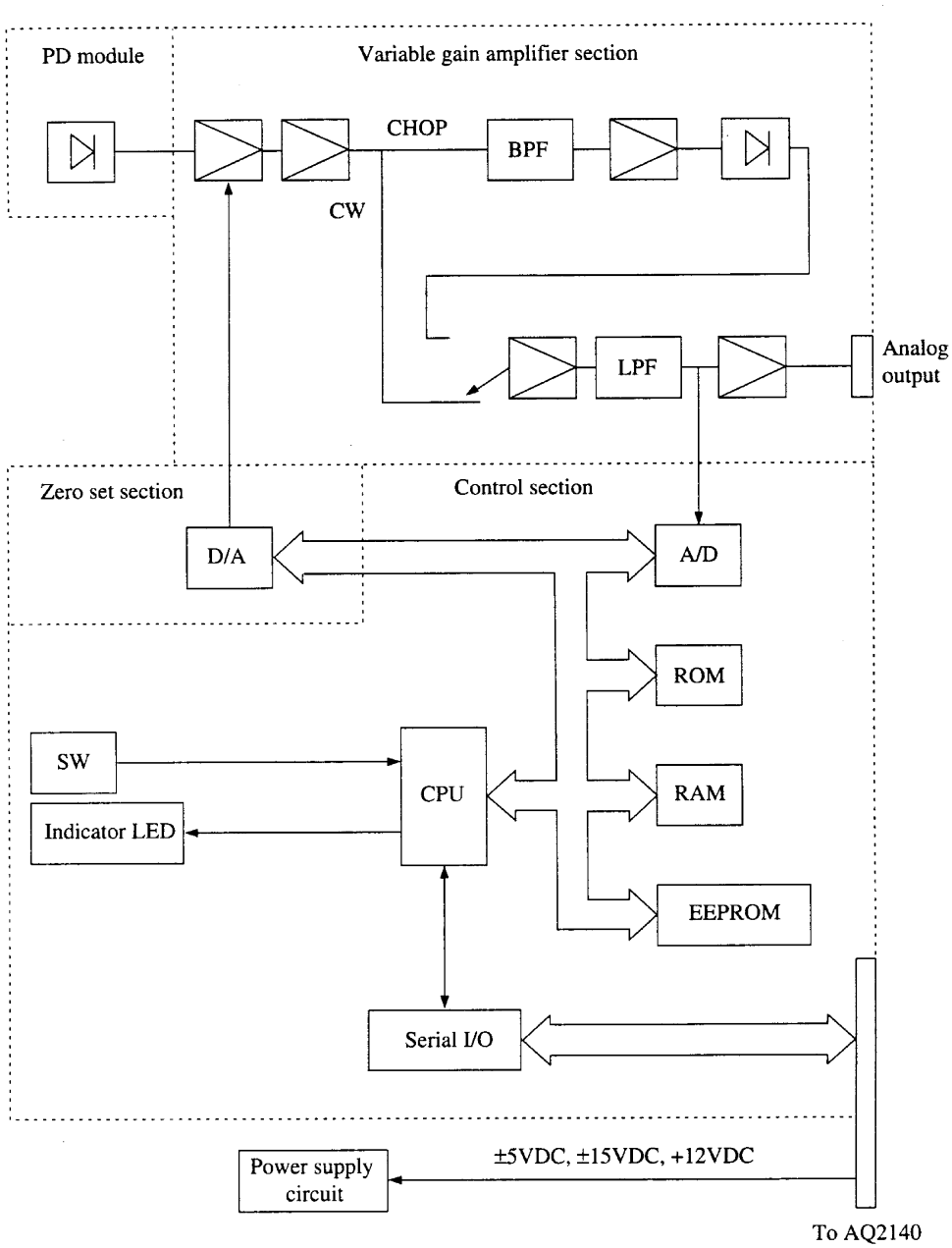


Figure 6-5 Sensor Unit (AQ2732) Circuit Configuration

6.5 Sensor Unit (AQ2733 to 2735)

6.5.1 Circuit Configuration

Block diagram of this sensor is given in Figure 6-5.
This sensor unit is operated by the key function or commands from the AQ2140.

(1) PD module
InGaAS photo diode on the sensor enables to output electric signals in proportion to the incident light applied to it.

(2) Variable gain amplifier section
Being consisted of the operational amplifier, active LPF, active BPF and wave detector circuit, the amplifier switches the gain according to level of the incident power.

(3) Zero set section
This unit negates the electric offset in the circuit by the output from the D/A conversion circuit.
Executing the zero set using the [ZERO] set key determines the output level from the D/A conversion circuit, and the value determined is maintained until the next zero set is executed.

(4) Control section
A signal amplified on the variable gain amplifier is converted to digital signal on the A/D conversion circuit, processed with various arithmetic operations (logarithmic conversion and various other corrections) then sent to the AQ2140 through the serial I/O port.

6.5.2 System Structure

External view of this sensor unit is given in the sketch of the sensor and OPM unit (optional).

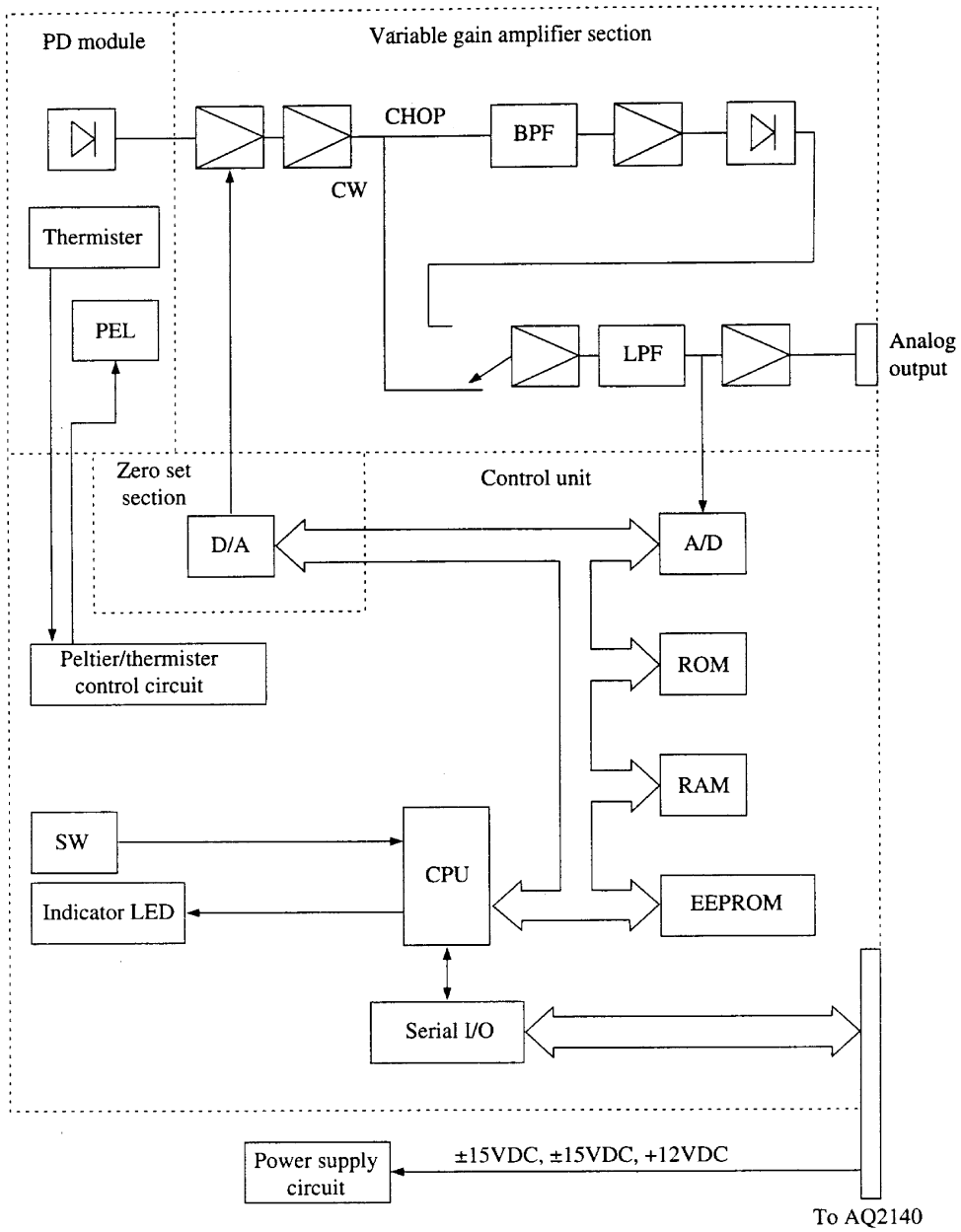


Figure 6-6 Sensor Unit (AQ2733 to 2735) Circuit Configuration

6.6 Optical Source Unit (AQ4211, AQ4212 and AQ4214)

6.6.1 Circuit Configuration.

Block diagram of this light source unit is given in Figure 6-7.
This light source unit is operated by the key function or commands from the AQ2140.

(1) LD module
This LD module is consisted of the LD, monitor PD, Peltier element and thermister.

(2) LD drive
Drives the LD in the CW or CHOP modulation mode. It stabilizes the optical output using feedback of the monitor PD output.

(3) Temperature controller
This controller uses the thermister for detecting temperature to control the Peltier element drive current and thus to maintain the LD temperature at a constant level.

(4) Control section
This control unit is used for turning the optical source unit on or off, selecting a desired optical modulation mode or selecting a desired attenuation volume through the optical source unit switch operation or commands from the AQ2140.

6.6.2 System Structure

External view of this optical source unit is given in the sketch of the LD, LED and EE-LED units (optional).

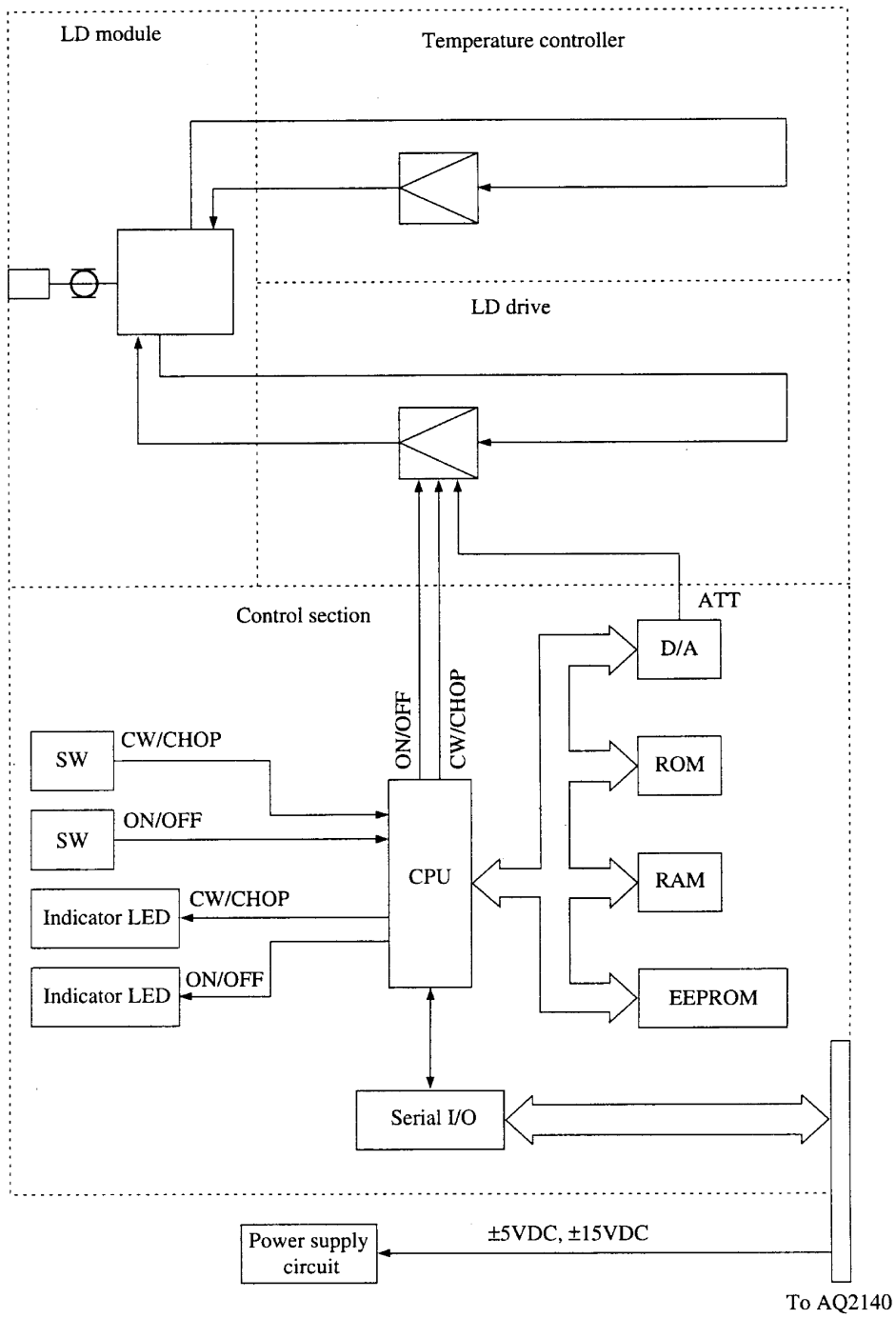


Figure 6-7 Optical Source Unit (AQ4211, AQ4212 and AQ4214) Circuit Configuration

6.7 LD Unit (AQ4213)

6.7.1 Circuit Configuration

Block diagram of this LD unit is given in Figure 6-8.
This LD unit is operated by the key function or commands from the AQ2140.

