ADVANTEST®
ADVANTEST CORPORATION

INSTRUCTION
MANUAL
Q89611F
LASER DIODE TEST SET

MANUAL NUMBER   OEB00 911

Q89611F
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INSTRUCTION MANUAL

TABLE OF CONTENTS

Q89611F
LASER DIODE TEST SET
INSTRUCTION MANUAL

1. GENERAL

1.1 Outline of Product

The laser diode test set Q89611F allows high reproducible measurement of laser diode electric and I-L characteristics by external control.

Nov 8/89

1.2 Preface

1.2.1 Checking of Appearance and Standard Accessories

When this device is delivered, check if any damage occurred during transportation.

Then, check the quantity of the standard accessories according to Table 1-1.

If there is any damage or shortage of the standard accessories, contact nearest sales office, or agent.

Table 1 - 1 Standard Accessories

Product name	Type name	Parts code	Quantity	Remarks
Power supply cable	-	DCB-DD1607X02	1	
I/O cable	-	DCB-SS3017X01	1	
Fuse	MDX-2A	DFT-AG2A-1	2	For 2A, 100/120V specifications
	MDL-1A	DFT-AH1A-1		For 1A, 220/240V specifications
Operation manual	-	J89611F	1	Japanese sentence
	-	E89611F		English sentence

1.2.2 General Cautions

(1) Replacement of Power Supply Fuses and Change of Supply Voltage

The power supply fuses are stored in the fuse box located in the power supply connector on the rear panel of this device.

To replace the fuse, remove the cable from the power supply connector, and slide the plastic cover open. Pull the lever marked FUSE PULL forward to remove the fuse. Be sure to replace the fuse with the standard one conforming to the supply voltage used, as shown in Table 1-2.
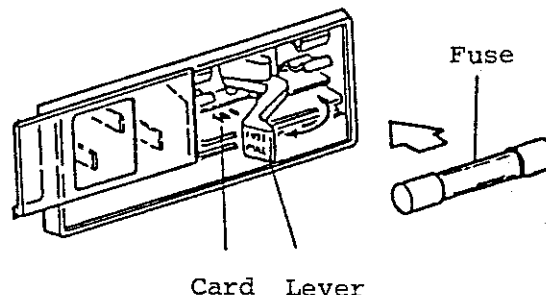
Figure 1 - 1   Replacement of Power Supply Fuse

Table 1 - 2   Change of Supply Voltage

Supply voltage to be used (VAC)	90V - 110V	103V - 132V	198V - 242V	207V - 250V
Fuse capacity	2A		1A	
Card setting	100	120	220	240
Supply voltage changeover switch	100V/120V		220V/240V	

When this device is to be with a different supply voltage, reset the card in the fuse box.   (See Figure 1-1.)

After the power is turned off, if the fuse is removed, the card where numerals (100, 120, 220, 240) are written can be seen under the FUSE PULL lever.

Pull out the card, and change the direction of the card, inserting it so that the supply voltage used comes to the left side of the upper surface.   The voltage value that can be read when the card is inserted is the set voltage value.

Next, change the supply voltage changeover switch to conform to the above set voltage.

Finally, check if the capacity of the power supply fuse coincides with the above set voltage.   (See Table 1-2.)

(2) Power Supply Cable

The plug of the power supply cable is 3-pin, with central round pin used for the ground. With the plug connected to the plug socket using the adapter A09034 supplied, connect the ground cable Figure 1-2 (a) coming from the adapter or the ground terminal on the rear panel of this unit to the ground on the outside.

The supplied adapter A09034 has been manufactured based on the regulations for electrical products.

Since the width A and B of the two electrodes of the adapter A09034 are different, as shown in Figure 1-2 (b), when the adapter is inserted into the plug socket, check the directions of the plug and plug socket before connection.

If the A09034 cannot be connected to the plug socket used, obtain the adapter KPR-13 sold separately.

To plug socket of AC power supply — Adapter A09034 — Ground pin — Power supply cable 3-pin plug — To mainframe — Connect this pin to ground

(a)

Adapter A09034

(b)

Figure 1 - 2 Plug and Adapter of Power Supply Cable
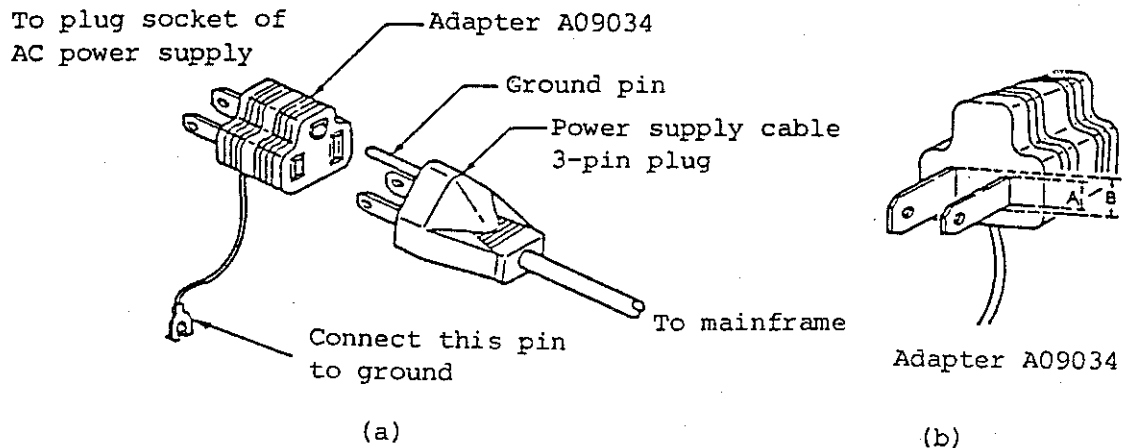
(3) Use Environment

This device must not be exposed to dusty environments, direct sunlight, or corrosive gases. This device shall be used in an ambient temperature of $0^{\circ}C$ to $+40^{\circ}C$, and relative humidity of less than 85%.

(4) Cooling Ventilation

Since this device is ventilated by blow off from the rear panel, be careful not to cover the fan during operation.

(5) Warm-up Time

Though all functions work as soon as the power is turned on, allow a warm-up time of at least 30 minutes to ensure the measuring precision.

(6) Alarm Function of Fan

When the fan stops for any reason, this device gives an alarm if the thermostat in the power unit reaches 75°C.

(7) Protective Function

In the measuring mode the measured device is isolated after setting the output of power supply to 0 to protect the measured device. For standby, both electrodes of the LD terminal are grounded.

(8) Storage

When this device will not be in use for a long time, cover it, with a vinyl sheet or place it in a carton, and sotre it in a dry place away from direct sunlight.

(9) Caution for Tranportation

When this device is transported, pack it in the container in which it was first delivered.

① Pack this device using a vinyl sheet or similar material.

② Use a carton with sides at least 5 mm thick to put this device into after wrapping it using cushioning material at least 50 mm thick.

③ Place the attachment on top, add more cushioning material, and then close the carton and fasten the outside using packaging string.

Q89611F
LASER DIODE TEST SET
INSTRUCTION MANUAL

2. EXPLANATION OF PANEL

Note that this device can be used by connecting to the CPU using the GPIB cable.

To control this device, generation and measurement of current and voltage and measurement of I-L characteristics can be performed by inputting the commands and numerals from the CPU.
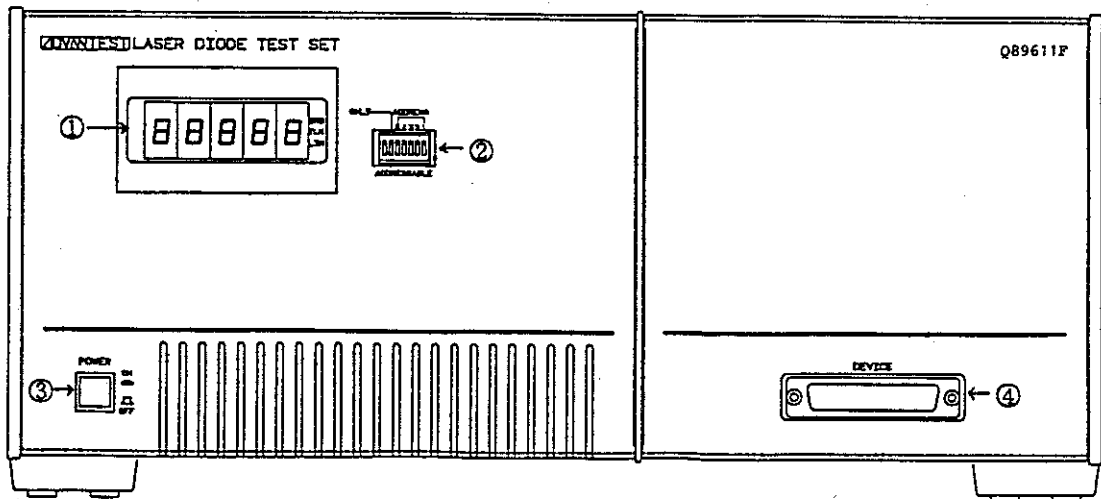
2.1 Explanation of Front Panel


Figure 2 - 1   Front Panel

① Display Unit

    The display unit, which consists of an
8-segment LED of five digits, displays
error codes and the equipment status.
And when this device is controlled by
means of GPIB, it displays the status as
a device.

    When the power supply switch is turned
on, all LEDs light, and the display
indicates rd (ready) after displaying the
ROM version and the header ON/OFF status.

    The ready display means the GPIB command
can be accepted. The SRQ lamp shows that
the service request is originated to the
controller.
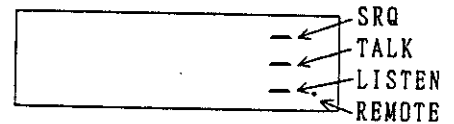
    The TALK lamp lights when the device is
in the talker status to send data, and
the LISTEN lamp lights when the device is
in the listener status to receive data.

    The REMOTE lamp shows whether this device
is in the externally controlled status.
During measurement, all lamps on the
lowest segment light.

    The operation lamp shows that the device
is in generation status after measurement
has been completed.
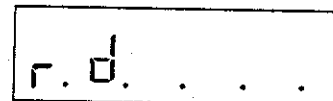
    The operation lamp goes off by means of
the SB (Stand-By) command. The display
indicates the error status for approx.
1 sec. after the device goes into error
status; then the display disappears. At
the same time, the buzzer rings. During
error display, the GPIB status lamp is
ignored.

Ready display

GPIB status lamp

Display during
measurement

Operation status
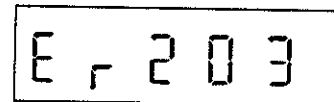
Error display

② Address Switch

    The addresses are set using the switches from the first bit to the
fifth bit. Thirty-one types of addresses can be set. Since the
contents of the address switches are always acknowledged, it is not
necessary to turn on the power supply again after the address has been
set.

③ Power Supply Switch

When this switch is pressed, the power supply is turned on, the power is supplied in the circuit, and the device starts operating. If this switch is pressed again under the ON status, the power supply is turned off.

④ Connect for Measuring Signal I/O Cable

Refer to 2.1 for connection to I/O cable.