(1) LD module
This LD module is consisted of the LD, monitor PD, Peltier element and thermister.

(2) LD drive
Drives the LD with in the CW or CHOP mode. It stabilizes the optical output using feedback of the monitor PD output.

(3) Temperature controller
This controller uses the thermister for detecting temperature to control the Peltier drive current and thus to maintain the LD temperature at a constant level.

(4) Control section
This control section is used for turning the optical output on or off, selecting a desired optical modulation mode or selecting a desired attenuation volume through the light source unit switch operation or commands from the AQ2140.

6.7.2 System Structure

External view of this light source is given in the sketch of the LD, LED and EE-LED units (optional).

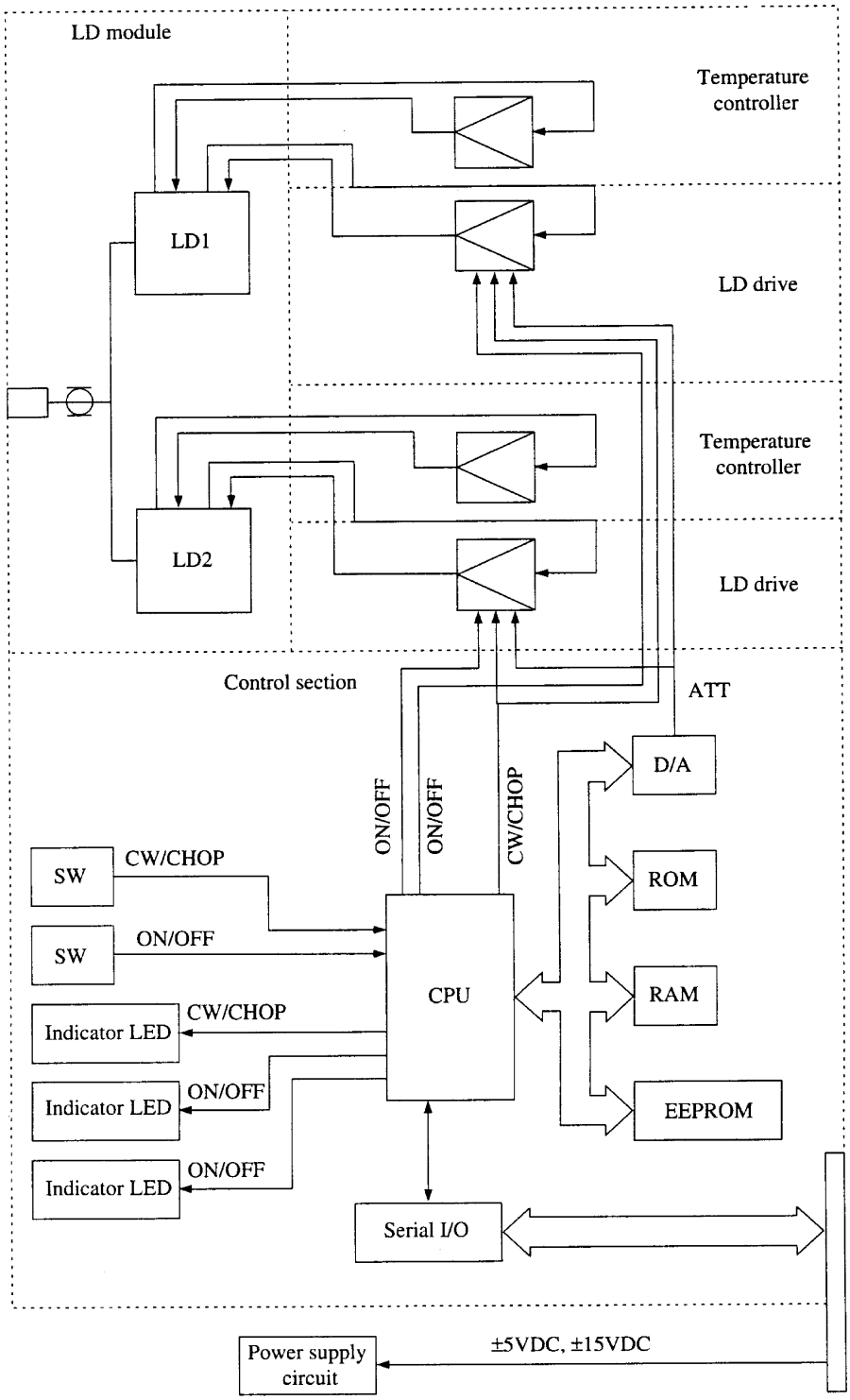


Figure 6-8 Light Source Unit (AQ4213) Circuit Configuration

6.8 LED Unit (AQ4215)

6.8.1 Circuit Configuration

Block diagram of this LED unit is given in Figure 6-9.
This LED unit is operated by the key function or commands from the AQ2140.

(1) LED module
This LED module is consisted of the LED and thermister.

(2) LED drive
Drives the LEDs in the CW or CHOP mode. It stabilizes the optical output using feedback of the drive current.

(3) Temperature correction circuit
This circuit uses the thermister for detecting the LED temperature to correct optical output according to temperature fluctuations.

(4) Control section
This control section is used for turning the optical output on or off, selecting a desired optical modulation mode or selecting a desired attenuation volume through the light source unit switch operation or commands from the AQ2140.

6.8.2 System Structure

External view of this LED unit is given in the sketch of the LED unit (optional).

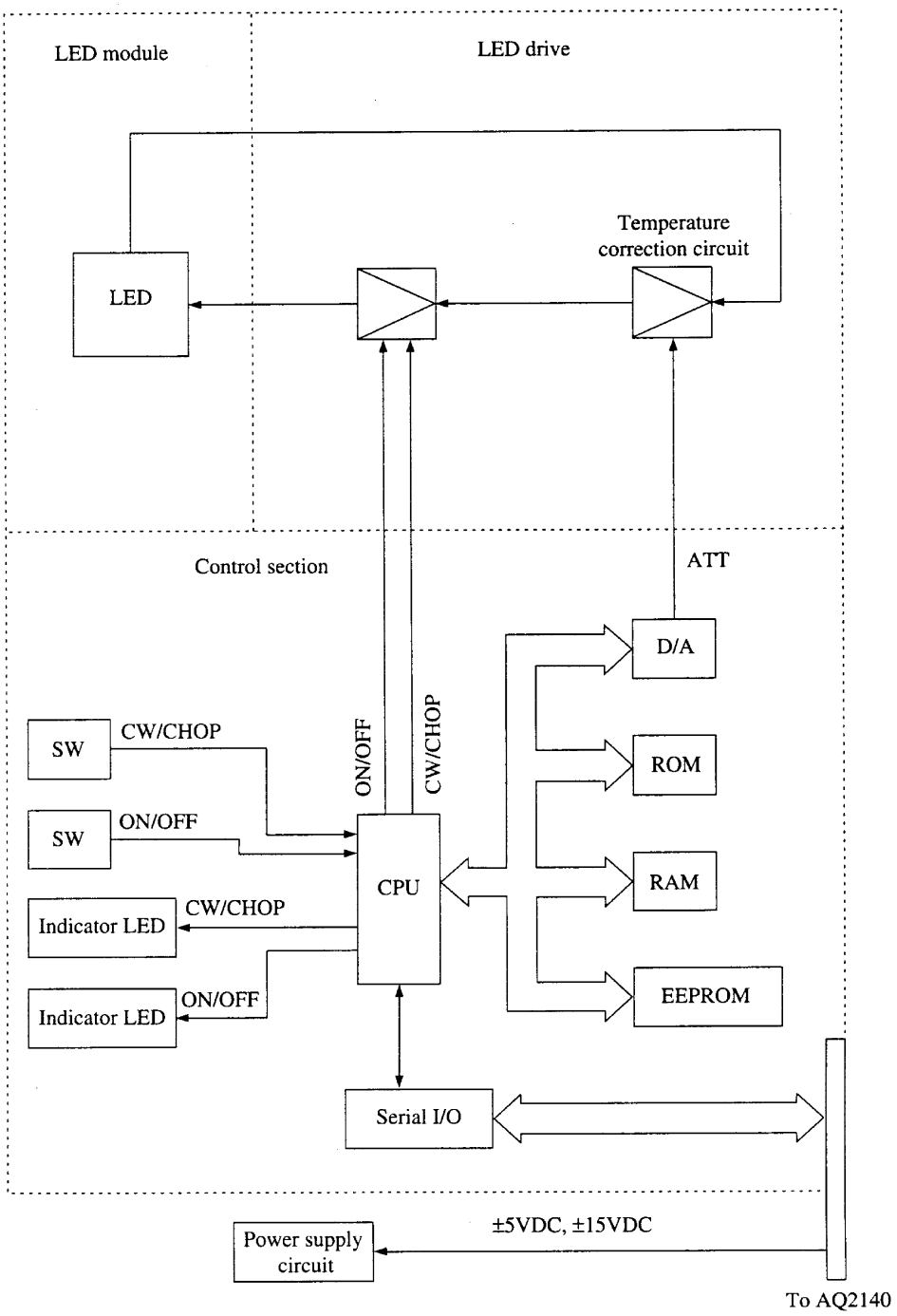


Figure 6-9 Optical Source Unit (AQ4215) Circuit Configuration

6.9 LED Unit (AQ4218)

6.9.1 Circuit Configuration

Block diagram of this LED unit is given in Figure 6-10.
This LED unit is operated by the key function or commands from the AQ2140.

(1) LED module
This LED module is consisted of the LED, Peltier element and thermister.

(2) LD drive
Drives the LEDs in the CW or CHOP modulation mode. It stabilizes the optical output using feedback of the drive current.

(3) Temperature controller
This controller uses the thermister for detecting temperature to control the Peltier element drive current and thus to maintain the LD temperature at a constant level.

(4) Control section
This control unit is used for turning the optical output on or off, selecting a desired optical modulation mode or selecting desired attenuation volume through the LED unit switch operation or commands from the AQ2140.

6.9.2 System Structure

External view of this LED unit is given in the sketch of the LD, LED and EE-LED units (optional).

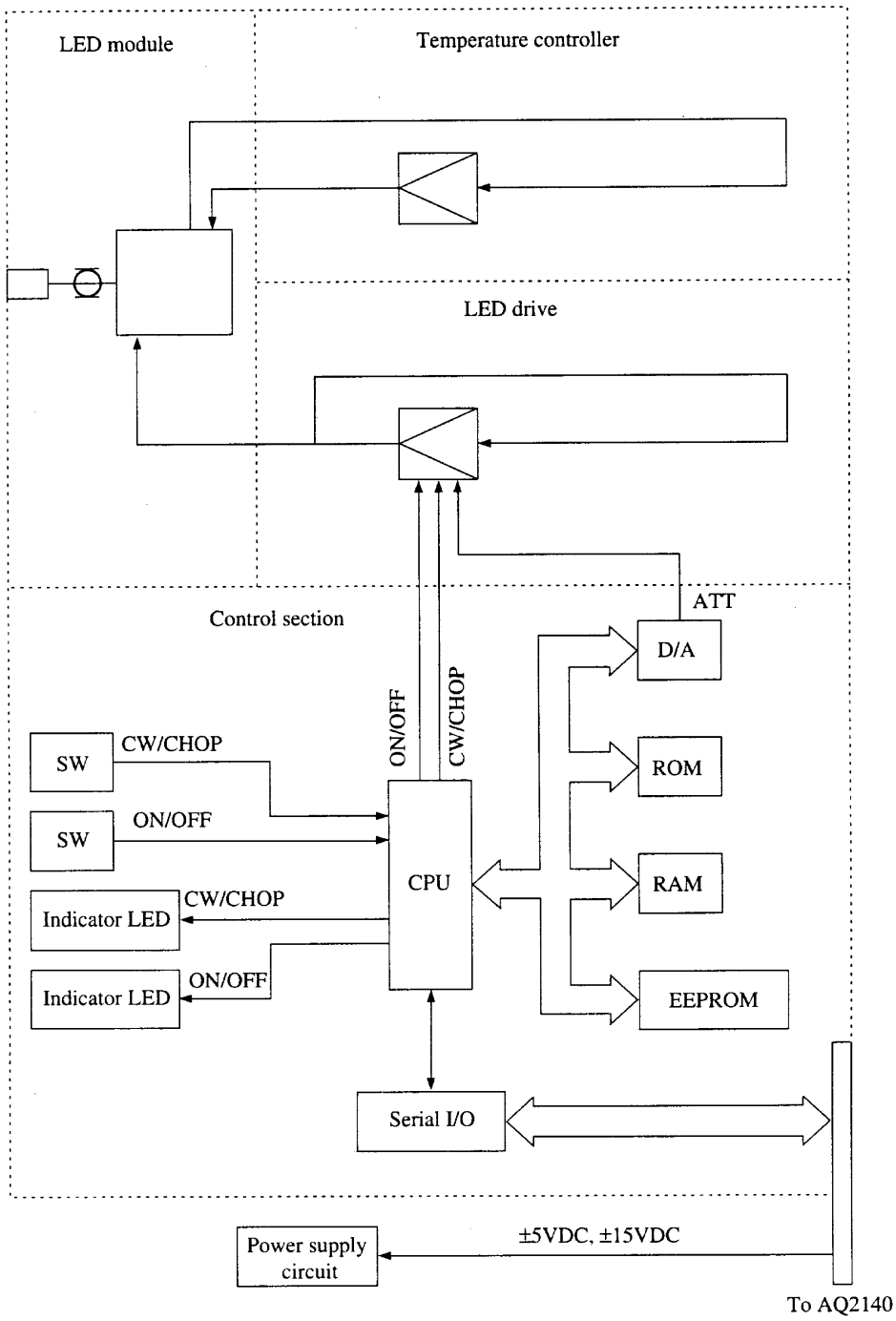


Figure 6-10 Light Source Unit (AQ4218) Circuit Configuration

6.10 EE-LED Unit (AQ4221)

6.10.1 Circuit Configuration

Block diagram of this EE-LED unit is given in Figure 6-11.
This EE-LED unit is operated by the key function or commands from the AQ2140.

(1) LED module
This LED module is consisted of the LED, Peltier element and thermister.

(2) LED drive
Drives the LEDs in the CW or CHOP modulation mode. It stabilizes the optical output using feedback of the drive current.

(3) Temperature controller
This controller uses the thermister for detecting temperature to control the Peltier element drive current and thus to maintain the LED temperature at a constant level.

(4) Control section
This control section is used for turning the optical output on or off, selecting a desired optical modulation mode or selecting desired attenuation volume through the LED switch operation or commands from the AQ2140.

6.10.2 System Structure

External view of this LED unit is given in the sketch of the LD, LED and EE-LED units (optional).

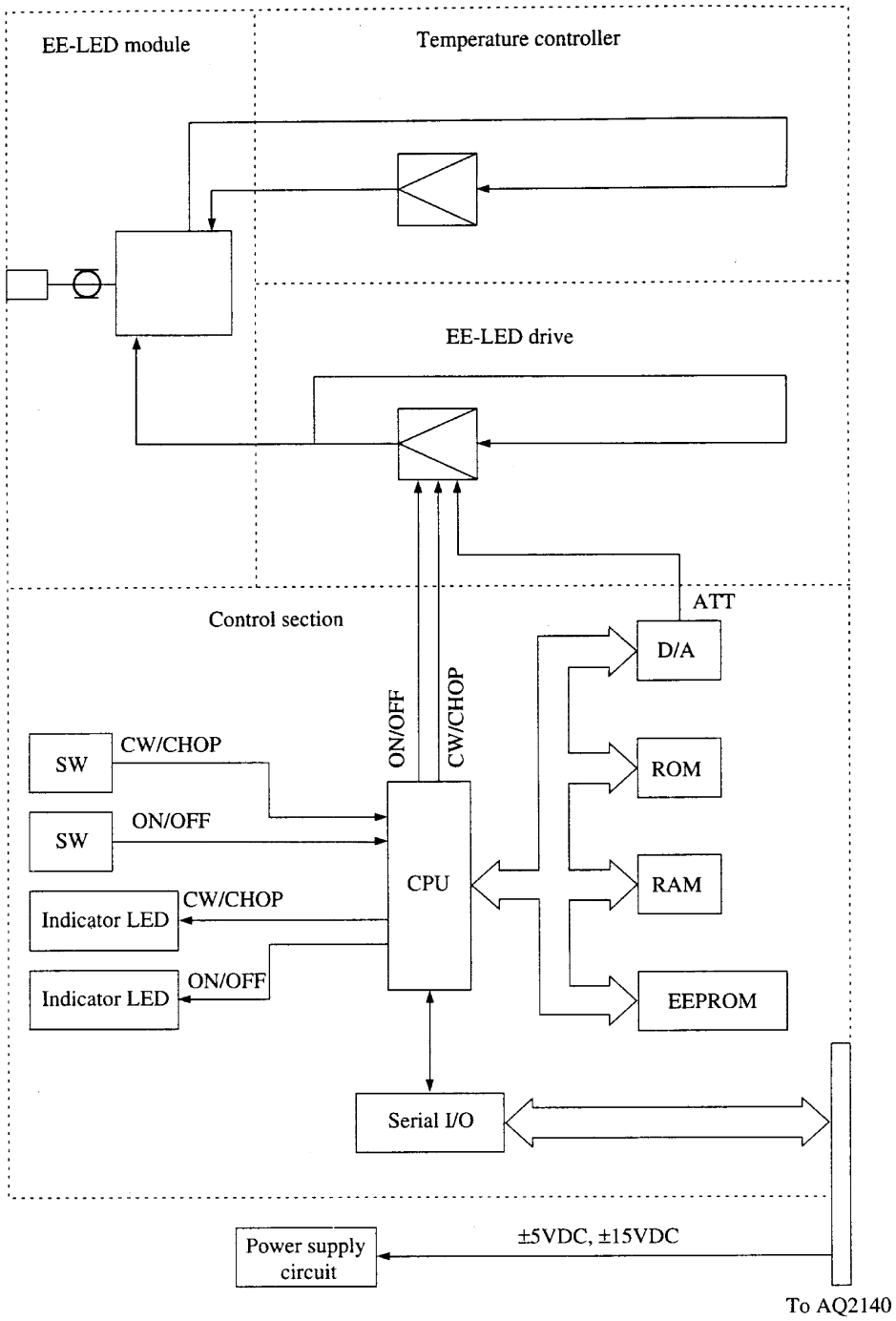


Figure 6-11 Light Source Unit (AQ4221) Circuit Configuration

6.11 Return Loss Tester Unit (AQ7310)

6.11.1 Circuit Configuration

Block diagram of this return loss tester unit is given in Figure 6-12.
This EE-LED unit is operated by the commands from the AQ2140.

(1) PD module
InGaAS photo diode on this unit enables to generate electric signals in proportion to the incident light applied to it.

(2) Variable gain amplifier section
Being consisted of the operational amplifier, active LPF, active BPF and wave detector circuit, this section is used for switching the gain according to level of the incident power.

(3) Control section
A signal amplified on the variable gain amplifier section is converted to digital signal on the A/D conversion circuit, processed with various arithmetic operations (logarithmic conversion and various other corrections) then sent to the AQ2140 through the serial I/O port.

6.11.2 System Structure

External view of the return loss tester unit is given in the sketch of the optical return loss tester unit (optional).

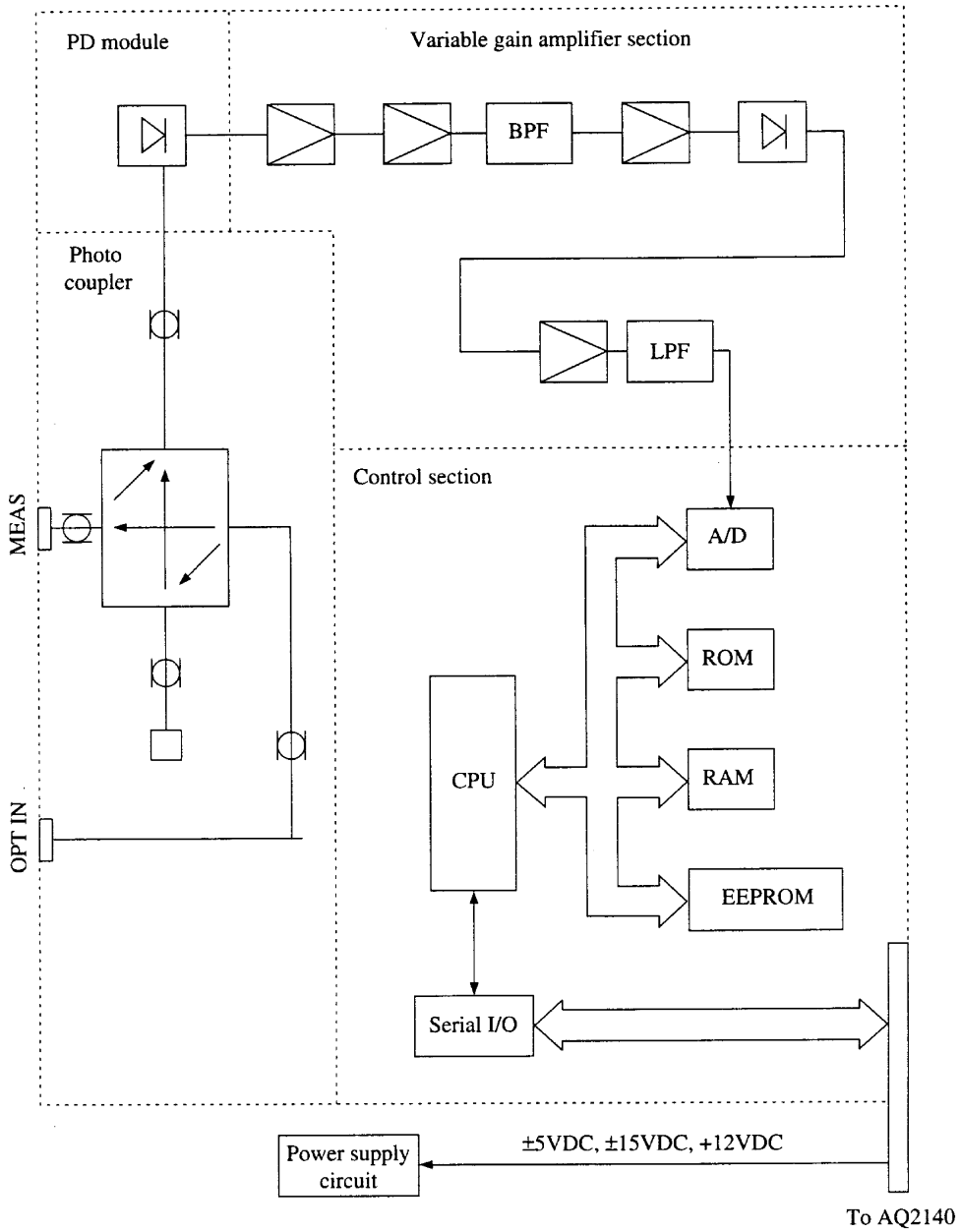


Figure 6-12 Return Loss Tester Unit (AQ7310) Circuit Configuration

7. Troubleshooting Guide

This chapter gives the basic checkpoints that you should use if your AQ2140 has failed.

7.1 Main System (AQ2140)

(1) The AQ2140 does not operate after power ON.

- Check the power fuse at the AQ2140 rear panel.

(2) The absolute value is incorrect.

- Check the calibration wavelength.
- Check the correction values.
- Check the optical modulation mode of the Light Source and the optical modulation mode of the Sensor Unit.

(3) The ERR13 error message is displayed.

- If the CHOP optical modulation mode is selected for the Sensor Unit, the optical noise that is greater than –60 dBm can cause an error. Shield the photosensor from the ambient light.

(4) The [CHAN] key does not function.

- If only a single Unit is connected to the AQ2140, the [CHAN] key is invalid.

7.2 OPM Unit, Sensor Unit and Sensor (AQ2730 to 2735 and AQ2741 to 2743)

(1) The absolute value is incorrect.

- Check the calibration wavelength.
- Check the correction value.
- Check the optical modulation mode selected for the light source and these units.
- Check if the connector adapter is securely mounted.
- Clean the end face of the connected optical fiber.

(2) Execution of the zero set is not available.

- Check if the photosensor is properly shielded from ambient light.
- Cancel the remote mode (control via the GP-IB interface) selected for the AQ2140.

(3) Switching of the optical modulation mode is not available.

- Cancel the remote mode (control via the GP-IB interface) selected for the AQ2140.

7.3 Optical Source Unit (AQ4211 to 4215, AQ4218 and AQ4221)

(1) Optical output is not available.

- Make sure that the [OPT] switch is turned on.
- Check if the optical fiber is securely mounted.
- Check if the universal adapter (for the AQ4211 to 4213, AQ4218 and AQ4221) or the connector adapter (for the AQ4215) is properly mounted.