(a) Connector D-sub (DDM-24W7) [JAE Company] is used
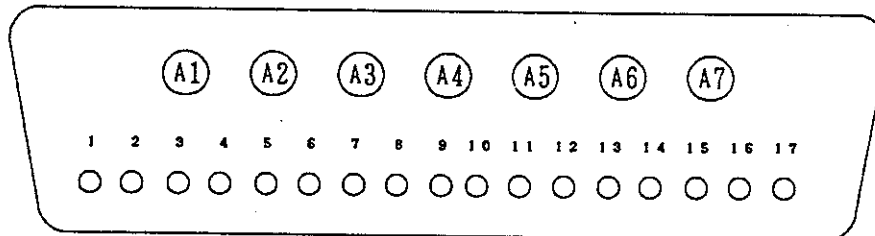
$$\begin{bmatrix} \text{A1 to A7 : Coaxial cable} \\ \text{1 to 14 : Shielding wire} \\ \text{15 to 17 : Twisted wire} \end{bmatrix}$$

Q89611F
LASER DIODE TEST SET
INSTRUCTION MANUAL

2.2 Explanation of Rear Panel
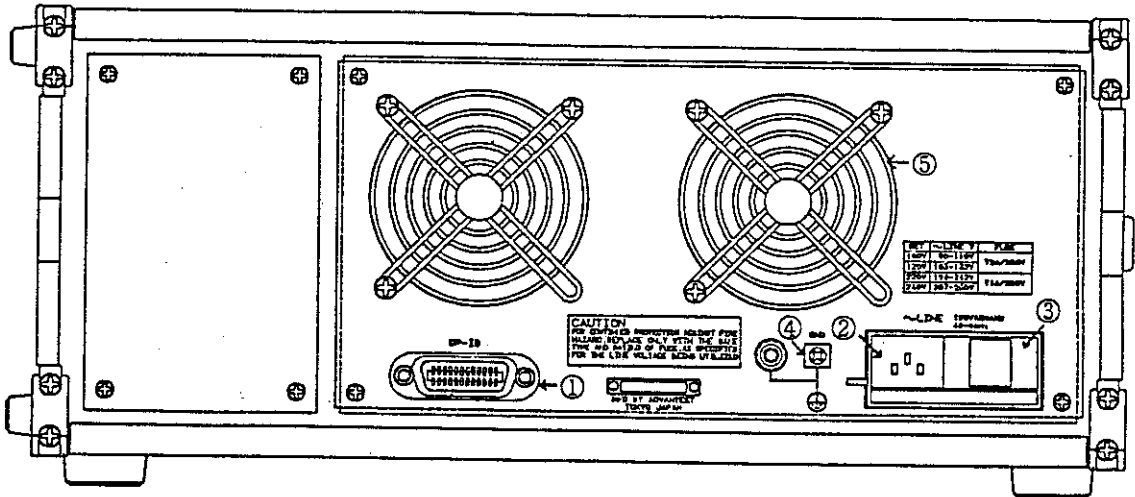
Figure 2 - 2   Explanation of Rear Panel

① Connector for GPIB Cable

② Connector for power supply cable

③ Fuse holder

④ Ground pin

⑤ Fan

3. CONNECTION OF DEVICE

3.1 I/O Cable Signal

(a) Connector D-sub (DDM-24W7) [JAE Company] is used
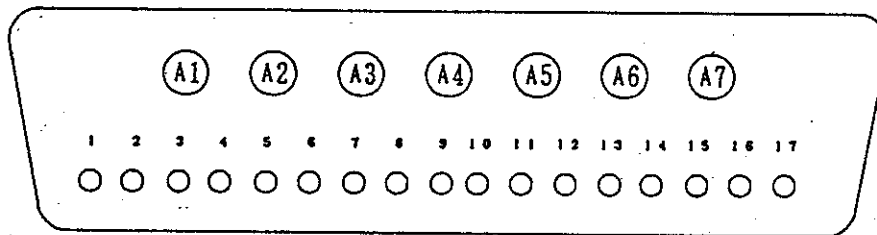

```
⌈ A1 to A7 : Coaxial cable  ⌉
│  1 to 14 : Shielding wire │
⌊ 15 to 17 : Twisted wire   ⌋
```

(b) Signal name

No.	Signal name		Description	No.	Signal name	Description
A1	Core wire	LDHF	Laser side High-force	3	LDLS	Laser side Low-sense
	Shield	Shield	Shield	4	Shield	Shield
A2	Core wire	LDHS	Laser side High-sense	5	PDLF	Monitor side Low-force
	Shield	Shield	Shield	6	Shield	Shield
A3	Core wire	PDHF	Monitor side High-force	7	PDLS	Monitor side Low-sense
	Shield	Shield	Shield	8	Shield	Shield
A4	Core wire	PDHS	Monitor side High-sense	9	NC	Not used
	Shield	Shield	Shield	10	NC	Not used
A5	Core wire	IL-A	Photodiode anode (CH-A)	11	VR-A	Photodiode cathode (CH-A)
	Shield	Shield	Shield	12	Shield	Shield
A6	Core wire	IL-B	Photodiode anode (CH-B)	13	VR-B	Photodiode cathode (CH-B)
	Shield	Shield	Shield	14	Shield	Shield
A7	Core wire	VR	Photodiode cathode	15	A/B	External CHA/CHB changeover signal
	Shield	Shield	Shield	16	GND	GND
1	LDLF		Laser side Low-force	17	NC	Not used
2	Shield		Shield			

3.2 Procedures for Connecting Devices

(1) Connecting with Fixture

Arrange the cables between the device and IL sensor based on the measurement system as shown in Figure 3-1.
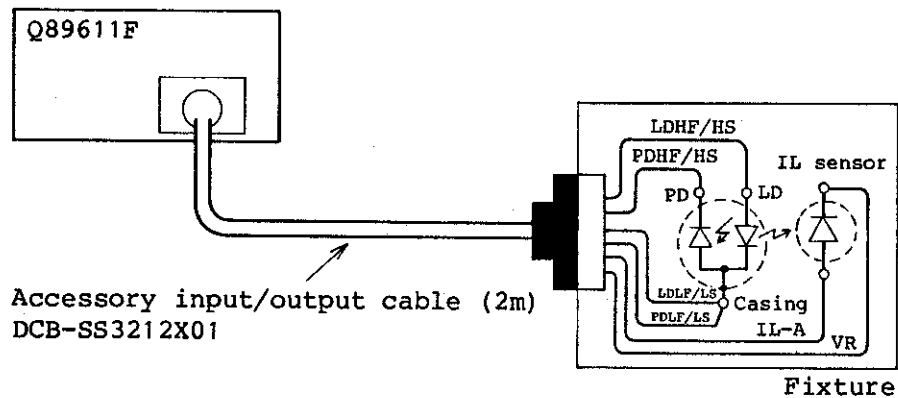
Figure 3 - 1   Example of Connection with Fixture

(Note)

o Attach the following connector inside of the fixture to connect the input/output cable:

- D-sub socket connector DDM-24W7S [JAE]
- Coaxial contact DM53742-5001 (Seven contacts are used.) [JAE]

o Use coaxial cable for detector and laser cable or shielding wire for wiring.

(2) Connecting Device

Example of connection

Connection of three-terminal type device (Example)

Connection of four-terminal type device (Example)

LDHF (A1)

LDHS (A2)

Cathode terminal
of monitor D

PDHF (A3)

PDHS (A4)

Anode terminal
of laser D

Monitor
diode

PDLF (5)
Shield (6)
PDLS (7)
Shield (8)

Laser
diode

Casing
(Common terminal)

LDLF (1)
Shield (2)
LDLS (3)
Shield (4)
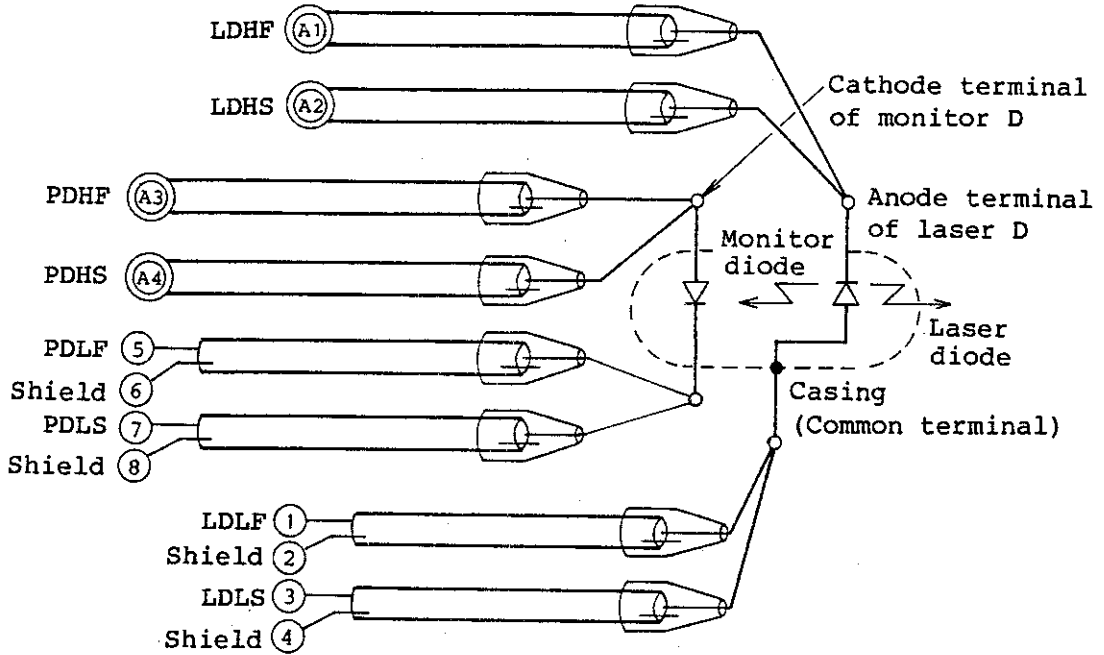
CAUTION

1. Arrange cables so that the device casing is connected to LF and LS of
   the device connector terminal no relation with the polarities (anode
   and cathode) of the laser diode or monitor doide. Add the symbols to
   the measuring program data for indicating the direction of the
   current. (See paragraphs 4-5 and 4-6.)

2. Do not connect the shielded side of the shield wire, connected to the
   monitor diode, to the fixture casing etc. If the above connection is
   made, the noise increases and the measuring precision may decrease.

(3) Connection of IL Sensor

Example of photodiode connection (One photodiode is used)
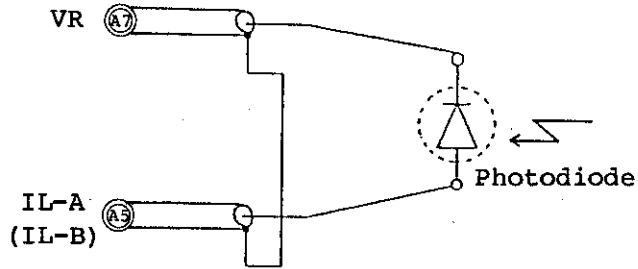
Example of photodiode connection (One long wave photodiode and one short wave photodiode are used)

Example of connection for changing over the diodes (external changeover
signal is used)
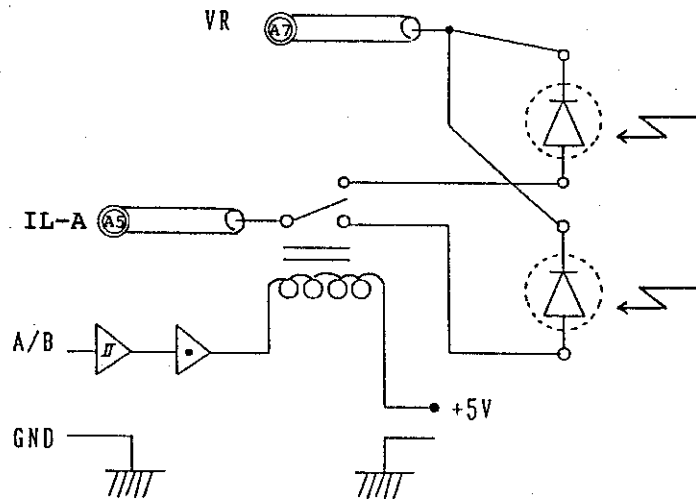
4. GPIB INTERFACE

4.1 General

The GPIB interface is used when this device is controlled through the standard bus (GPIB: General Purpose Interface Bus) of IEEE-488 standard. This device is operated by the GPIB interface only.

This chapter explains the standard of the GPIB interface, data output format, remote program code, program examples, etc. of this device.

4.2 Standards

- Compatible standard : IEEE STANDARD 488-1978 (DIGITAL INTERFACE FOR
  PROGRAMMABLE INSTRUMENTATION)

- Interface function : Table 4-1 lists the interface functions of this
  device and their descriptions.

Table 4 - 1   Interface Functions

Code	Functions
SH1	Source handshake function
AH1	Acceptor handshake function
T6	Basic talker function, serial pool function, talker cancel function specified by listener.
L4	Basic listener function, listener cancel function specified by talker.
SR1	Service request function
RL1	Remote/Local changeover function
PP0	No parallel poll function
DC1	Device clear function (SDC and DCL commands can be used.)
C0	No controller function
E2	Three state driver

- Code used: ASCII code

- Connector pin array:

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

24-pin GPIB connector

Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1
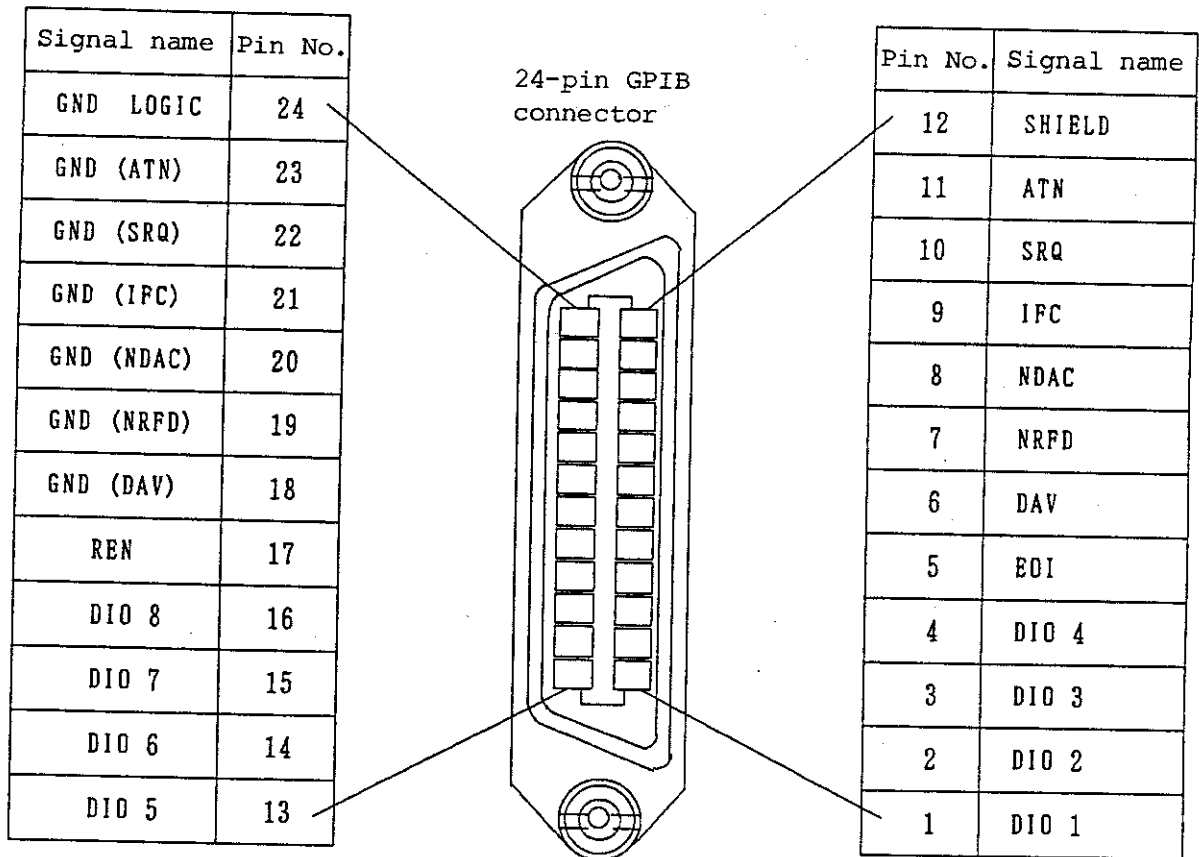
Figure 4 - 1   Pin Array of GPIB Connector

- Logical level: Logical 0 ('HIGH' state) +2.4 V or more
                  Logical 1 ('LOW' state) +0.5 V or less

- Termination of signal line:
  16 signal lines are terminated as shown in the figure below.
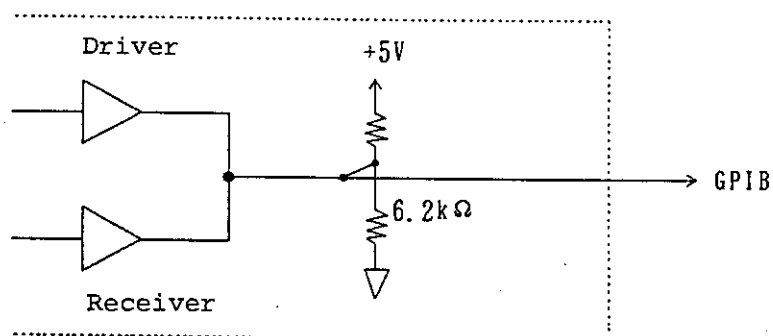
Figure 4 - 2   Termination of Signal Line

- Driver specification: (SN75160/SN75161 are used)

  NDAC, NRFD, SRQ   : Open collector format
  Other signals   : Three state format
  LOW state output voltage: +0.5 V or less, 48 mA
  HIGH state input voltage: +2.5 V or more, -5.2 mA

- Receiver specification: (SN75160/SN75161 are used)

  LOW state output voltage: +0.8 V or less
  HIGH state input voltage: +2.0 V or more

- Address specification: Thirty-one types (0 to 30) of talk addresses/
                          listen addresses can be selected optionally by
                          setting the address from the panel.

4.3 GPIB Commands

Table 4 - 2 Current, Voltage, Generation/Measurement Range

Code	LD-driver portion		PO-measure portion		PD-measure portion			
	IF/IM	VF/VM	IM	Differential efficiency (AC)	IF	IM	VF	VM
1	4μA	4V	—	0.075*KPW/A	—	0.2μA	—	4V
2	40μA	40V	—	0.15 *KPW/A	2μA	2μA	10V	—
3	400μA	—	2mA	0.3 *KPW/A	20μA	20μA	100V	100V
4	4mA	—	4mA	1.5 *KPW/A	200μA	200μA	—	—
5	40mA	—	8mA	—	2mA	2mA	—	—
6	200mA	—	16mA	—	20mA	20mA	—	—
7	—	—	32mA	—	—	—	—	—
8	600mA	—	—	—	400mA	—	—	—
9	—	—	—	—	—	—	—	—

IF: Current forcing
IM: Current measurement
VF: Voltage forcing
VM: Voltage measurement
KP: The value to be input by the KP command. (Refer to 4.3.1.(4).)

4.3.1 Measuring Command

(1) Spot Measuring Command

   Measurement is started by means of the following commands, and
   generation of current and voltage is in output status even after the
   end of measurement.

   Generation of current and voltage becomes 0 by means of the SB
   (Stand-by) command, and the output portion becomes high impedance
   status.

① Laser diode measurement

    "LD(<u>Fa,b,c,d</u> <u>Dnnn</u> , <u>DEnnn</u>)"
        *1   *2   *3

    LD: Laser diode measuring header

② Monitor diode measurement

    "PD(<u>Fa,b,c,d</u> <u>Dnnn</u> , <u>DEnnn</u>)"
        *1   *2   *3

    PD: Monitor diode measuring header

③ Optical output measurement

    "RPO(<u>Fa,d,</u> <u>Dnnn</u> , <u>DEnnn</u>)"
         *1   *2   *3

    RPO: Optical output measuring header

*1 F: Header (function)
      a: Generation mode
        0, CW
        1, Pulse
      b: Generation function
        0, Vf
        1, Vf-Im
        2, If
        3, If-Vm
      c: Generation range
      d: Measuring range (See Table 4-2)

*2 D: Header (data)
      nnn: Generation data
          Data format:
              data (Mantissa portion) data (Exponential portion)

      Data (Mantissa portion): Sign + decimal point + number of
                            optional digits
      o The sign and the decimal point can be omitted.
      o Numerals within five effective high order digits are
        recognized, and the rest ignored.

      Data (Exponential portion): E ± nn
      o Sign can be omitted (The same as +)
      o For +, nn is 0
        For -, 0 to 12 can be set.

*3 DE: Header (delay)
      nnn: 0 to 655.35 can be set as time data, and "MS" (msec) can
            be set as the unit. The unit data can be omitted.

(2) Sweep Program Command

    Measurement is not performed by setting this command. Measurement is
    performed by setting the ST command shown below. By the sweep
    command, the setting condition can be maintained unless the power is
    turned off or the device reset, so remeasuring is performed in the
    same condition by repeating the ST command.

"SW(IV(Fa,b,c, Dstart,stop,step, DEd)PO(Fe,f,Dg,Lh)PD(Fi,j, DK))"
    *1   *2   *3   *4 *5 *6   *7 | *8
                                                          |
                                                    r--_|
                                                    |
                                         PD(Fi,j,Dk) can be omitted.

    Header (measurement)
    SW : Sweep mode
    IV : IV measurement
    PO : IL measurement
    PD : Im measurement (Im measurement is not performed for pulse mode.)

    *1 F : Header (function)
          a : Occurrence mode
              0, CW
              1, Pulse
          b : LD current generation range
          c : LD voltage measurement range ... See Table 4-2.

    *2 D : Header (data)
          Start: Measurement start current
          Stop : Measurement end current
          Step : Step value of current

Data format: data (Mantissa portion) data (Exponential portion)

Data (Mantissa portion): Sign + decimal point + number of optional digits
o The sign and the decimal point can be omitted.
o Numerals within five effective high order digits are recognized, and the rest ignored.

Data (Exponential portion): E ± nn
o The sign can be omitted (The same as +)
o For +, nn is 0
  For −, 0 to 12 can be set.

*3 DE: Header (delay)
        d: 0 to 655.35 can be set as time data, and "MS" (msec) can be set as the unit. The unit data can be omitted.

*4 F: Header (function)
        e: Current range (optical output)
        f: Differential efficiency range ... See Table 4-2

*5 D: Header (data)
        g: Photodiode, bias voltage

*6 L: Header (Max. optical output)
        h: Max optical output data ... The same format as the generation data.

*7 F: Header (function)
        i: Monitor diode voltage generation range
        j: Monitor diode current measuring range ... See Table 4-2

*8 D: Header (data)
        k: Monitor diode voltage generation data

(3) Sweep Measurement Execution Command

        After the end of measurement, set the device to stand-by using the SB command because the generation status is being kept.

        ST: Executes the Sweep measurement.

(4) Other Measuring Commands

For measurement, set the following commands before sending the measuring commands. The command input can also be continued with a comma (,).

"KPnnn" :   This is the coefficient to convert the voltage flowing to the photodiode to the optical output of the laser diode.

nnn = 1/quantum efficiency =

$$\frac{1}{\text{PD current/optical output}} = \frac{\text{Optical output}}{\text{PD current}} = \text{[mW/mA]}$$

The data format of nnn is the same format as the generation data.

"IIDnnn"   Sets a dark current of photodiode on the measuring side of optical output.

nnn = The same format as [A] generation data
       [Initial value nnn = 0]

"PDSLn"   Changing over of channels A and B of photodiode

n = 0 : CHA [Initial value]
n = 1 : CHB

"ACn"   Measures n = 0, η, and Rs by means of the Normal mode AC current superimposed method.

Obtain n = 1, η, and Rs from I-L and I-V by operation.

(Note):   The LD spot measurement in ACO mode is also effective.

"KEnnn":   For ACO, coefficient of η.   (Refer to appendix 2)

$\eta = \eta'$ x KE ... The same format as the generation data
                        [Initial value : nnn = 1]

└──── Correction factor
└──── Differential efficiency measured
└──── Differential efficiency compensated

(5) APC Drive Command

This command drives the laser diode in the APC (Auto Power Cotrol) mode. In the APC mode, measure the laser diode monitor current, and control the laser diode drive current so that the monitor current is constant. The control is done by calculating the data digitally.

"AP(IV(Fa, Dstart,stop,step) PD(Fb,c, Dd))"
      *1   *2   *3   *4

Header (measurement)
 AP : APC mode
 IV : If mode
 PD : Im measurement

*1   F : Header (function)
      a : LD current generation range (See Table 4-2)

*2   D : Header (data)
      start : Generated initial LD current
      stop : Maximum generated LD current
      step : Current increasing/decreasing rate

*3   F : Header (function)
      b : Monitor diode voltage generation range (See Table 4-2)
      c : Monitor diode current generation range (See Table 4-2)

*4   D : Header (data)
      d : Monitor diode voltage generation data

Use "SB" command to terminate the APC mode.

- Flow chart

The following chart shows the operation of Q89611F after the APC command is received from GPIB:

```
        ┌──────────────────┐
        │  APC command     │
        │  received        │
        └──────────────────┘
        ┌──────────────────┐
        │ Drive laser diode│
        │ If=start         │
        │ Generate reverse │
        │ monitor voltage  │
        │ Vr=d             │
        └──────────────────┘
        ┌──────────────────┐
        │ Measure monitor  │          Set Imo to the reference
        │ current    Imo   │          current
        └──────────────────┘

        ┌──────────────────┐
        │ Measure monitor  │
        │ current Imx      │
        └──────────────────┘
              =    ╱╲    <
            ◄────◄ Imo : Imx ►─────┐   Compare Imo with Imx to
                  ╲╱                   determine the laser diode
                   > │                 drive current.
        ┌────────────┐  ┌────────────┐
        │ If = If + step│ │ If = If - step│
        └────────────┘  └────────────┘
              ╱╲     ≧
             ╱ If : stop ╲───────┐   Control the current so that
             ╲          ╱            it does not flow when If
              ╲╱   <                 reaches the maximum value.
                  ┌────────────┐
                  │  If = stop │
                  └────────────┘
        ┌──────────────────────┐
        │ Drive laser diode If │
        └──────────────────────┘
    No       ╱╲
    ◄───────╱  "SB"  ╲
            ╲ command ╱
             ╲╱
              │ YES
          ╭────────╮
          │  STOP  │
          ╰────────╯
```
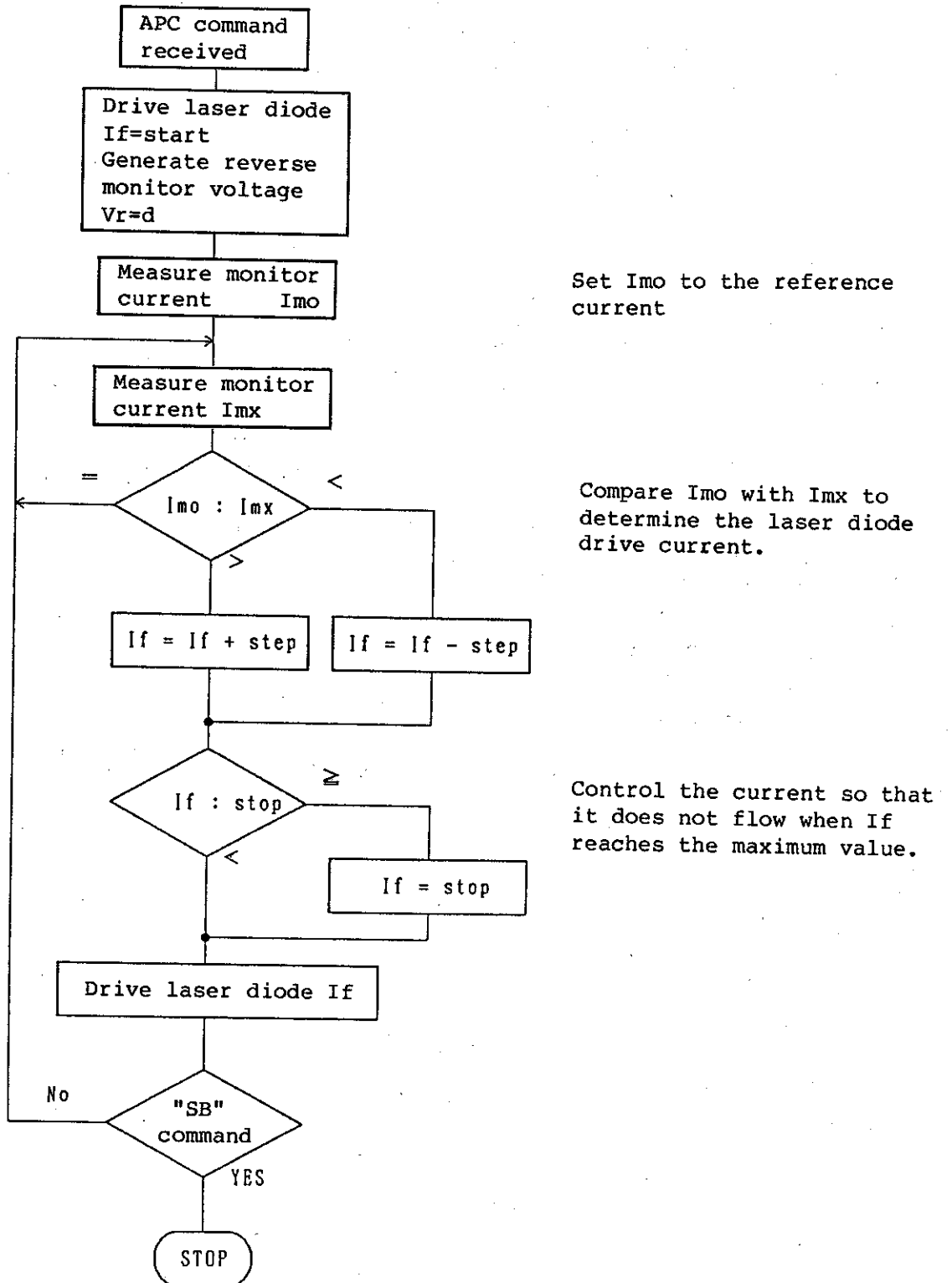
4.3.2 Operation Parameter Setting Command

Table 4 - 3   Operation Parameter Setting Command

Commands	Contents
POPnnn	Sets the data of the specified optical output to measure the operating current (Iop) and the operating voltage (Vop) of the laser diode and the operating current (Imop) of the monitor diode.
PIAnnn PIBnnn	Sets the data of threshold current (Ith1 or Ith2) and threshold voltage (Vth1, Vth2) and Pth of the laser diode.
IIAnnn IIBnnn	Sets the data of the threshold current (Ith2) and the threshold voltage (Vth2) of the laser diode.
PNAnnn PNBnnn	Sets the data of the optical output to measure the quantum differential efficiency of the laser diode.
IVFnnn	Sets the current data to obtain Vf of the laser diode.
IPOnnn	Sets the current data to obtain the optical output of the laser diode.
POXnnn	Sets the data of specified optical output for the specified operating current of the laser diode.
PMXnnn	Sets the data of optical output to obtain the current of the monitor diode.

nnn: Data of parameter
The data format is the same as the generation data. And data input can be continued with a comma (,).

o Definition of Operation
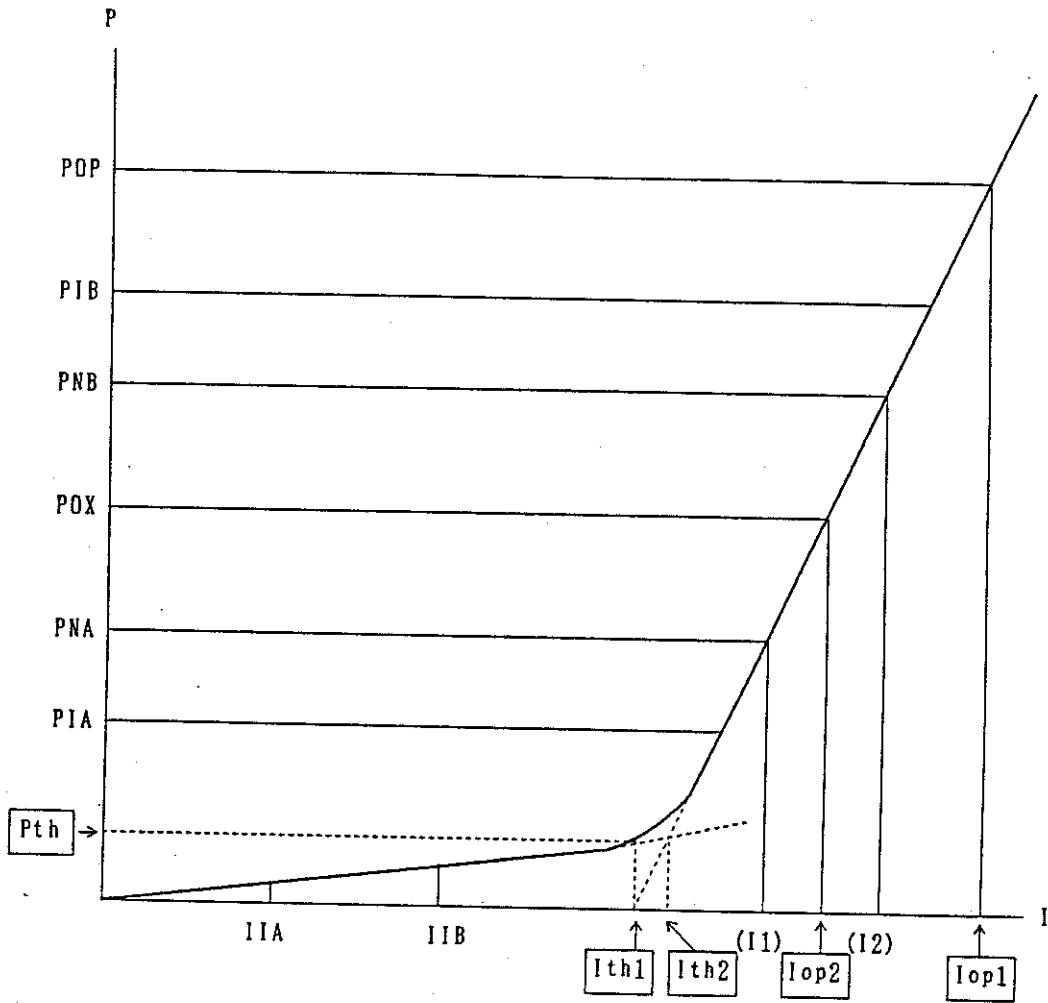
Figure 4 - 3   Definition of Current Value and
Differential Efficiency Operation

Iop1: Operating current at specified optical output (POP)
Iop2: Operating current at specified optical output (POX)
Ith1: Points of intersection of the straight line, connecting two
       points indicating optical output values PIA and PIB, and the
       current axis (x axis)
Ith2: Current value of the point of intersection of the straight line
       acquired in Ith1, and the straight line which connects two
       points indicating current values IIA and IIB (IIA < IIB)

η: Slope of the straight line which connects two optical output
values PIA and PIB

$$\eta = \frac{PNB-PNA}{I2-I1} \ [mW/mA]$$

Pth : Optical output at the laser diode threshold current (Ith1).
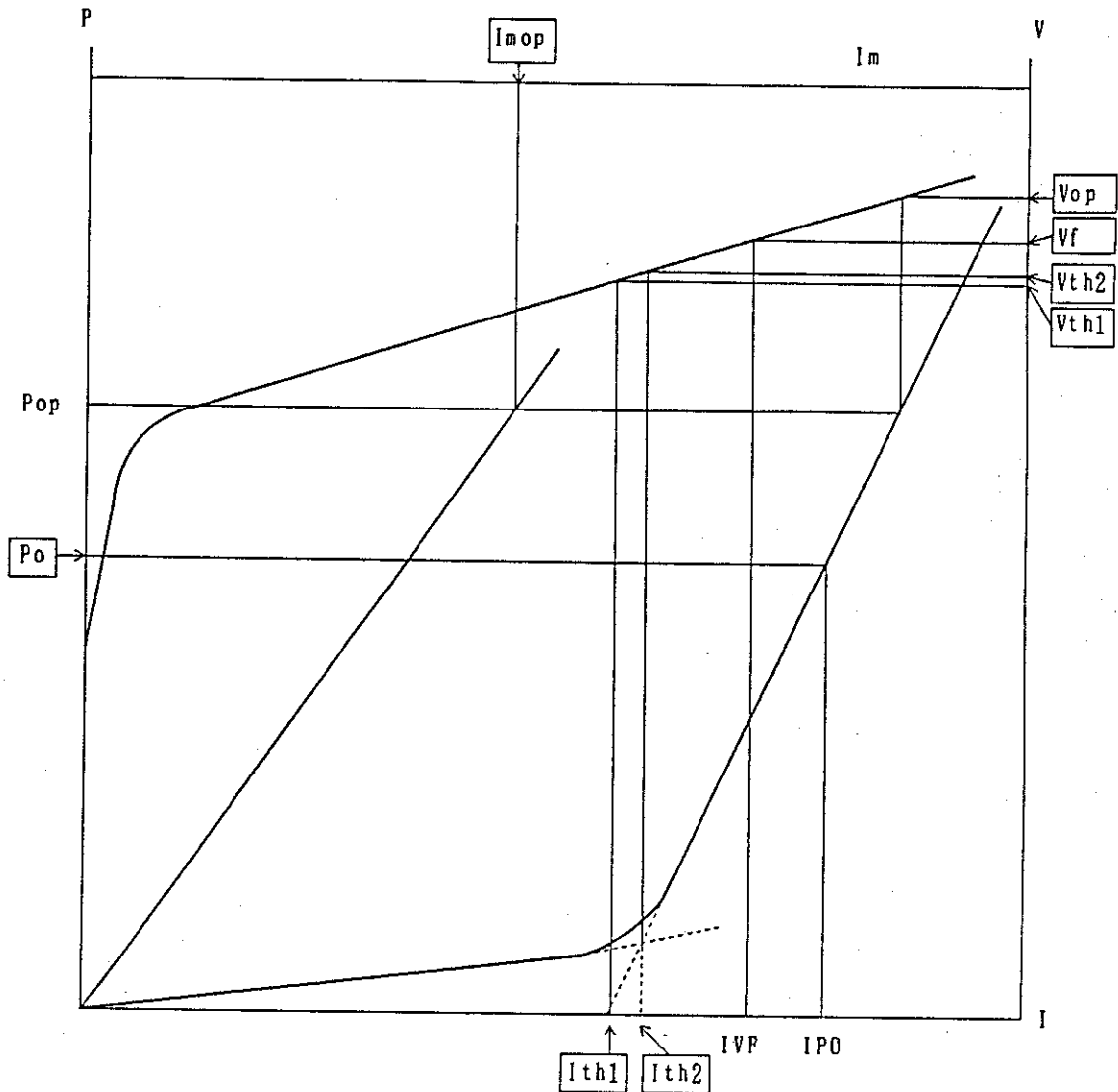
Figure 4 – 4   Definition of Voltage Value, Optical Output,
and Monitor Current Value Operation

Vop : Operating voltage at specified optical output (Pop)
Imop: Monitor current value at specified optical output (Pop)
Vf   : Forward voltage generated by specified current (IVF)
Po   : Optical output generated by specified current (IPO)
Vth1: Forward voltage at laser diode threshold current Ith1
Vth2: Forward voltage at laser diode threshold current Ith2

Q89611F
LASER DIODE TEST SET
INSTRUCTION MANUAL

_____
                                                                4.3 GPIB Commands
_____

4.3.3 Data Output Request Command

(1) Measuring data output request command

When exceeding AD input full scale, the data of 9.9999E+9 is output.

Table 4 - 4 Measuring Data Output Request Command

Commands	Contents
BOSD	Requests output of laser diode driving current data
BOPO	Requests output of laser diode optical output data
BOVF	Requests output of laser diode forward direction voltage measured data
BOIM	Requests output of monitor diode current measured data
BONC	Requests output of laser diode quantum differential efficiency measured data (Operated from I-L data)
BONA	Requests output of laser diode quantum differential efficiency measured data (AC measuring data)
BORC	Requests output of laser diode operating resistance measured data (Operated from I-V data)
BORA	Requests output of laser diode operating resistance measured data (AC measuring data)

Output format

There are two types of output formats, the ASCII format and the binary format. The output format is selected according to the command.