(2) Optical output level is lower than the specification

- Check stains or dusts on the optical output section of the optical source unit or the connected optical fiber end.
- Check which of the CW or CHOP mode is selected.
- With AQ2140, make sure that 0.0 dBm is selected for the ATT.
- Check if the optical fiber is properly mounted.
- Check if the universal adapter (for the AQ4211 to 4213, AQ4218 or AQ4221) or the connector adapter (fro the AQ4215) is properly mounted.
- Check insertion loss on the optical fiber.

(3) Optical output level is not stable.

- Using a microscope, check stains or dusts on the optical source optical connector and the connected optical fiber end.
  (Prior to this operation, turn the AQ2140 power off and be sure optical output is not generated.)
- With the AQ4211 to 4213, make sure that the connected optical fiber is a SPC polished product (reflective attenuation 40 dB minimum).
- For the AQ4214, make sure that the used optical fiber is an APC polished product.

(4) Switching of the optical modulation mode is not available. Or, turning on or off of the optical output is not available.

- Make sure that the remote mode (control via the GP-IB interface) is canceled for the QA2140.

7.4 Return Loss Tester Unit (AQ7310)

(1) The message "NO UNIT" appears on the AQ2140 display.

- Check the software version used on the AQ2140. Check the version in the following manner:
  Remove the unit from the AQ2140, turn power on, press the [CHAN] key, then press the [ENTER] key and the software version will appear on the display.
  This return loss tester unit operates on the software of version 2.0 or after. If the QA2140 display indicates Ver.1.2, this unit does not work. In such case, contact us at our Service Department, Marketing Department in Headquarters, a branch office or sales office of your convenience.

(2) The message "ERR05" appears on the AQ2140 display.

- Make sure that no unit other than the AQ4211 or AQ4213 is connected to other channels of this return loss tester unit. This error message appears when the return loss tester unit alone is installed or when the tester unit is combined with any other unit than the AQ4211 or 4213.
- Make sure that the AQ2141 is not connected.

(3) Switching of the LD light source optical modulation mode is not available.

- This return loss tester unit is for 270 Hz, CHOP only.
  Therefore, LD unit, which is installed with the tester unit, will be set to the CHOP mode automatically.
  Additionally, note that the optical modulation mode can not be changed.

(4) Measured data blinks on the screen.

- Make sure that the optical output of the LD light source is turned on.
- When an external light source is used, check the optical modulation mode being selected for it. The external optical source must be the AQ4211 or AQ4213 equivalent.
- Make sure that the optical output level of the LD light source is set within the range of 0 to –5 dBm.

(5) Stable measurements are not available.

- When the AQ4211, AQ4213 or an equivalent is used as the light source, if the fluctuation indicated in the reference reflection measurement is within ± 0.02 dB, the seemingly unstable measurements are due to fluctuation of reflected light of the target object. It is not due to failure on the return loss tester unit.

- When the AQ4211, AQ4213 or an equivalent is used as the external light source, if the fluctuation indicated in the reference reflection measurement is ±0.02 dB or greater, unstable measurements can be due to contamination of the master cord connections, photosensor or optical fiber connector. Clean the optical fiber and master cord connectors, photosensor and master cord connection with alcohol. If the trouble recurs after cleaning, failure on the return loss tester unit should be suspected. In this case, contact us at our Service Department, Headquarters Marketing Department or a branch or sales office of your convenience.

8. Maintenance

This chapter describes the standard system maintenance and service procedure.

8.1 Main System (AQ2140)

Since your AQ2140 is a controller to control the dedicated system units, you need not maintain your AQ2140 separately. The actual unit maintenance varies depending on the units used. Refer to section 8.2 and after for maintenance of respective units.

8.2 OPM Unit (AQ2730) and Sensor (AQ2741 to 2743)

8.2.1 Tester Units Used for the Test

Table 8-1 lists the tester units required for the maintenance.

Table 8-1 Tester Units Used for the Test (AQ2730)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter	Power range : –80 to +10 dBm Wavelength range : Short wave band 400 to 1100 nm Long wave band 750 to 1800 nm Measurement accuracy/resolution: ±2% maximum at 0.01 dB.
Variable optical attenuator	Attenuation obtainable : 0 to ∞ dB at 850 nm band 0 to ∞ dB at 1310 nm band
Light source	Emission light wavelength : 850±20 nm, 1310±20 nm Output level : –3 dBm minimum
Optical fiber cord	Single mode optical fiber (fiber length 2 meters minimum) with the PC polished ferule connectors at both ends.

8.2.2 Periodic Inspection

Periodic inspection is an effective measure for maintaining the system in normal condition over a long period of time, as well as for detecting a failure on the system at its early stage. The inspection interval is determined according to the system storage conditions or its use frequency.

The periodic inspection comprises the mechanical inspection, performance test, adjustment and calibration.

Periodic inspection at six-month interval is recommended for this OPM unit since its design ensures higher stability and reliability.

⚠ CAUTION
Don't try to touch inside of the OPM unit.

(1) Mechanical inspection

This inspection checks the appearance and mechanical action of the OPM unit. The appearance is checked visually for damage or deformation. Also, the assembled parts are checked for looseness, and switches and stoppers are checked for smooth action.

(2) Basic performance test

This test compares performance of the OPM unit against its specification. The following describes procedure of the performance test which takes place succeeding the acceptance inspection, periodic inspection and repair work.

Basic performance of the OPM unit is tested in the following procedure.

① Connect the OPM unit to the AQ2140, then turn power on. When there is failure on the unit, an error message will appear on the AQ2140 display panel. Refer to Chapter 5 of this manual for the meaning of respective error messages.

② Connect the OPM unit as shown in Figure 8-1, then make sure that the AQ2140 display indications change in response to the variable optical attenuator settings.

(3) Performance test

① Connect the OPM unit and a calibrated optical power meter as shown in Figure 8-1. Compare the OPM measurements against the results obtained from the optical power meter.

② The OPM performance can also be checked by changing power and wavelength of the incident light.

(4) Calibration

The volume control for calibration is provided on the sensor body side surface (see Figure 8-2).

Remove the side plate, then, using the volume control, calibrate the absolute value in the sensor reference wavelength.

REMARKS
When the system is shipped, the volume controls is calibrated to the marked wavelength. Don't touch the volume control, otherwise the absolute value can be shifted.

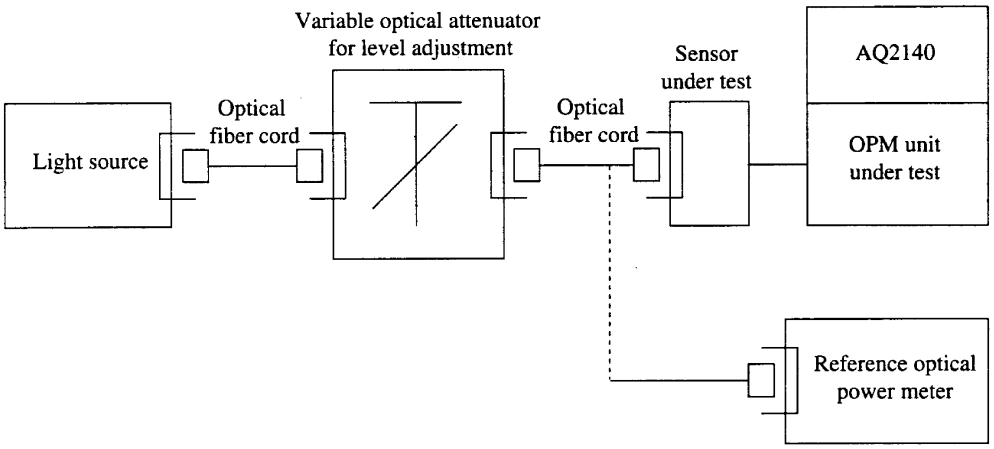


Figure 8-1 Performance Test (AQ2730)

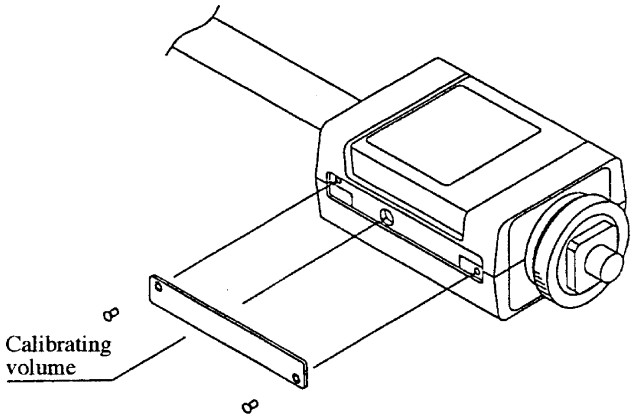


Figure 8-2 Location of Calibrating Volume Control

8.2.3 Servicing the OPM Unit

If the OPM unit photosensor or connector is contaminated by dirts or dusts, its measurement accuracy becomes unpredictable. Check the unit for contamination when replacing the connector, when absolute value is incorrect or in the periodic inspection work.

8.3 Sensor Unit (AQ2731)

8.3.1 Tester Unit Used for the Test

Table 8-2 lists the tester unit required for the maintenance.

Table 8-2 Tester Units Used for the Test (AQ2731)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter	Power range : –90 to +3 dBm Wavelength range : 400 to 1100 nm Measurement accuracy/resolution: ±2% maximum at 0.01 dB.
Variable optical attenuator	Attenuation obtainable : 0 to ∞ dB
Light source	Emission light wavelength : 850±20 nm Output level : –3 dBm minimum
Optical fiber cord	Single mode optical fiber (fiber length 2 meters minimum) with the PC polished ferule connectors at both ends.

8.3.2 Periodic Inspection

Periodic inspection is an effective measure for maintaining the system in normal condition over a long period of time, as well as for detecting a failure on the system at its early stage. The inspection interval is determined according to the system storage conditions and its use frequency.

The periodic inspection comprises the mechanical inspection, performance test, adjustment and calibration.

Periodic inspection at six-month interval is recommended for this sensor unit since its design ensures higher stability and reliability.

⚠ CAUTION
Don't try to touch inside of the sensor unit.

(1) Mechanical inspection

This inspection checks the appearance and mechanical action of the sensor unit. The appearance is checked visually for damage or deformation. Also, the assembled parts are checked for looseness, and switches and stoppers are checked for smooth action.

(2) Basic performance test

This test compares performance of the sensor unit against its specification. The following describes procedure of the performance test which takes place succeeding the acceptance inspection, periodic inspection and repair work.

The sensor unit basic performance is checked in the following procedure.

① Connect the sensor unit to the AQ2140, then turn power on. If there is failure on the unit, an error message will appear on the AQ2140 display. Refer to Chapter 5 of this manual for the meaning of respective error messages.

② Connect the sensor unit as shown in Figure 8-3, then make sure that the AQ2140 display indications change in response to the variable optical attenuator settings.

(3) Performance test

① Connect the sensor unit and a calibrated optical power meter as shown in Figure 8-3. Compare the sensor unit measurements against the measurements obtained from the optical power meter.

② The sensor unit performance can also be checked by changing power level and wavelength of the incident light.

(4) Calibration

The calibrating volume control or knob is not provided to this sensor unit. When the absolute value is found to be incorrect in the reference wavelength, please contact us.

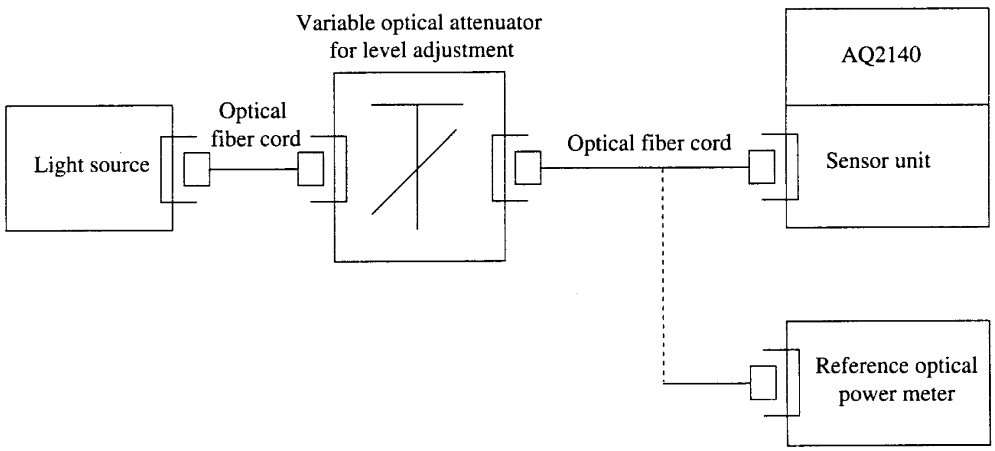


Figure 8-3 Performance Test (AQ2731)

8.2.3 Servicing the Sensor Unit

If the sensor unit photosensor or connector is contaminated by dirts or dusts, its measurement accuracy becomes unpredictable. Check the unit for contamination when replacing the connector, absolute value is incorrect or in the periodic inspection work.

8.4 Sensor Unit (AQ2732 to 2735)

8.4.1 Tester Units Required

Table 8-3 lists the tester units required for the maintenance.

Table 8-3 Tester Units Used for the Test (AQ2732 to 2735)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter	Power range : –90 to +13 dBm Wavelength range : 700 to 1700 nm Measurement accuracy/resolution: ±2% maximum at 0.01 dB.
Variable optical attenuator	Attenuation obtainable : 0 to ∞ dB
Light source	Emission light wavelength : 1310±20 nm Output level : –3 dBm minimum
Optical fiber cord	Single mode optical fiber (fiber length 2 meters minimum) equipped with the PC polished ferule connector.

8.4.2 Periodic Inspection

Periodic inspection is an effective measure for maintaining the system in normal condition over a long period of time, as well as for detecting a failure on the system at its early stage. The inspection interval is determined according to the system storage and its use frequency.

The periodic inspection comprises the mechanical inspection, performance test, adjustment and calibration.

Periodic inspection at six-month interval is recommended for this sensor unit since its design ensures higher stability and reliability.

⚠ CAUTION
Don't try to touch inside of the sensor unit.

(1) Mechanical inspection

This inspection checks the appearance and mechanical action of the OPM unit. The appearance is checked visually for damage or deformation. Also, the assembled parts are checked for looseness, and switches and stoppers are checked for smooth action.

(2) Basic performance test

This test compares performance of the OPM unit against its specification. The following describes procedure of the performance test which takes place succeeding the acceptance inspection, periodic inspection and repair work.

Basic performance of this sensor unit is tested in the following procedure.

① Connect the sensor unit to the AQ2140, then turn power on. If there is failure on the unit, an error message will appear on the AQ2140 display. Refer to Chapter 5 of this manual for the meaning of respective error messages.

② Connect the sensor unit as shown in Figure 8-4, then make sure that the AQ2140 display indication changes in response to the variable optical attenuator settings.

(3) Performance test

① Connect the sensor unit and a calibrated optical power meter as shown in Figure 8-4. Compare the sensor unit measurements against the measurements obtained from the optical power meter.

② The sensor unit performance can also be checked by changing power level and wavelength of the incident light.

(4) Calibration

The calibrating volume control or knob is not provided to this sensor unit. If the absolute value is found to be incorrect in the reference wavelength, please contact us.

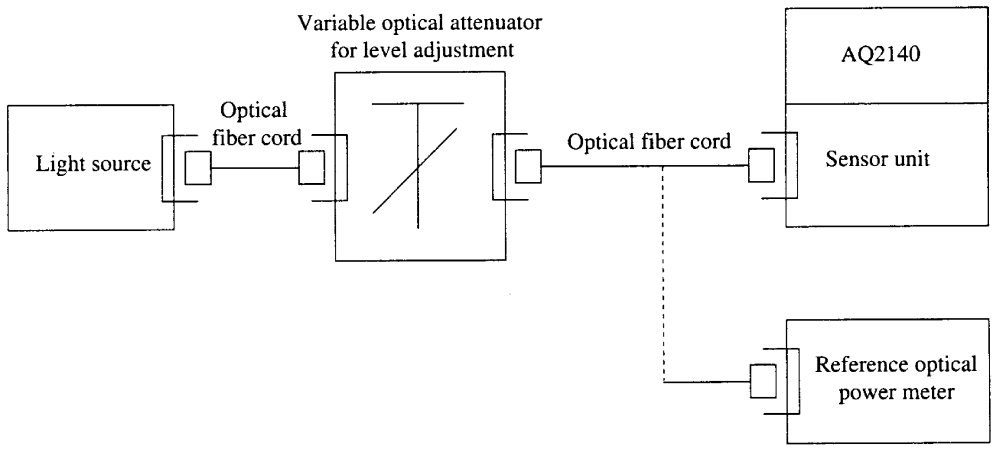


Figure 8-4 Performance Test (AQ2732 to AQ2735)

8.4.3 Servicing the Sensor Unit

If the sensor unit photosensor or connector is contaminated by dirts or dusts, its measurement accuracy becomes unpredictable. Check the unit for contamination by dirts or dusts and clean them, if any, when replacing the connector, when absolute value is incorrect or in the periodic inspection work.

8.5 LD Unit (AQ4211 to 4213)

8.5.1 Tester Units Required

Table 8-4 lists the tester units required for the maintenance.

Table 8-4 Tester Units Used for the Test (AQ4211 to 4213)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter (AQ2140+AQ2733)	Power measurement range : –110 to +10 dBm Wavelength range : 0.7 to 1.7 μm
Optical spectrum analyzer (AQ-6315A)	Wavelength range : 0.35 to 1.75 μm Resolution : 0.05 nm
Optical fiber cord	Single mode optical fiber (short length) with the FC/SPC polished ferule connectors at both ends.

(Testers in the parentheses are equivalent Ando products)

8.5.2 Periodic Inspection

Periodic inspection at six-month interval is recommended for this LD unit since its design ensures higher stability and reliability. The following describes the check points.

⚠ CAUTION
Don't try to touch inside of the LD unit.

(1) Center wavelength and spectral width
Select the CW for the unit optical modulation mode, then measure the center wavelength and and spectral width using the optical spectrum analyzer.

(2) Optical output level and stability
Select the CW mode for the respective unit output waveforms, connect the unit to the optical power meter using a short fiber (2 meters), then measure the optical output level.

(3) Optical modulation mode
Using the optical power meter, make sure that the CHOP output level is approximately –3 dB when 0 dB is selected for the CW optical output level.

8.5.3 Servicing the LD Unit

Dusts or dirts on the unit light output connector can adversely affect the light output level and stability. The optical connector, universal connector and optical fiber must be cleaned with alcohol prior to use.

8.6 DFB-LD Unit (AQ4214)

8.6.1 Tester Units Required

Table 8-5 lists the tester units required for the maintenance.

Table 8-5 Tester Units Used for the Test (AQ4214)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter (AQ2140+AQ2733)	Power measurement range : –110 to +10 dBm Wavelength range : 0.7 to 1.7 μm
Optical spectrum analyzer (AQ-6315A)	Wavelength range : 0.35 to 1.75 μm Resolution : 0.05 nm
Optical fiber cord	Single mode optical fiber (short length) with SC/APC-FC/PC

(Testers in the parentheses are equivalent Ando products)

8.6.2 Periodic Inspection

Periodic inspection at six-month interval is recommended for this DFB-LD unit since its design ensures higher stability and reliability. The following describes the check points.

⚠ CAUTION
Don't try to touch inside of the DFB-LD unit.

(1) Center wavelength and spectral width
Select the CW for the unit optical modulation mode, then measure the center wavelength and and spectral width using the optical spectrum analyzer.

(2) Optical output level and stability
Select the CW mode for the respective unit output waveforms, connect the unit to the optical power meter using the short optical fiber (2 meters), then measure the optical output level.

(3) Optical modulation mode
Using the optical power meter, make sure that the CHOP output level is approximately –3 dB when 0 dB is selected for the CW output level.

8.6.3 Servicing the DFB-LD Unit

Dusts or dirts on the unit light output connector can adversely affect the light output level and stability. The optical fiber connected must be cleaned with alcohol prior to its use.

For cleaning of the DFB-LD unit optical output section, Kuretop Stick Type from NTT International Co. is recommended.

8.7 LED Unit (AQ4215)

8.7.1 Tester Units Required

Table 8-6 lists the tester units required for the maintenance.

Table 8-6 Tester Units Used for the Test (AQ4215)

Tester Name	Major Performance
AQ2140 optical multimeter	
Product name: AQ4215 (850) Optical power meter (AQ2140+AQ2731)	Power measurement range : –110 to +3 dBm Wavelength range : 0.4 to 1.1 µm
Product name: AQ4215(131), AQ4215(155) Optical power meter (AQ2140+AQ2733)	Power measurement range : –110 to +10 dBm Wavelength range : 0.7 to 1.7 µm
Optical spectrum analyzer (AQ-6315A)	Wavelength range : 0.35 to 1.75 µm Resolution : 0.05 nm
Product name: AQ4215(085), AQ4215(131) Optical fiber cord	GI (50/125) fiber cord (short length) with FC/PC at both ends.
Product name: AQ4215(131), AQ4215(155) Optical fiber cord	Single mode optical fiber cord (short length) with FC/PC at both ends.

(Testers in the parentheses are equivalent Ando products)

8.7.2 Periodic Inspection

Periodic inspection at six-month interval is recommended for this LED unit since its design ensures higher stability and reliability. The following describes the check points.

⚠ CAUTION
Don't try to touch inside of the LED unit.

(1) Center wavelength and spectral half-value width
Select the CW for the unit optical modulation mode, then measure the center wavelength and and spectral half-value width using the optical spectrum analyzer.

(2) Optical output level and stability
Select the CW mode for the respective unit output waveforms, connect the unit to the optical power meter using a short fiber (2 meters), then measure the optical output level.

(3) Optical modulation mode
Using the optical power meter, make sure that the CHOP output level is approximately –3 dB when 0 dB is selected for the CW output level.

8.7.3 Servicing the LED Unit

Dusts or dirts on the unit optical output connector can adversely affect the optical output level and stability. The optical fiber connected must be cleaned with alcohol prior to use.

8.8 Light Source Unit (AQ4214 and AQ4221)

8.8.1 Tester Units Required

Table 8-7 lists the tester units required for the maintenance.

Table 8-7 Tester Units Used for the Test (AQ4218, 42221)

Tester Name	Major Performance
AQ2140 optical multimeter	
Optical power meter (AQ2140+AQ2733)	Power measurement range : –110 to +10 dBm Wavelength range : 0.7 to 1.7 μm
Optical spectrum analyzer (AQ-6315A)	Wavelength range : 0.35 to 1.75 μm Resolution : 0.05 nm
Optical fiber cord	Single mode optical fiber (short length) with the FC/SPC polished ferule connectors at both ends.

(Testers in the parentheses are equivalent Ando products)

8.8.2 Periodic Inspection

Periodic inspection at six-month interval is recommended for this light source unit since its design ensures higher stability and reliability. The following describes the check points.

⚠ CAUTION
Don't try to touch inside of the optical source unit.

(1) Center wavelength and spectral half-value width
Select the CW for the unit optical modulation mode, then measure the center wavelength and and spectral half-value width using the optical spectrum analyzer.

(2) Optical output level and stability
Select the CW for the respective unit output waveforms, connect the unit to the optical power meter using a short fiber (2 meters), then measure the optical output level.

(3) Optical modulation mode
Using the optical power meter, make sure that the CHOP output level is approximately –3 dB when 0 dB is selected for the CW output level.

8.8.3 Servicing the LD Unit

Dusts or dirts on the unit optical output connector can adversely affect the optical output level and stability. The optical connector, universal connector and optical fiber connected must be cleaned with alcohol prior to use.

8.9 Return Loss Tester Unit (AQ7310)

8.9.1 Tester Units Required

Table 8-8 lists the tester units required for the maintenance.

Table 8-8 Tester Units Used for the Test (AQ7310)

Tester Name	Major Performance
AQ2140 optical multimeter	
LD light source	Emission light wavelength : 1310 ±20 mm Optical modulation mode : CHOP at 270 Hz Output level : 0 to –5dBm
Optical fiber cord	Single mode optical fiber (fiber length 2 meters) with the AC polished ferule connectors at both ends.

8.9.2 Periodic Inspection

Periodic inspection at six-month interval is recommended for this return loss tester unit since its design ensures higher stability and reliability. The following describes the check points.

⚠ CAUTION
Don't try to touch inside of the return loss tester unit.

(1) Checking the dynamic range
Connect the unit as shown in Figure 8-5 to measure the reference reflection, then remove the master cord and make sure that the displayed indication is 65 dB or above.

(2) Checking the indicated stability
Connecting the unit as shown in Figure 8-5, make sure that the indicated stability is ±0.02 dB or less during the five minutes of reference reflection measurement (when the AQ4211 or AQ4213 is used as the optical source).

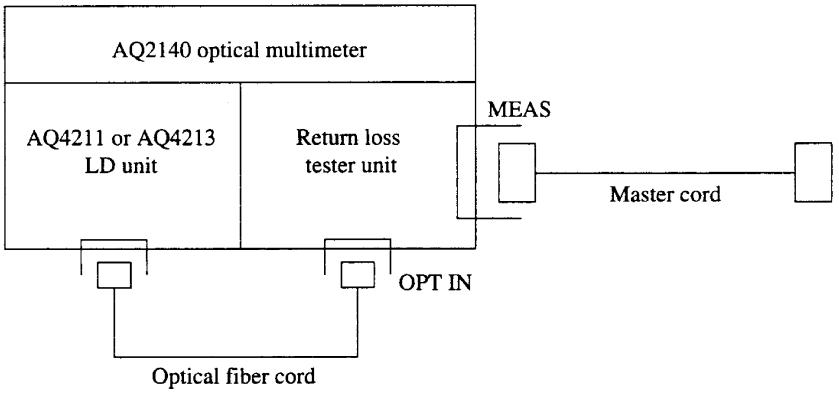


Figure 8-5 Performance Test (AQ7310)

8.9.3 Servicing the LD Unit

Dusts or dirts on the unit photosensor or master cord connections can make the unit's dynamic range, relative measurement accuracy or measurement stability unpredictable. Prior to the measurement, the unit photosensor, master cord connections and optical fiber connector must be cleaned with alcohol. For the above mentioned cleaning, Kuretop Stick Type from NTT International Co. is recommended.