① ASCII Format

DCNT <nnn> <bd> <data1> <sd> <data2> .... <dataN> <bd>
 *1   *2   *3   *4   *5   *4   *4   *3

*1 : The header showing that the next data is the number of output
     data (For header ON)
*2 : The number of data to be output in a row
*3 : Block delimiter
*4 : Measuring data (For header ON, the command BO** is inserted in
     front of the data as a header)
*5 : String delimiter

(2) Binary Format

$$\underset{*1}{\underline{DCNT}} \quad \underset{*2}{\underline{<nnn>}} \quad \underset{*3}{\underline{<bd>}} \underset{*4}{\underline{<kkk>}} \quad \underset{*3}{\underline{<bd>}} \quad \underset{*5}{\underline{<data1>}} \quad \underset{*5}{\underline{<data2>}} \quad \ldots\ldots\ldots \quad \underset{*5}{\underline{<dataN>}}$$

*1: The header showing that the next data is the number of output data (For header ON)
*2: The number od data to be output in a row (ASCII format)
*3: Block delimiter
*4: Coefficient: By multiplying this coefficient to the binary data to be output, the measured data can be obtained. (ASCII format)
*5: Measured data (Binary 16-bit without sign)

Table 4 - 5   ASCII, Binary Output Format Selection Command

Commands		Contents
FMTn	n = 0	Requests ASCII output format (Initial value)
	n = 1	Requests binary output format

(2) All Measured Data Output Request Command

Table 4 - 6   All Measured Data Output Request Command

Commands	Contents
BOALn	Requests output of all measured data output n = 1 ...

Output format

$$\underset{*1}{\text{DCNT}} \quad \underset{*2}{<nnn>} \quad \underset{*3}{<bd>} \quad \underset{*4}{<data1-1>} \quad \underset{*6}{<,>} \quad \underset{*4}{<data1-2>} \quad \underset{*6}{<,>} \quad \ldots\ldots\ldots \quad \underset{*4}{<data1-6>} \quad \underset{*5}{<sd>}$$

$$\underset{*4}{<data2-1>} \quad \underset{*6}{<,>} \quad \ldots\ldots\ldots \quad \underset{*4}{<dataN-6>} \quad \underset{*3}{<bd>}$$

*1: The header showing that the next data is the number of output data blocks (For header ON)
*2: The number of data blocks to be output in a row
*3: Block delimiter
*4: Measured data (For header ON, the command BOAL is inserted in front of the data as a header.)

                  <Data block>

data n-1	If
data n-2	Vf
data n-3	Po
data n-4	PD
data n-5	Rs
data n-6	η

*5: String delimiter (However, for n $\neq$ 1, the position shown by *5 becomes the string delimiter for every nth number, and others become commas.)
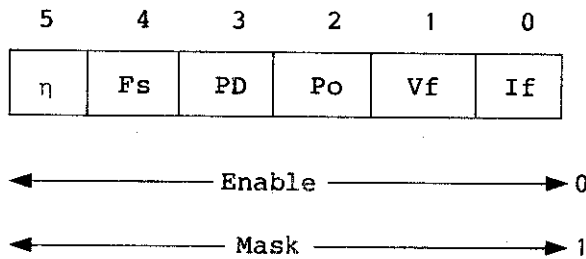*6: Comma

(3) Mask of Measured Data Output

This mask is used when only the data of an item in the data to be output through the "BOAL" command is not to be output.

Table 4 - 7   Mask Command of Measured Data Output

Commands	Contents
BOMSnn	Data output mask nn = 0 to 62 { 63 is inhibited. (However, initial value is 0.)}

5	4	3	2	1	0
η	Fs	PD	Po	Vf	If

◄────────── Enable ──────────► 0

◄────────── Mask ──────────► 1

(Example) When the output data block is set to Vf, Po, Pd, and η, (Mask IF and Rs)

$$nn = 2^4 + 2^0 = 16 + 1 = 17$$

(4) Request Command for Operation Data Output

Table 4 - 8 Request Command for Operation Data Output

Com-mands	Contents	Items
RITH	Requests output of laser diode threshold current operation data	Ith1
RITX	Requests output of laser diode threshold current operation data	Ith2
RIOP	Requests output of laser diode operating current operation data	Iop
RVOP	Requests output of laser diode operating voltage operation data	Vop
RIMO	Requests output of monitor diode operating current operation data	Imop
RNSX	Requests output of laser diode quantum differential efficiency operation data	η
RVFX	Requests output of laser diode specified voltage operation data	Vf
RVTH	Requests output of laser diode threshold voltage operation data	Vth1
RVTX	Requests output of laser diode threshold voltage operation data	Vth2
RPOA	Requests output of optical output data of set current value	Po
RPTH	Requests output of optical output data for Ith1	Pth
RIOX	Requests output of operating current data of laser diode	Iox
RIMX	Requests output of monitor diode specified current operation data	Imx

Format

<Header> <Sign> <Mantissa> <Exponent>
   Header   : The same as the output request command
   Sign   : + or -
   Mantissa: Five digits numeral + decimal point
   Exponent: "E+0", "E-3", E-6", "E-9"

(5) Request Command for Operation Data Package Output

For the operation impossible item, "9.9999E+9" is output.

Table 4 - 9 Request Command for Operation Data Package Output

Commands	Contents
BODT	Request command for operation data package output

$$\underset{*1}{\underline{DCNT}} \ \underset{*2}{\underline{<nnn>}} \ \underset{*3}{\underline{<bd>}} \ \underset{*4}{\underline{<Hd>}} \ \underset{*5}{\underline{<data1>}} \ \underset{*6}{\underline{<sd>}} \ \underset{*4}{\underline{<Hd>}} \ \underset{*5}{\underline{<data2>}} \ \underset{*6}{\underline{<sd>}} \ \ldots\ldots$$

$$\ldots\ldots \ \underset{*6}{\underline{<sd>}} \ \underset{*4}{\underline{<hd>}} \ \underset{*5}{\underline{<data9>}} \ \underset{*3}{\underline{<bd>}}$$

*1: The header showing that the next data is the number of output
     data (For header ON)
*2: The number of data to be output in a row
*3: Block delimiter
*4: The header of next data (RXXX)
*5: Operation data
*6: String delimiter

In the operation data, the following nine items are packaged output.
(output in numerical sequence)

1 : Ith1 (RITH)
2 : Ith2 (RITX)
3 : Iop   (RIOP)
4 : Vop   (RVOP)
5 : Imop (RIMO)
6 : η   (RNSX)
7 : Vf   (RVFX)
8 : Po   (RPOA)
9 : Pth   (RPTH)

4.3.4 Specified Commands of Block Delimiter/String Delimiter

Table 4 − 10 Specified Commands of Block Delimiter/String Delimiter

Commands	Contents
DL0	Outputs the single wire signal (EOI) as a block delimiter when CR/LF and LF are output. (Initial value)
DL1	Outputs LF as a block delimiter.
DL2	Outputs the single wire signal (EOI) as a block delimiter when the final data is output.
SL0	Outputs "," (comma) as a string delimiter. (Initial value)
SL1	Outputs " " (space code) as a string delimiter.
SL2	Outputs "CR/LF" as a string delimiter.

4.3.5 Other Commands

Table 4 - 11   Other Commands

Commands	Contents
BC	Clear of waveform data
CS	Clear of GPIB status
BZn	n = 0: Buzzer OFF (initial value). The buzzer rings only for an error. .... n = 1: Buzzer ON. The buzzer rings either when receiving a command or when error occurs.
NSn	n = 0: Performs operations of η and RS. (Initial value) .... n = 1: Does not perform operations of η and RS. .... n = 2: Performs curve operations of η and RS. (No smoothing)
CALC	Performs the operation again.
C .... Z	Set to the status of power supply leading edge.
Sn	n = 0: GPIB interruption Enable .... n = 1: GPIB interruption Disable
SB	Clear the generation mode of current voltage to set to the stand-by status.
Hn	Header OFF for n = 0 (Initial value) .... Header ON for n = 1
MSnn	GPIB status mask (0 to 127) initial value 0
CALn	For n = 0, performs the operation after the end of I-L measurement. (Initial value) .... For n = 1, does not perform the operation after the end of I-L measurement.

4.3.6 Service Request

When this device is set in the "S0" mode, it originates the service request to the controller depending on the operating status. When the service request is originated, this device sends the status byte when it is specified to the talker after receiving the SPA command from the controller through serial polling execution. (Sending of the status byte is performed even in the "S1" mode.)

Each bit in the status byte is set/reset in the operating status shown below. Each bit in the status byte can be masked with the program code "MSnnn". (All bits can be cleared by program code "CS".)

```
    b7   b6   b5   b4   b3   b2   b1   b0
  ┌────┬────┬────┬────┬────┬────┬────┬────┐
  │    │    │    │    │    │    │    │    │
  └────┴────┴────┴────┴────┴────┴────┴────┘
                                    └──► Execution end
                                └──────► Syntax error
       └─────────────────────────────► RQS
```
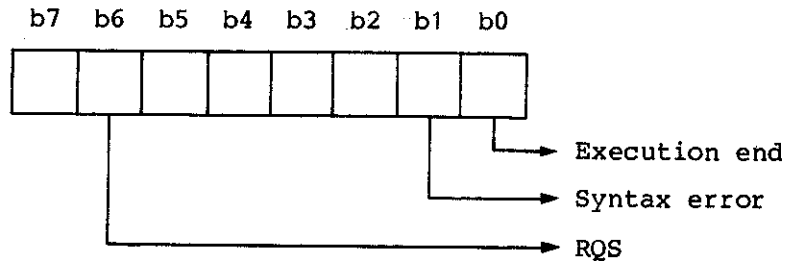
Execution end b0

This bit is set to "1" when the execution of Spot and Sweep measurement are completed.

Syntax error b1

This bit is set to "1" when there is an error for grammar condition/setting in the command.

RQS b6

This bit indicates that the service request is being performed, and is set to "1" when either b0 or b1 is set, and is reset to "0" when all bits b0 to b1 are reset.

4.4 Error Code

Table 4 - 12 Error Code Table (1 of 4)

Codes	Contents
000	* ⎤
001	* ⎥ System error
002	* ⎥
003	* ⎦
100	Start of Sweep mode is not set.
200	Listen of GPIB is an error.
201	Error for Listen of GPIB and Buffer over
202	GPIB character error
203	A command that is not present is set by means of the GPIB command.
302	"S" command error
303	Header of "H" program code is abnormal.
304	"SL" string delimiter is not present.
305	"DL" block delimiter is not present.
306	"MS" GPIB status mask is not present within 0 through 127.
307	"BZ" buzzer ON/OFF command is not suitable.
308	Operation command of "NS" n. Rs is not suitable.
309	Operation command after the end of "CAL" I-1 measurement is not suitable.
310	Setting command of "AC" n . Rs is not suitable.
311	Setting command of "PDSL" photodiode is not suitable.
312	KE command error
313	SHT command is not present within 0 to 1.
315	Optical output conversion coefficient of "KP" photodiode is abnormal.
316	Setting of dark current of "IID" photodiode is not suitable.
317	Settings of specified optical output data of "POP" laser diode and monitor diode are not suitable.
318	Threshold current (Ith1, 2) and threshold voltage (Vth1, 2) and Pth setting data of "PIA" laser diode are not suitable.
319	Threshold current (Ith1, 2), threshold voltage (Vth1, 2) and Pth setting data of "PIB" laser diode are not suitable.
320	Setting of optical output data (low output side) of "PNA" n is not suitable.
321	Setting of optical output data (high output side) of "PNB" n is not suitable.
336	Data setting of threshold current (Ith1) and threshold voltage (Vth2) of "IIA" laser diode are not suitable.
337	Data setting of threshold current (Ith1) and threshold voltage (Vth2) of "IIB" laser diode are not suitable.
340	Setting of Vf measured current data of "IVF" laser diode is not suitable.
341	Setting of optical output measured current data of "IPO" laser diode is not suitable.