List of OPM Unit (AQ2730) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Plug for analog output	1	Plug alone. Connection is not provided.

List of Sensor (AQ2741 to 2743) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Shield cap	1	Mounted on the sensor
2	Stopper ring	1	Mounted on the shield cap

List of the Sensor Unit (AQ2731) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Plug for analog out	1	Plug alone. Connection is not provided.
2	Dust prevention cap	1	Mounted on the photosensor
3	Stopper ring	1	Mounted on the photosensor

List of Sensor Unit (AQ2732 to 2735) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Plug for analog output	1	Plug alone. Connection is not provided.

List of Light Source Unit (AQ4211 to 4213, AQ4218 and AQ4221) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Connector protection cap	1	Mounted on the optical output section.

List of Optical Source Unit (AQ4214) Accessories

No.	Accessory Name	Q'ty	Remarks
1	Protection cap (for SC)	1	Mounted on the optical output section.

List of Optical Source Unit (AQ4215) Accessories

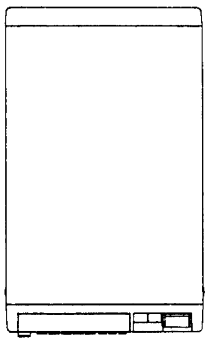
No.	Accessory Name	Q'ty	Remarks
1	Stopper ring	1	Mounted on the optical output section
2	Dust protection cap	1	Mounted on the optical output section

List of Return Loss Tester Unit (AQ7310) Accessories

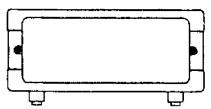
No.	Accessory Name	Q'ty	Remarks
1	Protection cap (for FC)	1	Mounted on the photosensor
2	Protection cap (for SC)	1	Mounted on the master cord connection.

OUTSIDE VIEW OF OPTICAL MULTIMETER 1/3

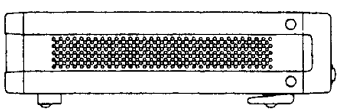
AQ2140 OPTICAL MULTIMETER



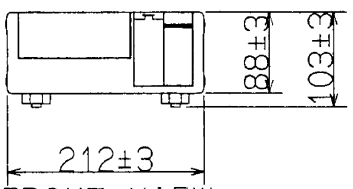
TOP VIEW



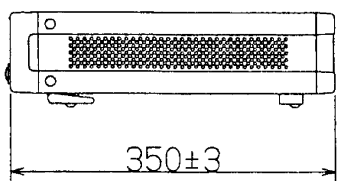
REAR VIEW



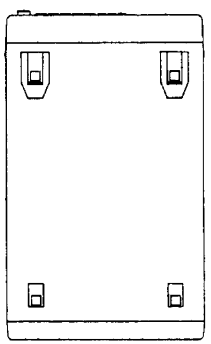
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

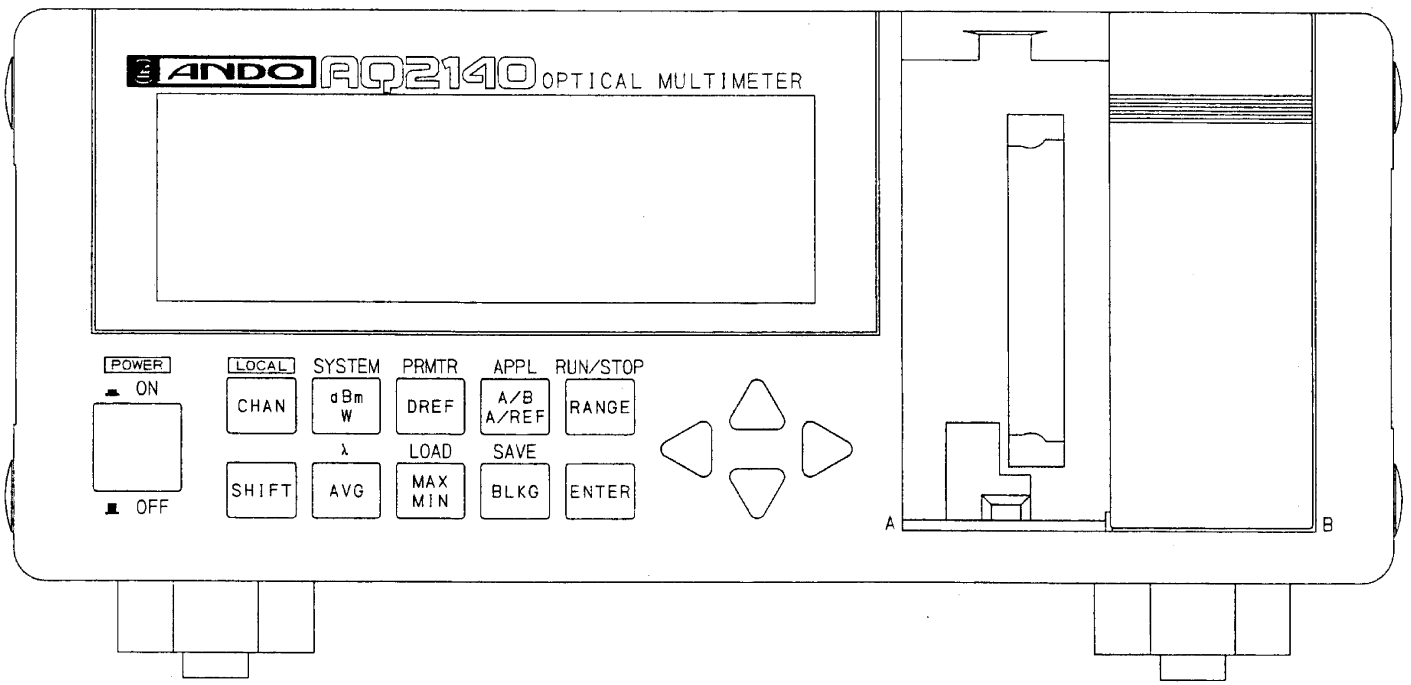


BOTTOM VIEW

DIMENSION SHOWN IN mm

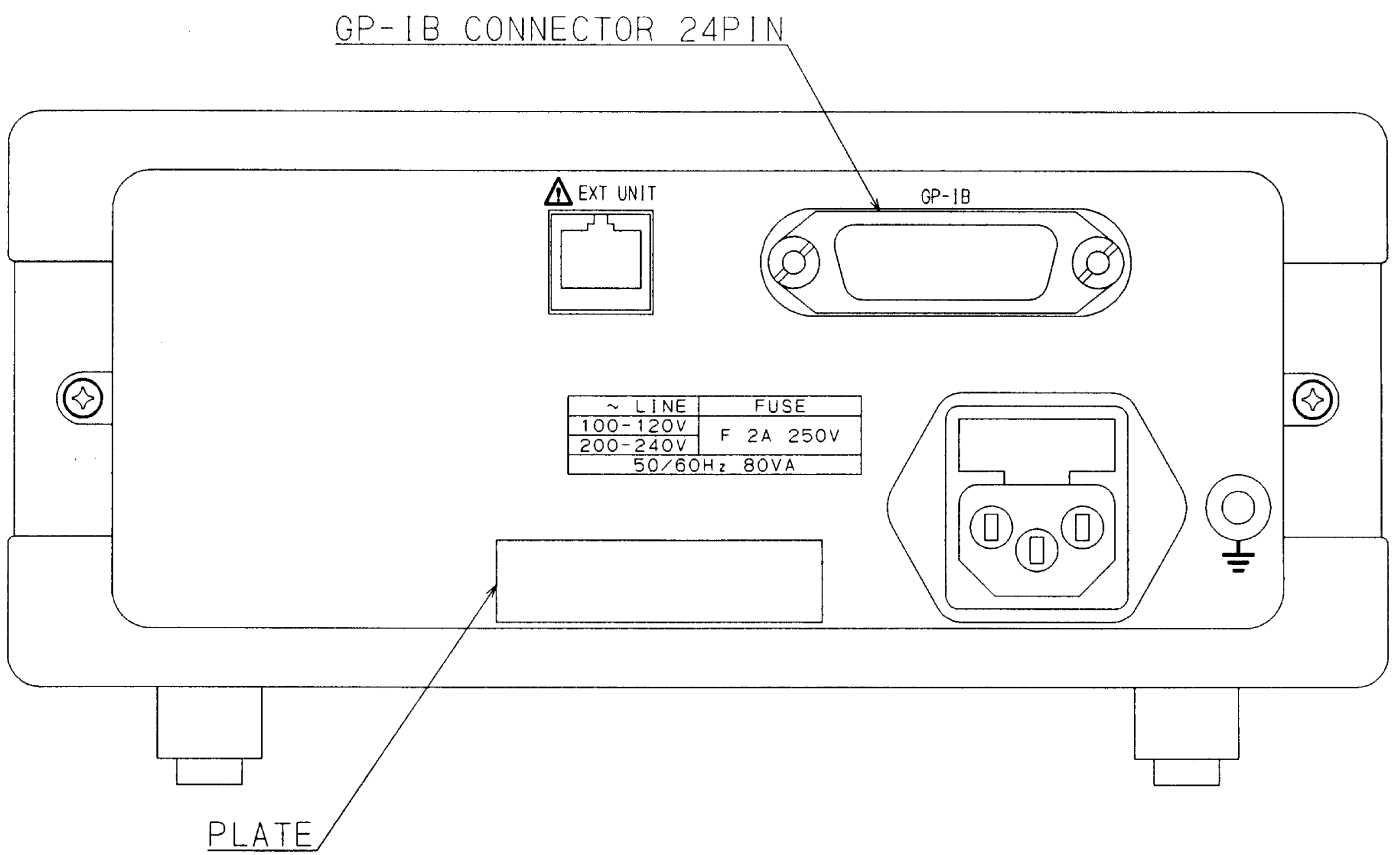
OUTSIDE VIEW OF OPTICAL MULTIMETER 2/3

AQ2140 OPTICAL MULTIMETER



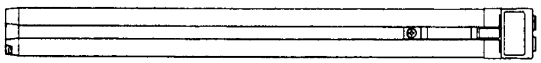
OUTSIDE VIEW OF OPTICAL MULTIMETER 3/3

AQ2140 OPTICAL MULTIMETER

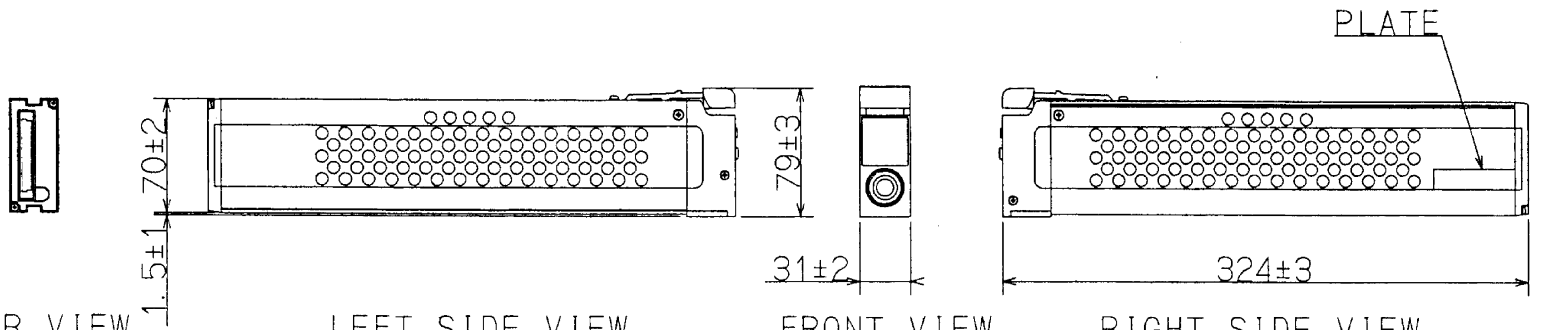


OUTSIDE VIEW OF SENSOR/OPM UNITS(OPTIONAL) 1/4

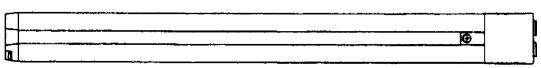
AQ2730 OPM UNIT



TOP VIEW



REAR VIEW　LEFT SIDE VIEW　FRONT VIEW　RIGHT SIDE VIEW

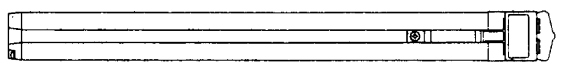


BOTTOM VIEW

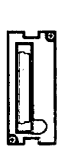
DIMENSION SHOWN IN mm

OUTSIDE VIEW OF SENSOR/OPM UNITS(OPTIONAL) 2/4

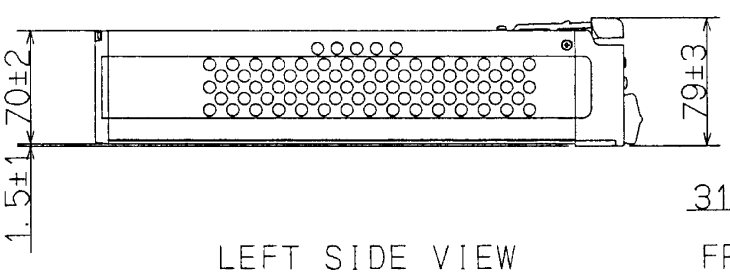
AQ2731 SENSOR UNIT



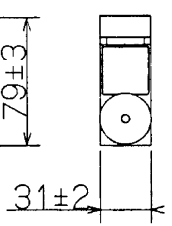
TOP VIEW



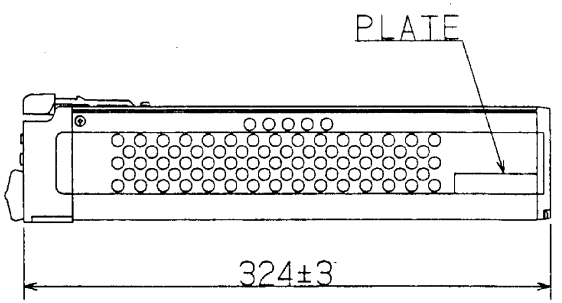
REAR VIEW



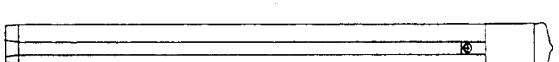
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

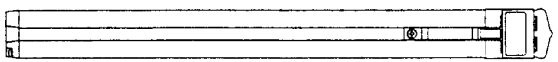


BOTTOM VIEW

DIMENSION SHOWN IN mm

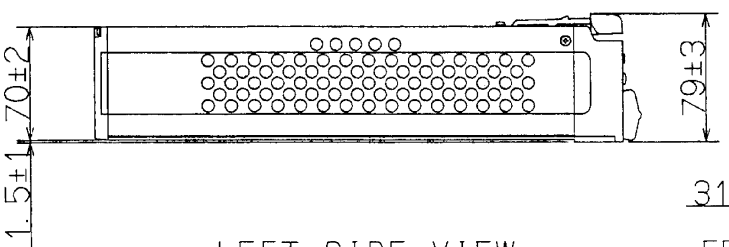
OUTSIDE VIEW OF SENSOR/OPM UNITS(OPTIONAL) 3/4

AQ2732 SENSOR UNIT
AQ2733 SENSOR UNIT
AQ2734 SENSOR UNIT
AQ2735 SENSOR UNIT

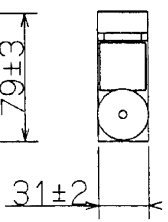


TOP VIEW

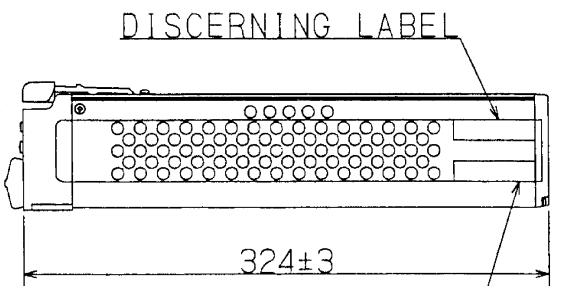
REAR VIEW



LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

BOTTOM VIEW

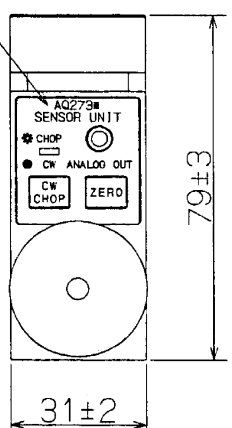
DIMENSION SHOWN IN mm

OUTSIDE VIEW OF SENSOR/OPM UNITS(OPTIONAL) 4/4

CORRESPONDENCE TABLE

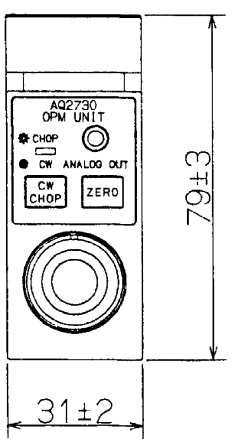
AQ2731 SENSOR UNIT	AQ2731 SENSOR UNIT
AQ2732 SENSOR UNIT	AQ2732 SENSOR UNIT
AQ2733 SENSOR UNIT	AQ2733 SENSOR UNIT
AQ2734 SENSOR UNIT	AQ2734 SENSOR UNIT
AQ2735 SENSOR UNIT	AQ2735 SENSOR UNIT

REFER TO THE ABOVE



DIMENSION SHOWN IN mm

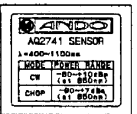
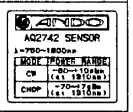
AQ2730 OPM UNIT

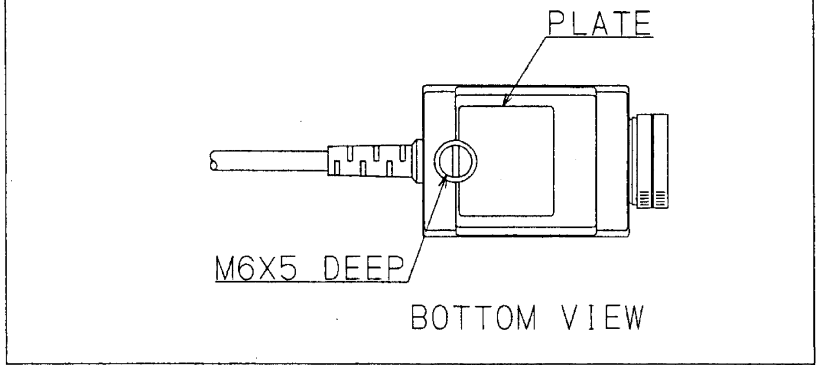


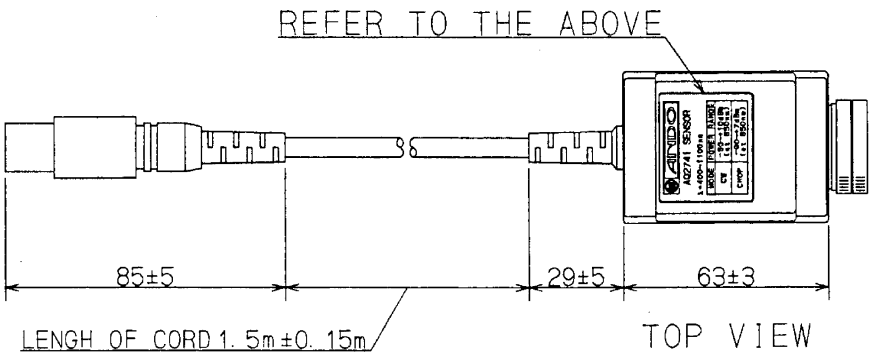
DIMENSION SHOWN IN mm

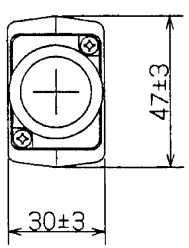
OUTSIDE VIEW OF AQ2730 OPM UNIT(OPTIONAL)

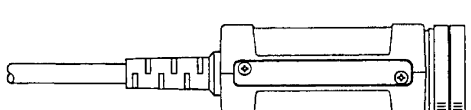
CORRESPONDENCE TABLE

AQ2741 SENSOR	
AQ2742 SENSOR	
AQ2743 SENSOR	





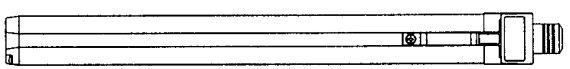




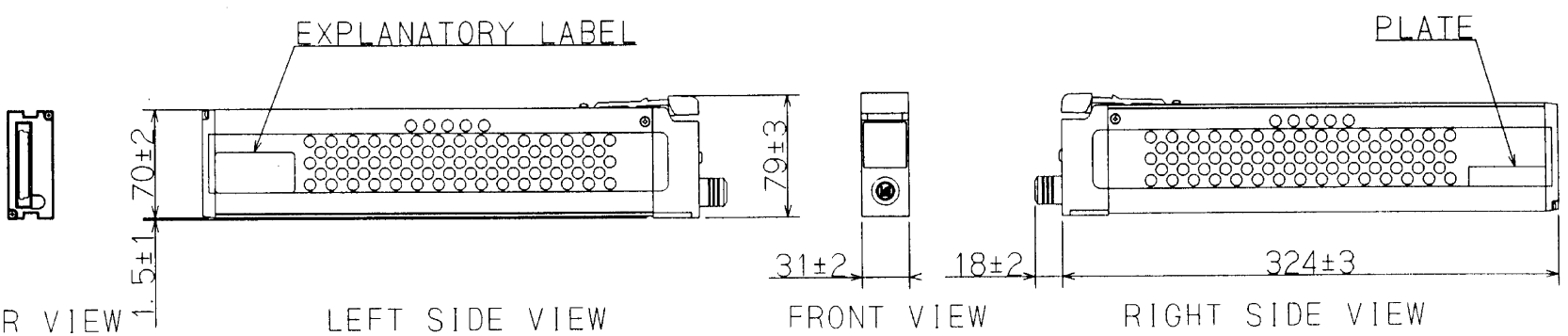
DIMENSION SHOWN IN mm

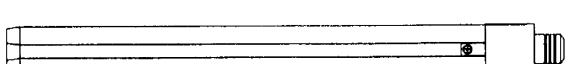
OUTSIDE VIEW OF LD/LED/EE-LED UNITS(OPTIONAL) 1/2

AQ4211(131)LD UNIT
AQ4211(155)LD UNIT
AQ4211(165)LD UNIT
AQ4212(130)LD UNIT
AQ4213(131/155)LD UNIT
AQ4218(131)LED UNIT
AQ4218(155)LED UNIT
AQ4221(131)EE-LED UNIT
AQ4221(155)EE-LED UNIT



TOP VIEW





BOTTOM VIEW

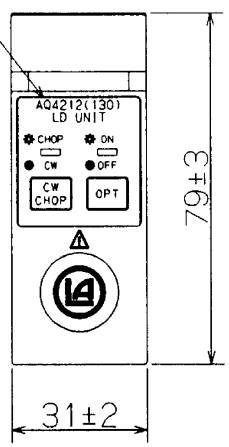
DIMENSION SHOWN IN mm

OUTSIDE VIEW OF LD/LED/EE-LED UNITS(OPTIONAL) 2/2

CORRESPONDENCE TABLE

AQ4211(131) LD UNIT	AQ4211(131) LD UNIT
AQ4211(155) LD UNIT	AQ4211(155) LD UNIT
AQ4211(165) LD UNIT	AQ4211(165) LD UNIT
AQ4212(130) LD UNIT	AQ4212(130) LD UNIT

REFER TO THE ABOVE

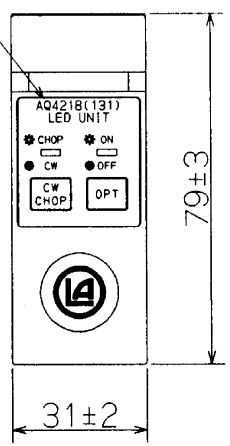


DIMENSION SHOWN IN mm

CORRESPONDENCE TABLE

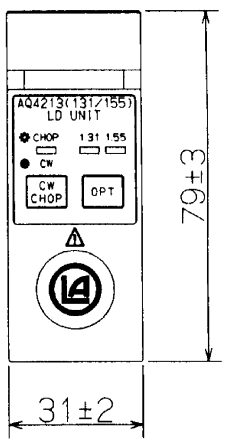
AQ4218(131) LED UNIT	AQ4218(131) LED UNIT
AQ4218(155) LED UNIT	AQ4218(155) LED UNIT
AQ4221(131) EE-LED UNIT	AQ4221(131) EE-LED UNIT
AQ4221(155) EE-LED UNIT	AQ4221(155) EE-LED UNIT