Table 4 - 12   Error Code Table (2 of 4)

Codes	Contents
345	Setting of specified optical output data to measure the specified operating current (Iop) of "POX" laser diode is not suitable.
346	"BOMS" data output mask is not present within 0 to 62 (63 is inhibited).
347	Setting of "BOAL" all measured data output command is not suitable.
348	Data of "PMX" is not suitable.
400	Laser diode measuring command error for "LD" Spot mode
401	Header (function) command error of laser diode measurement for "LS" "F" Spot mode
402	Setting of generation mode of laser diode measurement for "LD" "F_a" Spot mode is not suitable.
403	Setting of generated function of laser diode measurement for "LD" "F_b" Spot mode is not suitable.
404	Setting of generated range of laser diode measurement for "LD" "F_c" Spot mode is not suitable.
405	Setting of measured range of laser diode measurement for "LD" "F_d" Spot mode is not suitable.
406	Setting of header (data format) of laser diode measurement for "LD" "D" Spot mode is not suitable.
407	Header command error of "LD" "T".
408	Data of "LD" "T_width" pulse width is not suitable.
409	"LD" "T_repeat" pulse repeating data is not suitable.
410	Setting of header (delay) data of laser diode measurement for "LD" "DE" Spot mode is not suitable.
420	Monitor diode measuring command error of "PD" Spot mode.
421	Header (function) command error of monitor diode measurement for "PD" "F" Spot mode
422	Setting of generation mode of monitor diode measurement for "PD" "F_a" Spot mode is not suitable.
423	Setting of generated function of monitor diode measurement for "PD" "F_b" Spot mode is not suitable.
424	Generated range measurement of monitor diode measurement for "PD" "F_c" Spot mode is not suitable.
425	Measuring range measurement of monitor diode measurement for "PD" "F_d" Spot mode is not suitable.
426	Header (data format) setting of monitor diode measurement for "PD" "D" Spot mode is not suitable.
427	Header (delay) data setting of monitor diode measurement for "PD" "DE" Spot mode is not suitable.
440	Optical output measurement command error of "RPO" Spot mode
441	Header (function) command error of optical output measurement for "RPO" "F" Spot mode
442	Setting of generated function of optical output measurement for "RPO" "F_a" Spot mode is not suitable.
443	Setting of measuring range code of optical output measurement for "RPO" "F_b" Spot mode is not suitable.

Table 4 - 12 Error Code Table (3 of 4)

Codes	Contents
444	Header (data format) setting of optical output measurement for "RPO" "D" Spot mode is not suitable.
445	Header (delay) setting of optical output measurement for "RPO" "DE" Spot mode is not suitable.
500	Command error of header (Sweep mode measurement) of "SW" Sweep mode
501	Command error of header (I-V measurement) of "SW" "IV" Sweep mode
502	Header (function) command error of I-V measurement of "SW" "IV" "F" Sweep mode
503	Generation mode setting of I-V measurement of "SW" "IV" "F" "F_a" Sweep mode is not suitable.
504	Setting of LD current generation range of I-V measurement of "SW" "IV" "F_b" Sweep mode is not suitable.
505	Setting of LD voltage generation range of "SW" "IV" "F_c" Sweep mode is not suitable.
506	Header (data) command error of I-V measurement of "SW" "IV" "D" Sweep mode
507	Setting of measurement start current of I-V measurement of "SW" "IV" "D_Start" Sweep mode is not suitable.
508	Setting of measurement end current of I-V measurement of "SW" "IV" "D_stop" Sweep mode is not suitable.
509	Setting of current step value of I-V measurement of "SW" "IV" "D_Step" Sweep mode is not suitable.
510	Header command error of timing of I-V measurement of "SW" "IV" "T" Sweep mode
511	Data of pulse width of "SW" "IV" "T_width" Sweep mode is not suitable.
512	Pulse repeating data of "SW" "IV" "T_repeat" Sweep mode is not suitable.
513	Header (delay) setting of I-V measurement of "SW" "IV" "DE" Sweep mode is not suitable.
520	Header (Im measurement) command error of "SW" "PD" Sweep mode
521	Header (function) command error of Im measurement of "SW" "PD" "F" Sweep mode
522	Setting of monitor diode voltage generation of Im measurement of "SW" "PD" "F_i" Sweep mode is not suitable.
523	Setting of monitor diode current measuring range of Im measurement of "SW" "PD" "F_j" Sweep mode is not suitable.
524	Monitor diode voltage generated data of Im measurement of "SW" "PD" "D_k" Sweep mode is abnormal.
540	Command error of header (I-L measurement) of "SW" "PO" "F" Sweep mode
541	Header (function) command error of I-L measurement of "SW" "PO" "F" Sweep mode
542	Setting of current range of I-L measurement of "SW" "PO" "F_e" Sweep mode is not suitable.
543	Setting of differential efficiency range of I-L measurement of "SW" "PO" "F_f" Sweep mode is not suitable.

Table 4 - 12 Error Code Table (4 of 4)

Codes	Contents
544	Setting of photodiode bias voltage of I-L measurement of "SW" "PO" "D_g" Sweep mode is not suitable.
545	max. optical output data of I-L measurement of "SW" "PO" "L_h" Sweep mode is abnormal.
550	Header command error of the "AP" APC mode
551	IV header command error of the "AP" "IV" APC mode
552	IV function error code of the "AP" "IV" "F" APC mode
554	IV current range code error of the "AP" "IV" "F_a" APC mode
556	IV data error of the "AP" "IV" "D" APC mode
557	IV start data error of the "AP" "IV" "D_Start" APC mode
558	IV stop data error of the "AP" "IV" "D_Stop" APC mode
559	IV step data error of the "AP" "IV" "D_Step" APC mode

* When the error codes 000 to 003 are output on the display, turn off the power and contact the nearest sales office or ATCE.

4.5 Examples of Programming

Examples of programs to operate this device using the HP-98216 and HP300 series are shown below.

(1) When measuring the voltage in the forward direction of a laser diode to output the measured result on the CRT (Program example 1)

      Voltage generation range: 200mA range
      Voltage measuring range : 4V range
      Generated data   : 50mA

(2) When measuring the leak current of a laser diode to output the measured result on the CRT (Program example 2)

      Voltage generation range: 4V range
      Current measuring range : 40µA range
      Generated data   : 1V

(3) When measuring the dark current of a monitor diode to output the measured result on the CRT (Program example 3)

      Voltage generation range: 10V range
      Current measuring range : 0.2µA
      Generated data   : 5V

(4) When measuring the dark current of an external photodiode, which is set to this device as an offset (Program example 4)

Line No.		
60	:	The photodiode is connected to channel A.
70	:	Sets to current conversion with KP1. Clear the offset.
80	:	Measures with current range ImA and bias 1V.
100	:	Sets the measured current as an offset.

(5) When Sweep is measured (Program example 5)

Line No.		
60 to 70:		Condition
80 to 120:		Offset setting of photodiode (See the program example 4)
130	:	Setting of conversion coefficient of photodiode
160 to 210:		Calculation of current range of optical output measurement
230	:	Sets the programs shown below. Sweeps 0 to 100mA with 0.5mA step Limits the optical output with Max. 5mW.
240	:	Starts measurement
250 to 270:		Read serial poll and wait the end of measurement
290	:	Stand-by output

(6) Setting of operation condition (Program example 6)

Line No.
60	:	Setting of Pop
70	:	Sets parameter of Ith1
80	:	Sets parameter of η
90 to 100:		Sets parameter of Ith2

(7) When the operation result is output on CRT (Program example 7)

Line No.
60	:	Requests Iop output
80	:	Requests Ith1 output
100	:	Requests η output
120	:	Requests Ith2 output
140	:	Outputs the data to CRT

(8) When measured data (curve data) is output (Program example 8)

Line No.
70	:	Setting of delimiter and string delimiter
90	:	Requests output of If data
100	:	Reading of number of data
120	:	Reading of If data
140	:	Requests output of Vf data
150	:	Reading of the number of data
160 to 180:		Reading of Vf data

<Program example 1 >

```
10  !*********************************************************************
20  !                       Q89611F sample program
30  !       Laser Diode Forward Voltage Measurement  (LD-VF)
40  !*********************************************************************
50        A89611f=710                           ! GP-IB address
60        OUTPUT A89611f;"LD(F0,3,6,1,D.05)"    ! If:50mA , Vm:4V range
70         ENTER A89611f;Dd
80        PRINT Dd
90  END
```

<Program example 2 >

```
10   !***********************************************************************
20   !                    Q89611F sample program
30   !          Laser Diode Reverse Current Measurement   (LD-IR)
40   !***********************************************************************
50        A89611f=710                                   ! GP-IB address
60        OUTPUT A89611f;"LD(F0,1,2,3,D-1,DE500)" ! Vf:1V , Im:40 μA range
70         ENTER A89611f;Dd
80         PRINT Dd
90   END
```

<Program example 3 >

```
10   !***********************************************************************
20   !                    Q89611F sample program
30   !          Monitor Diode Dark Current Measurement     (Idark)
40   !***********************************************************************
50        A89611f=710                                   ! GP-IB address
60        OUTPUT A89611f;"PD(F0,1,2,1,D-5,DE500)" ! Vf:5V , Im:.2V μA range
70         ENTER A89611f;Dd
80         PRINT Dd
90   END
```

<Program example 4 >

```
10   !***********************************************************************
20   !                    Q89611F sample program
30   !          Photo Diode Dark Current Measurement for I-L
40   !***********************************************************************
50        A89611f=710                           ! GP-IB address
60        OUTPUT A89611f;"PDSL0"                 ! PD select 0
70        OUTPUT A89611f;"KP1,IID0"
80        OUTPUT A89611f;"RPO(F0,3,D1)"          ! Vf:1V , Im:2mA range
90         ENTER A89611f;Dd                      ! set PD offset
100       OUTPUT A89611f;"IID";Dd
110       PRINT Dd
120  END
```

<Program example 5>

```
10    !**********************************************************************
20    !                    Q89611F sample program
30    !                       I-L Measurement
40    !**********************************************************************
50          A89611f=710                                    ! GP-IB address
60          Kpd=0.56                                       ! Kpd [A/W]
70          Pmax=0.005                                     ! Power limit: 5mW
80          OUTPUT A89611f;"PDSL0"                         ! PD select 0
90          OUTPUT A89611f;"KP1,IID0"                      !
100         OUTPUT A89611f;"RP0(F0,3,D1)"                  ! Vf:1V  ,Im:2mA range
110          ENTER A89611f;Dd
120         OUTPUT A89611f;"IID";Dd                        ! set PD offset
130         OUTPUT A89611f;"KP";1/Kpd
140         OUTPUT A89611f;"Cs"                            ! GP-IB status clear
150         !
160         !*** Po Im range selest ******
170         Imr=6                                          ! 16mA range
180         IF Pmax*Kpd+Dd<.008 THEN Imr=5                 !  8mA range
190         IF Pmax*Kpd+Dd<.004 THEN Imr=4                 !  4mA range
200         IF Pmax*Kpd+Dd<.002 THEN Imr=3                 !  2mA range
210         IF Pmax*Kpd+Dd<.001 THEN Imr=2                 !  1mA range
220         !
230         OUTPUT A89611f;"SW(IV(f0,6,1,D0,.1,.0005)P0(F";Imr;",3,D0,L";Pmax;"
)P0(F2,6,D0))"
240         OUTPUT A89611f;"ST"
250Loop1:!
260         S=Spool(A89611f)
270         IF S<>0 THEN Loop1
280         !
290         OUTPUT A89611f;"SB,CS"
300 END                                                   ! Q89611F Stand-by
```

<Program example 6 >

```
10   !********************************************************************
20   !                    Q89611F sample program
30   !                    Caliblation parametor set
40   !********************************************************************
50        A89611f=710                              ! GP-IB address
60        OUTPUT A89611f;"POP.003"                 ! Pop :3mW
70        OUTPUT A89611f;"PIA1E-3,PIB.004"         ! P1:1mW,P2:4mW for Ith1
80        OUTPUT A89611f;"PNA.002,PIB3E-3"         ! P1:2mW,P2:3mW for Se
90        OUTPUT A89611f;"IIA.01"                  ! I1:10mA for Ith2
100       OUTPUT A89611f;"IIB.02"                  ! I2:20mA
110  END
```

<Program example 7 >

```
10   !********************************************************************
20   !                    Q89611F sample program
30   !                    Read Caliblation Result
40   !********************************************************************
50        A89611f=710                              ! GP-IB address
60        OUTPUT A89611f;"RIOP"                     ! Iop
70         ENTER A89611f;Iop
80        OUTPUT A89611f;"RITH"                     ! Ith1
90         ENTER A89611f;Ith1
100       OUTPUT A89611f;"RNSX"                     ! Sloop eff.
110        ENTER A89611f;Se
120       OUTPUT A89611f;"RITX"                     ! Ith2
130        ENTER A89611f;Ith2
140       PRINT Iop,Ith1,Se,Ith2
150  END
```

<Program example 8>

```
10    !************************************************************************
20    !                    Q89611F sample program
30    !                    Read Measurement Result
40    !************************************************************************
45    OPTION BASE 1
50    DIM Sd_buff(2000),Vf_buff(2000),Po_buff(2000),Im_buff(2000)
60         A89611f=710                              ! GP-IB address
70         OUTPUT A89611f;"DL0,SL2"                 !
80         !
90         OUTPUT A89611f;"BOSD"
100        ENTER A89611f;Cnt
110        REDIM Sd_buff(Cnt)
120        ENTER A89611f;Sd_buff(*)
130        !
140        OUTPUT A89611f;"BOVF"
150        ENTER A89611f;Cnt
160        FOR I=1 TO Cnt
170        ENTER A89611f;Vf_buff(I)
180        NEXT I
190    END
```

5. OPERATION TIME

Below is the operation time when generation/measurement is performed using this device.

5.1 Generation Measuring Time

(1) Spot Measurement

Generation measuring data processing time t_{PRE}	Generation measuring range processing time t_{RNG}	Generation settling time t_{SET}	Measurement delay time t_{DLY}	A/D measuring time t_{ADM}	Measuring operation processing time $t_{CAL.}$

(a) Generation/measuring data processing time (t_{PRE})

Approx. 8 msec

(b) Generation/measuring range changeover time (t_{RNG})

LD measurement: Approx. 40 msec
PD measurement: Approx. 100 msec
PO measurement: Approx. 20 msec

(c) LD measurement (t_{SET})

LD measurement

IF/IM	t_{SET}
4µA	Approx. 400 msec
40µA	Approx. 100 msec
400µA	Approx. 50 msec
4mA	
40mA	Approx. 5 msec
200mA	
600mA	

PD measurement

IF/IM	t_{SET}
0.2µA	
2µA	Approx. 300 msec
20µA	
200µA	
2µA	
20µA	Approx. 50 msec
400µA	

PO measurement

t_{SET}
Approx. 5 msec

(d) Measurement delay time (t_{DLY})

Setting value (0 to 655.35 msec)

(e) A/D measuring time (t_{ADM})

Approx. 400 μsec

(f) Measuring operation processing time

Approx. 3 msec

(2) Sweep Measurement

Generation measuring data processing time t_{PRE}	Generation measuring range change-over time t_{RNG}	Generation settling time $t_{SET}1$	Start data measuring time t_{MST}	Sweep data setting time $t_{SET}2$	Sweep measuring time t_{ADM}	Data processing time $t_{CAL.}$

	Sweep1	Sweep2
Generation/measuring data processing time t_{PRE}	Approx. 4 msec	Approx. 4 msec
Generation/measuring range changeover time t_{RNG}	Approx. 50 msec	Approx. 50 msec
Generation setting time $t_{SET}1$	Approx. 120 msec	Approx. 320 msec
Start data measuring time t_{MST}	Approx. 400 μsec	Approx. 400 μsec
Sweep data measuring time $t_{SET}2$	Approx. 20 msec	Approx. 20 msec
Sweep data measuring time t_{ADM}	DC (Approx. 400 μsec + measurement delay)/1 step Pulse (Pulse repeating x 3 + measurement delay)/1 step Measurement delay: Setting value (0 to 655.35 msec)	(Approx. 5.3 msec + measurement delay)/1 step Measurement delay: Setting value (0 to 655.35 msec)
Data processing time $t_{CAL.}$	Approx. 8 msec/1 step	Approx. 2 msec/1 step

DC and Pulse Sweep measuring time = (Total of Sweep 1)
AC Sweep measuring time = (Total of Sweep 2) + 100 msec

5.2 Operation Time

After measurement of I-L sweep, the operations will be done automatically. the operation can be also done with the "CALC" command.

Operation time = 500 msec/200 steps

6. OPERATION

   Figure 6-1 shows the block diagram of Q89611F. The device is divided into
   the following blocks:

   (1) POWER block

   (2) Control Logic

   (3) LD DRIVER block

   (4) PD MEASURE block

   (5) PO MEASURE block

      The Logic power supply is separated from the analog power supply in
      Q89611F, and the control logic section is floated with the signal
      isolator.
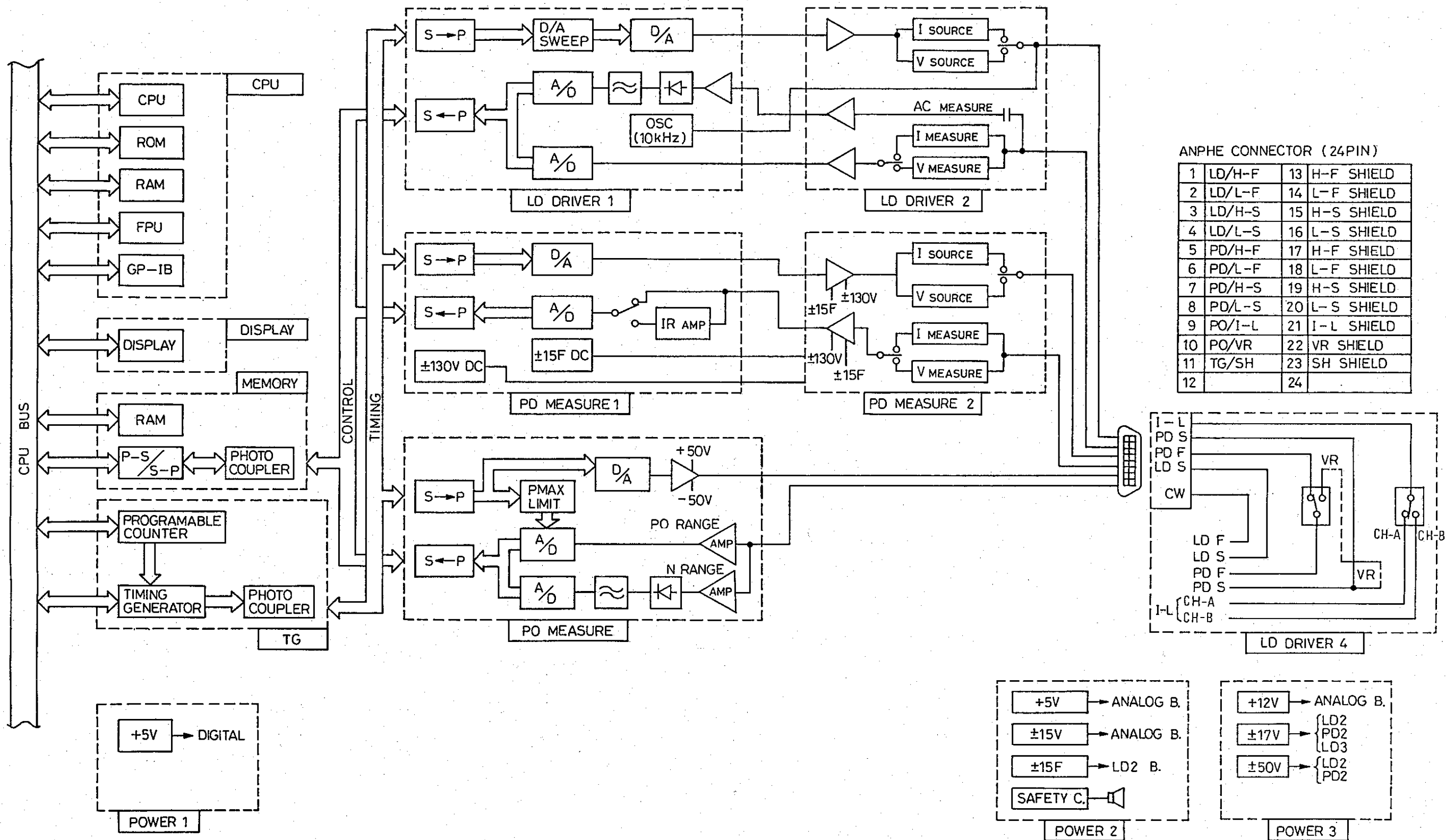
CPU
- CPU
- ROM
- RAM
- FPU
- GP-IB

DISPLAY
- DISPLAY

MEMORY
- RAM
- P-S / S-P
- PHOTO COUPLER

TG
- PROGRAMABLE COUNTER
- TIMING GENERATOR
- PHOTO COUPLER

CPU BUS — CONTROL — TIMING

POWER 1
- +5V → DIGITAL

LD DRIVER 1
- S→P → D/A SWEEP → D/A
- S←P ← A/D ← $\approx$ ← ⊠ ←
- OSC (10kHz)
- A/D

LD DRIVER 2
- I SOURCE
- V SOURCE
- AC MEASURE
- I MEASURE
- V MEASURE

PD MEASURE 1
- S→P → D/A
- S←P ← A/D — IR AMP
- ±130V DC
- ±15F DC

PD MEASURE 2
- I SOURCE
- V SOURCE
- I MEASURE
- V MEASURE
- ±130V, ±15F

PO MEASURE
- S→P → PMAX LIMIT → D/A → +50V / −50V
- S←P ← A/D — PO RANGE — AMP
- A/D — $\approx$ — ⊠ — N RANGE — AMP

LD DRIVER 4
- I-L
- PD S
- PD F
- LD S
- CW
- LD F
- LD S
- PD F
- PD S
- I-L { CH-A, CH-B }
- VR
- CH-A CH-B

POWER 2
- +5V → ANALOG B.
- ±15V → ANALOG B.
- ±15F → LD2 B.
- SAFETY C. →◁
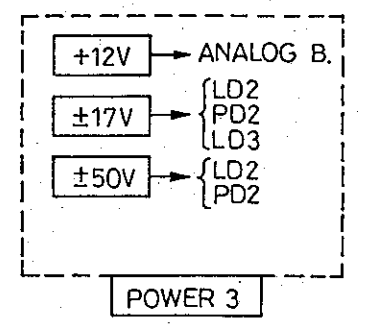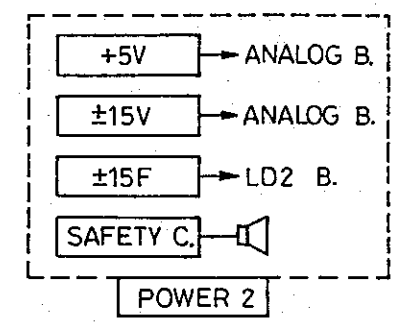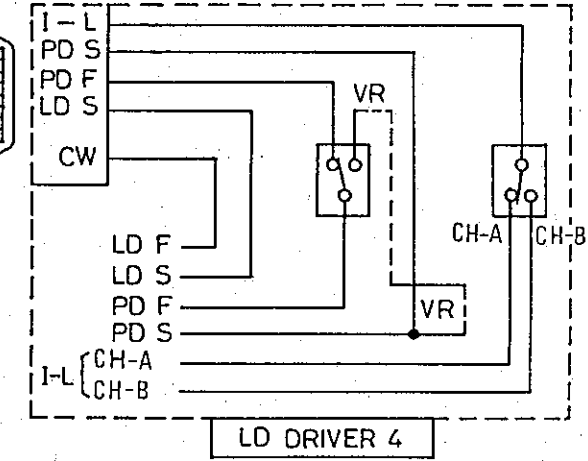
POWER 3
- +12V → ANALOG B.
- ±17V → { LD2, PD2, LD3 }
- ±50V → { LD2, PD2 }

7. SPECIFICATIONS

(1) General Specification

Environment range used	:	Temperature 0°C to 40°C, Relative humidity 85% or less
Power supply	:	90 to 110VAC, 48 to 66Hz, 140VA or less
Outline dimension	:	Approx. 424 (W) x 117 (H) x 450 (D) mm
Weight	:	Approx. 20kg
Storage environment range:		-25°C to +70°C

(2) Specifications of LD Driver

Driving portion		
Range		**Resolution**
Current range	DC 600mA	60μA
	DC 200mA	20μA
	DC 40mA	4μA
	DC 4mA	0.4μA
	DC 400μA	40nA
	DC 40μA	4nA
	DC 4μA	0.4nA
Voltage range	DC 40V	4 mV
	DC 4V	0.4mV
η, RS	AC10kHz, 0.2mAp-p	–

Measurement portion		
Range		**Resolution**
Current range	40mA	10μA
	4mA	1μA
	400μA	100nA
	40μA	10nA
	4μA	1nA
Voltage range	40V	10mV
	4V	1mV
RS	50Ω	–

(3) Specifications of Optical Power Measuring Portion

Range		Resolution
Current range	32mA	16μA
	16mA	8μA
	8mA	4μA
	4mA	2μA
	2mA	1μA

(Note 1)

The correction factor of the external photodiode is input with GPIB.

(Note 2)

The converted value of the current range to the optical power will slightly fluctuate according to the quantum efficiency or sensitive wave.