REFER TO THE ABOVE



DIMENSION SHOWN IN mm

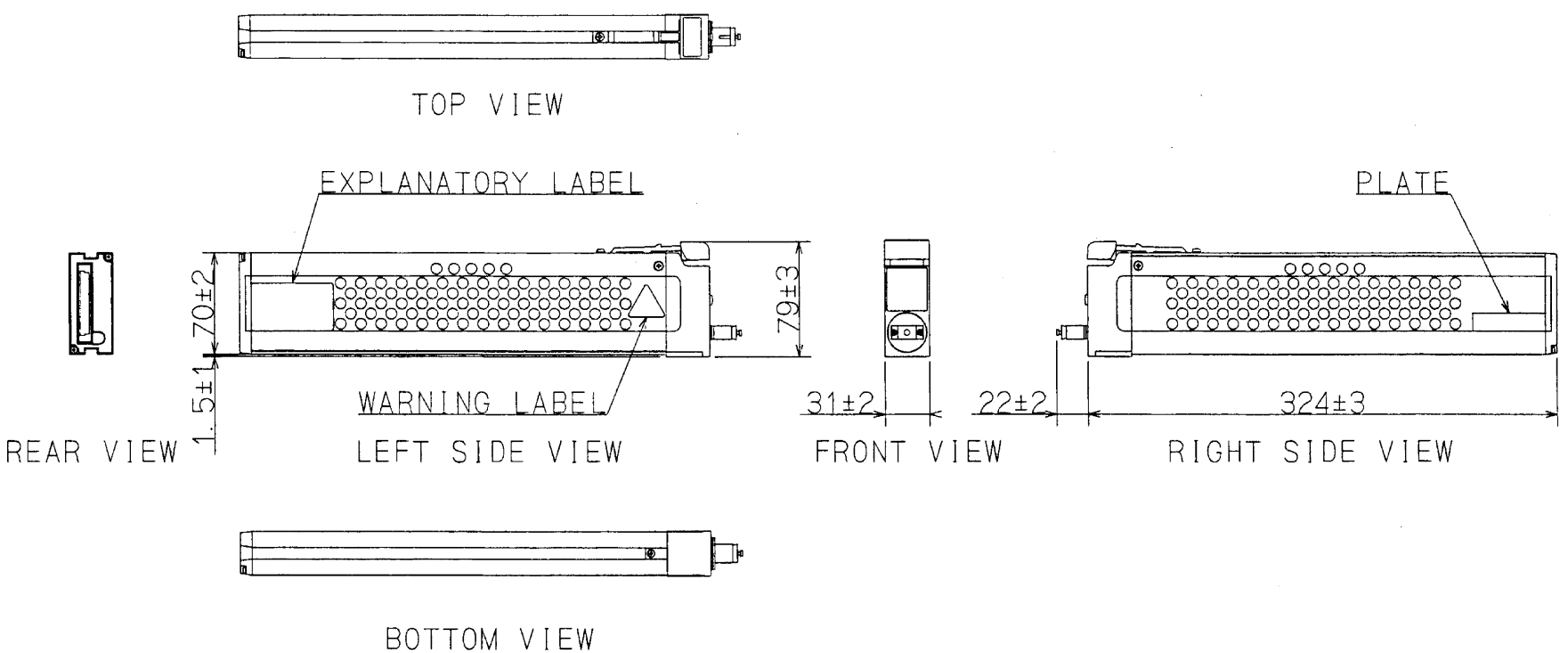
AQ4213(131/155)
LD UNIT



DIMENSION SHOWN IN mm

OUTSIDE VIEW OF DFB-LD UNIT(OPTIONAL) 1/3

AQ4214(131)DFB-LD UNIT

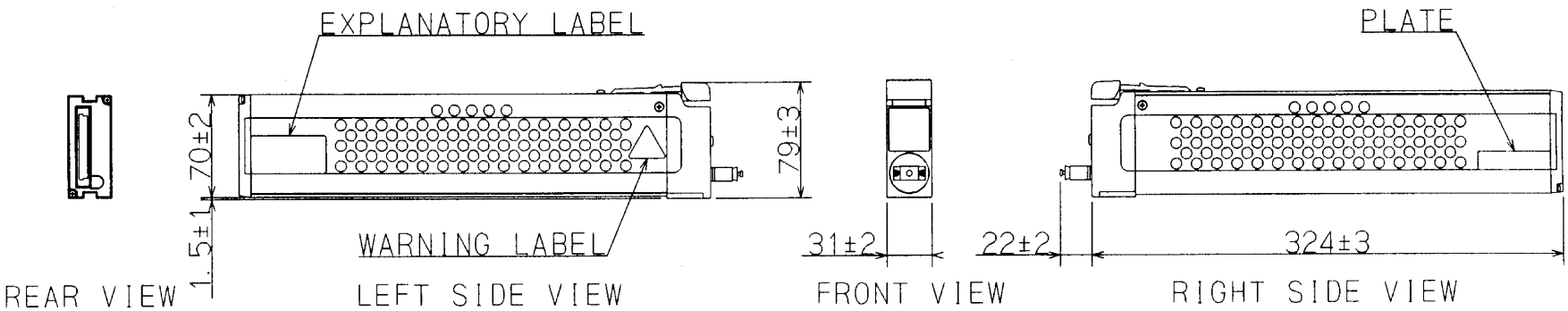


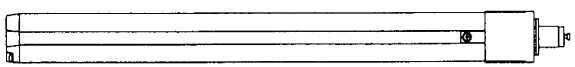
DIMENSION SHOWN IN mm

OUTSIDE VIEW OF DFB-LD UNIT(OPTIONAL) 2/3

AQ4214(155)DFB-LD UNIT

TOP VIEW





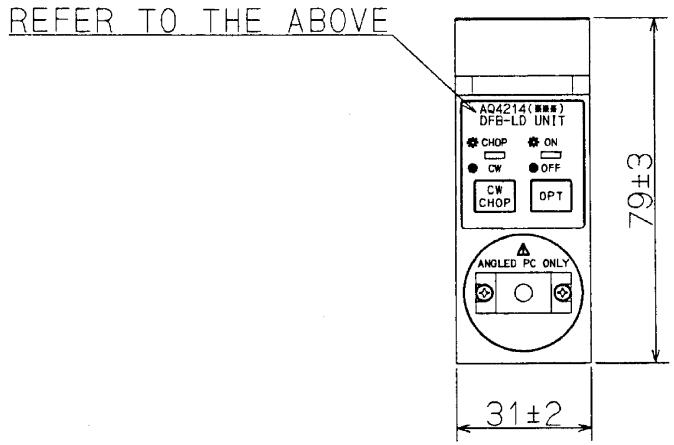
BOTTOM VIEW

DIMENSION SHOWN IN mm

OUTSIDE VIEW OF DFB-LD UNIT(OPTIONAL) 3/3

CORRESPONDENCE TABLE

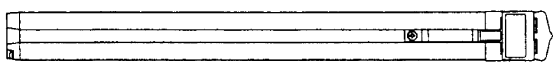
AQ4214(131) DFB-LD UNIT	AQ4214(131) DFB-LD UNIT
AQ4214(155) DFB-LD UNIT	AQ4214(155) DFB-LD UNIT



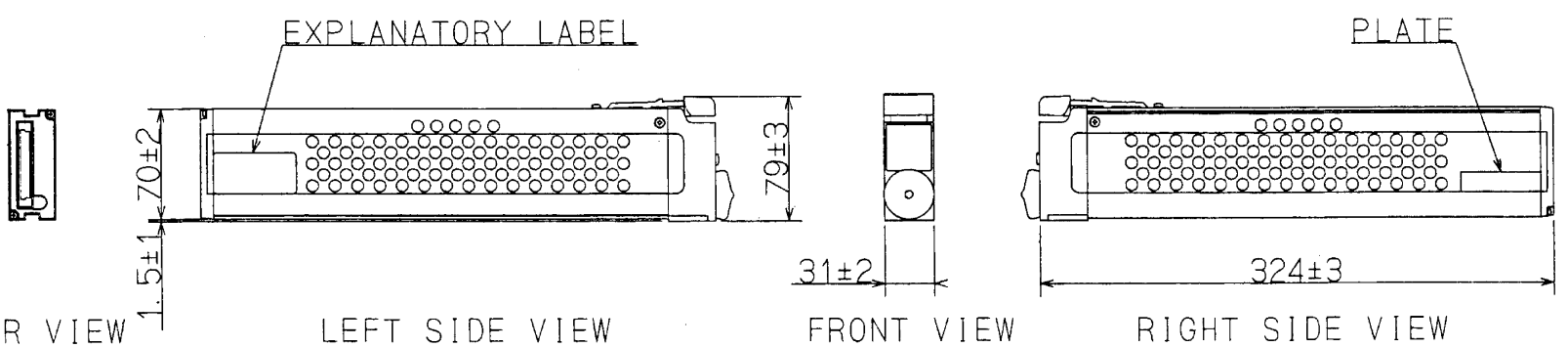
DIMENSION SHOWN IN mm

OUTSIDE VIEW OF LED UNIT(OPTIONAL) 1/2

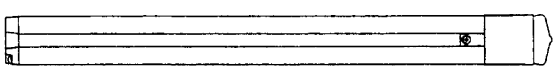
AQ4215(085)LED UNIT
AQ4215(131)LED UNIT
AQ4215(155)LED UNIT



TOP VIEW



REAR VIEW　LEFT SIDE VIEW　FRONT VIEW　RIGHT SIDE VIEW



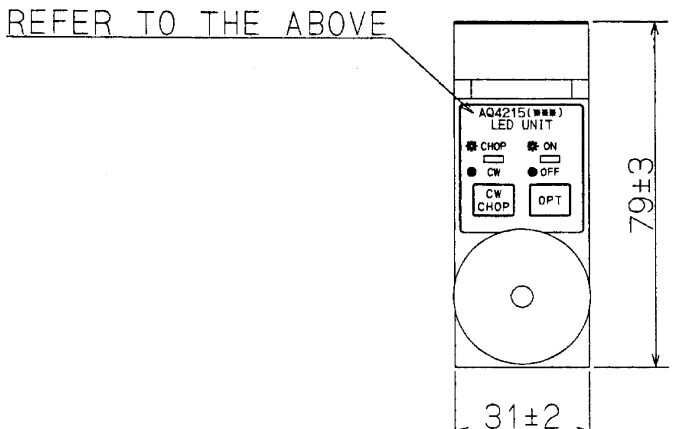
BOTTOM VIEW

DIMENSION SHOWN IN mm

OUTSIDE VIEW OF LED UNIT(OPTIONAL) 2/2

CORRESPONDENCE TABLE

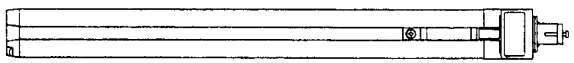
AQ4215(085) LED UNIT	AQ4215(085) LED UNIT
AQ4215(131) LED UNIT	AQ4215(131) LED UNIT
AQ4215(155) LED UNIT	AQ4215(155) LED UNIT



DIMENSION SHOWN IN mm

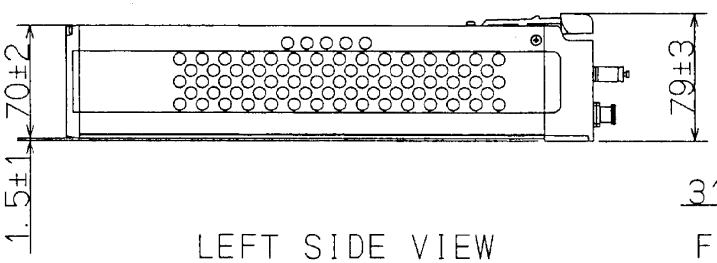
OUTSIDE VIEW OF OPTICAL RETURN LOSS UNIT(OPTIONAL) 1/2

AQ7310 OPTICAL RETURN LOSS UNIT

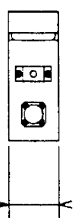


TOP VIEW

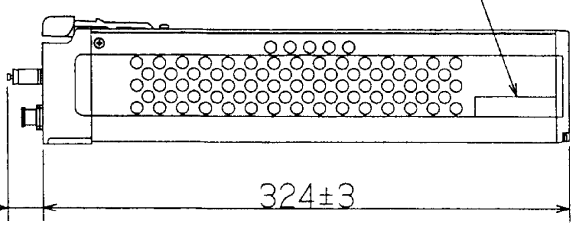
REAR VIEW



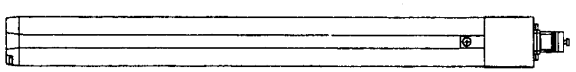
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

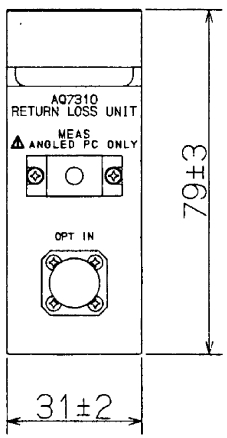


BOTTOM VIEW

DIMENSION SHOWN IN mm

OUTSIDE VIEW OF OPTICAL RETURN LOSS UNIT(OPTIONAL) 2/2

AQ7310 OPTICAL RETURN LOSS UNIT



DIMENSION SHOWN IN mm