Resolution of   measuring portion (AC method)

Range (mW/mA)	Resolution (μW/mA)
1.5/quantum efficiency	0.75/quantum efficiency
0.3/quantum efficiency	0.5/quantum efficiency
0.15/quantum efficiency	0.25/quantum efficiency
0.075/quantum efficiency	0.125/quantum efficiency

IL sensor reverse bias resolution

Range	Resolution
DC 40V	50mV

(4) Specifications of Monitor Diode

Driving portion		
Range		Resolution
Current range	DC 400mA	0.2mA
	DC 20mA	0.01mA
	DC 200µA	0.1µA
	DC 20µp	10nA
	−	−
Voltage range	DC 100V	50mV
	DC 10V	5mV

Measurement portion		
Range		Resolution
Current range	20mA	10µA
	2mA	1µA
	200µA	0.1µA
	20µA	10nA
	2µA	1nA
	0.2µA	0.1nA
Voltage range	100V	0.05V
	4V	2mV

APPENDIX 1   SPECIFICATIONS OF INPUT/OUTPUT CABLE

External view of cable section

Components and cables

	Component	Manufacturer's standard	Manufacturer
①	D-sub connector (pin side)	DDM-24W7P	JAE
②	Coaxial contact (plug side)	DDM53740-5001	JAE
③	Junction shell	DD-C8-J13-B4-1	JAE
④	Cable (double-core shielded type)	0.2SQX2B-XV	Bando Cable
⑤	Cable (50Ω coaxial cable)	1.5D-2V	Bando Cable
⑥	Cable (20Ω coaxial cable)	WGF-0022-0500	Junko
⑦	Cable (twisted wire)	UL1431AWG28 (Black)	Hitachi Cable Ltd.
⑧	Cable (twisted wire)	UL1431AWG28 (Red)	Hitachi Cable Ltd.
⑨	Cable (twisted wire)	UL1431AWG28 (Blue)	Hitachi Cable Ltd.
⑩	Tube	EXLONJ tube 15 (Gray)	IWASE

Connection diagram

(Double-core shield)

(Contact)

20Ω coaxial cable

50Ω coaxial cable

APPENDIX 2   DIFFERENTIAL EFFICIENCY

When the differential efficiency is measured by the AC superposed method using Q89611F, the level will be low compared with the DC method (operation) due to the low response of the long wave sensor.   (Figure A2-1 and A2-2)   To compensate the level, use the command (KEnnn) of Q89611F which multiplies the coefficient to the data measured in the AC superposed method.   Set the coefficient so that the level of the DC method is harmonized with that of the AC method.   (Figure A2-3)
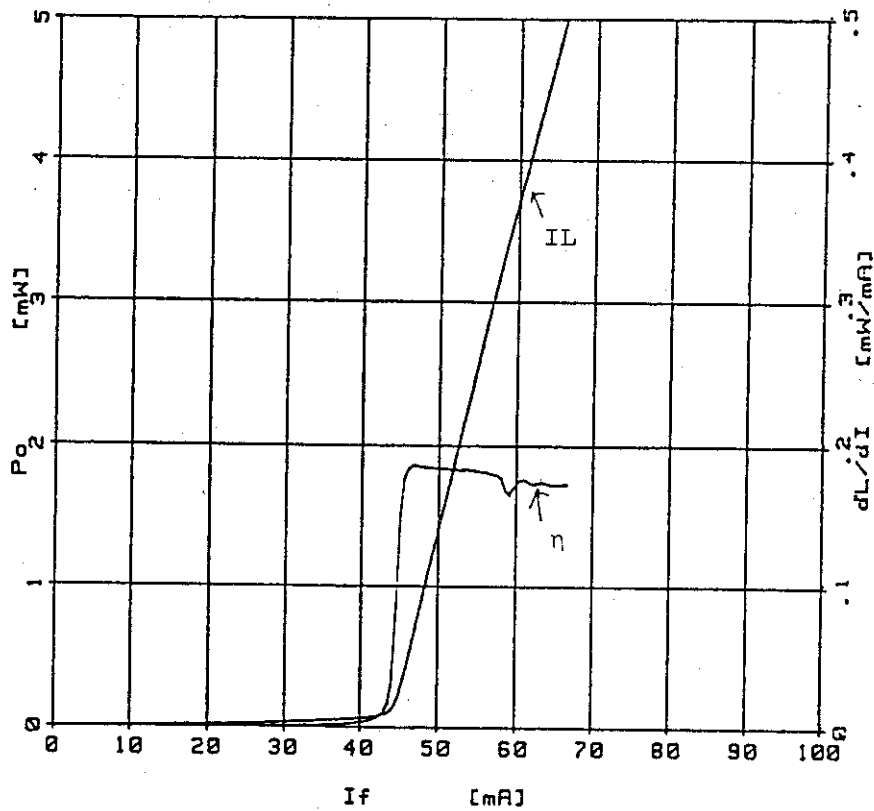
Figure A2 - 1   Measurement of I-L and Differential Efficiency
with AC Superposed Method

Figure A2 - 2   Measurement of I-L and Differential Efficiency
with DC Superposed Method

Figure A2 - 3 Measured Data of Differential Efficiency Compensated
with KE Command

LIST OF FIGURES

LIST OF TABLES

LIST OF EXAMPLES

Q89611F
EXTERNAL VIEW

FRONT VIEW

TOP VIEW

SIDE VIEW

REAR VIEW

145
177
112
424
450
30

Q89611F

DEVICE

ADVANTEST LASER DIODE TEST SET

ONLY ADDRESS
5 4 3 2 1
ADDRESSABLE

SRQ
TLK
LTN

POWER
ON
OFF
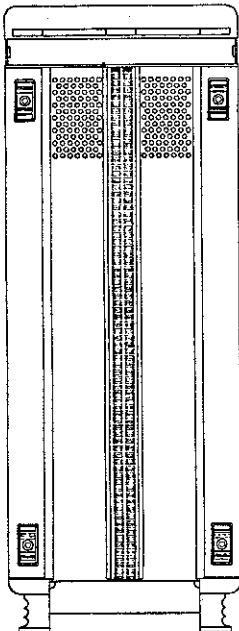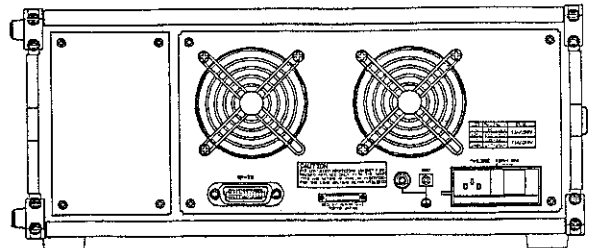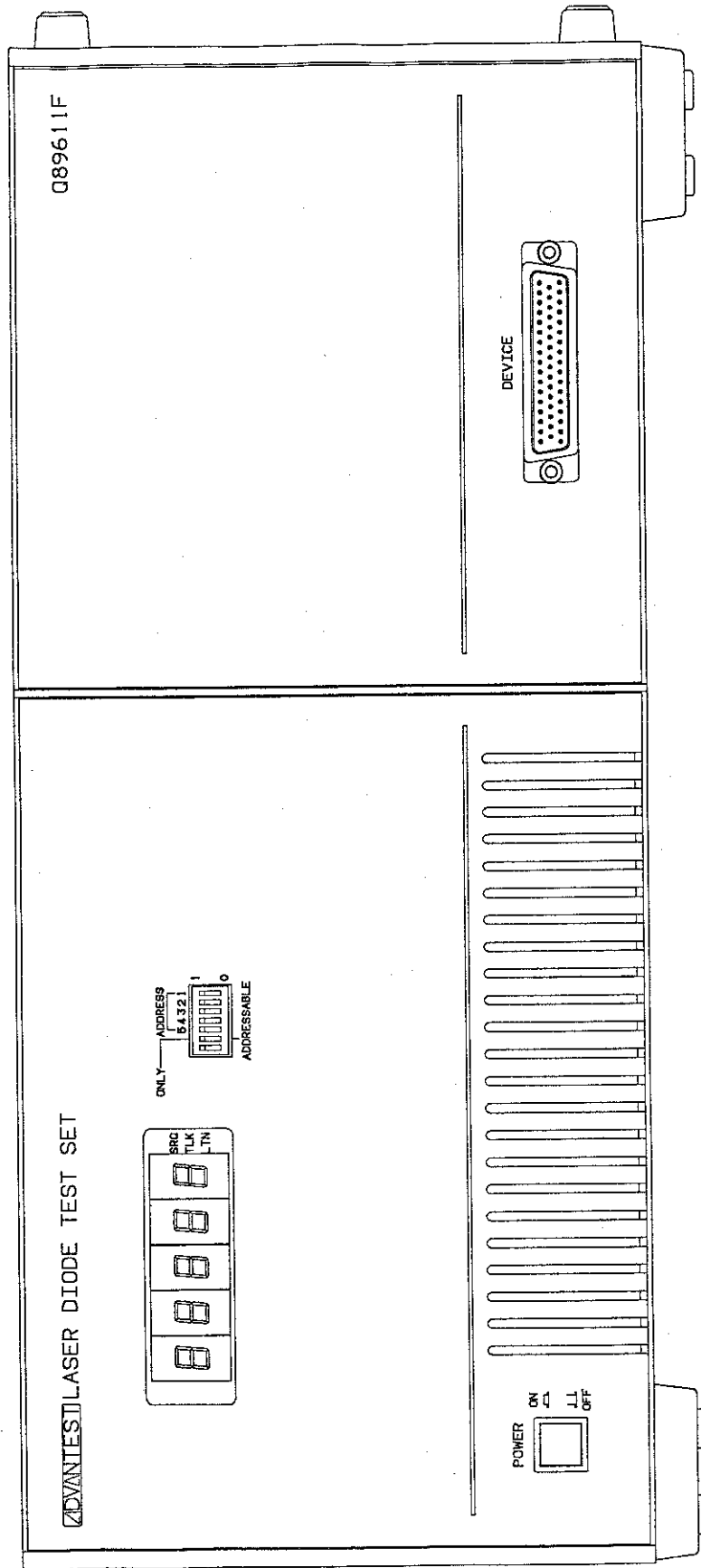
Q89611F
FRONT VIEW

Q89611FEXT2-712-A

SET	~LINE V		FUSE
100V	90-110V	103-132V	T2A/250V
120V			
220V	198-242V	207-260V	T1A/250V
240V			

~LINE 140VA MAX
48-66Hz

GND

CAUTION
FOR CONTINUED PROTECTION AGAINST FIRE
HAZARD, REPLACE ONLY WITH THE SAME
TYPE AND RATING OF FUSE AS SPECIFIED
FOR THE LINE VOLTAGE BEING UTILIZED

MFD BY ADVANTEST
TOKYO JAPAN

RP-IB
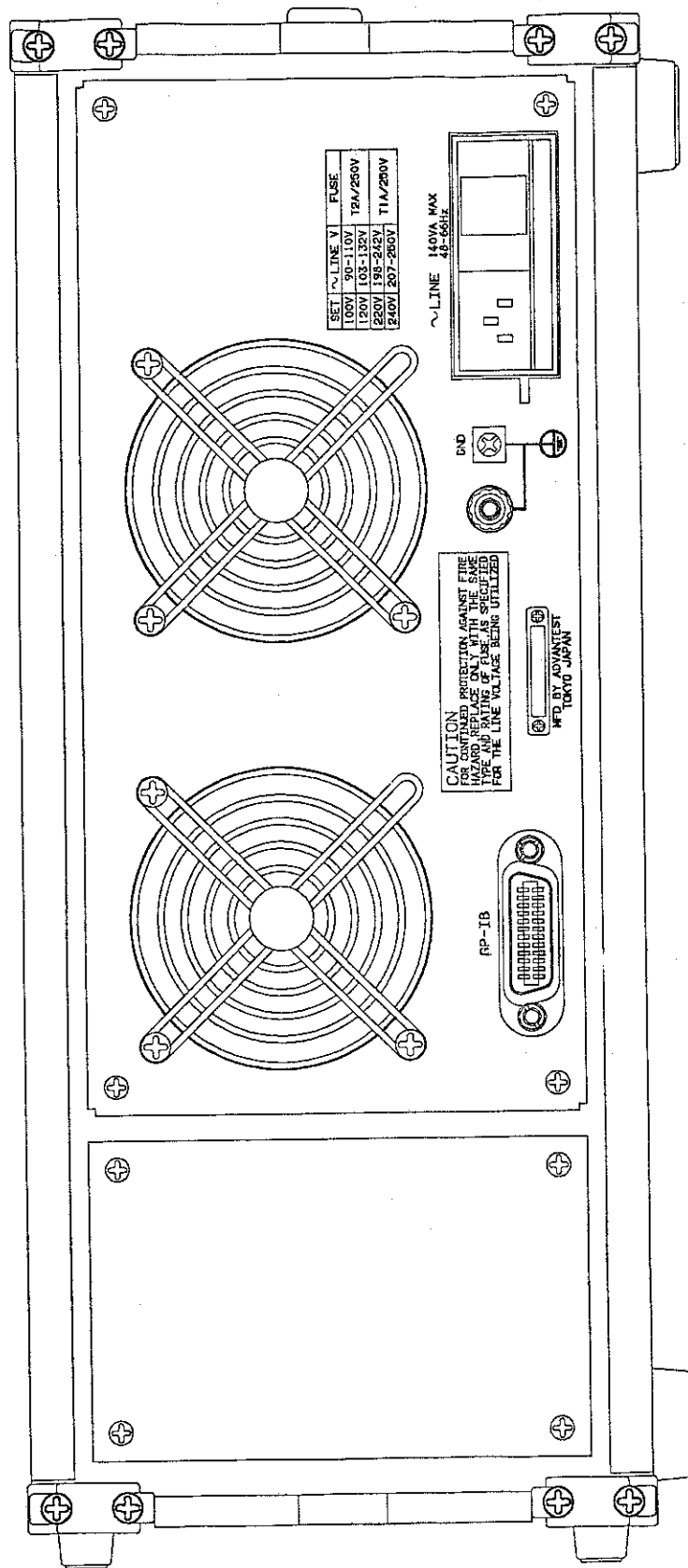
Q89611FEXT3-712-A

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