ADVANTEST

ADVANTEST CORPORATION

INSTRUCTION MANUAL

Q89611P

LASER DIODE TEST SET

MANUAL NUMBER OED00 9203

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1. GENERAL

1.1 Outline of Product

The laser diode test set Q89611P can measure electrical characteristics of laser diodes and I-L characteristics with good repeatability through external control.

It can also measure devices such as chips, according to the pulse current drive.

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	-	J89611P	1	Japanese sentence
	-	E89611P		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.

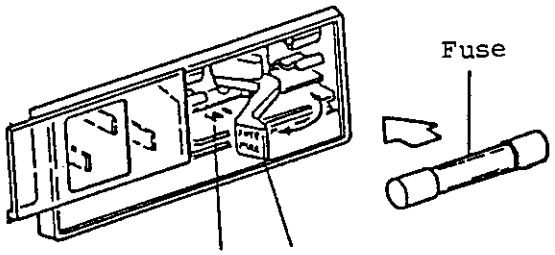


Figure 1 - 1 Replacement of Power Supply Fuse

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.

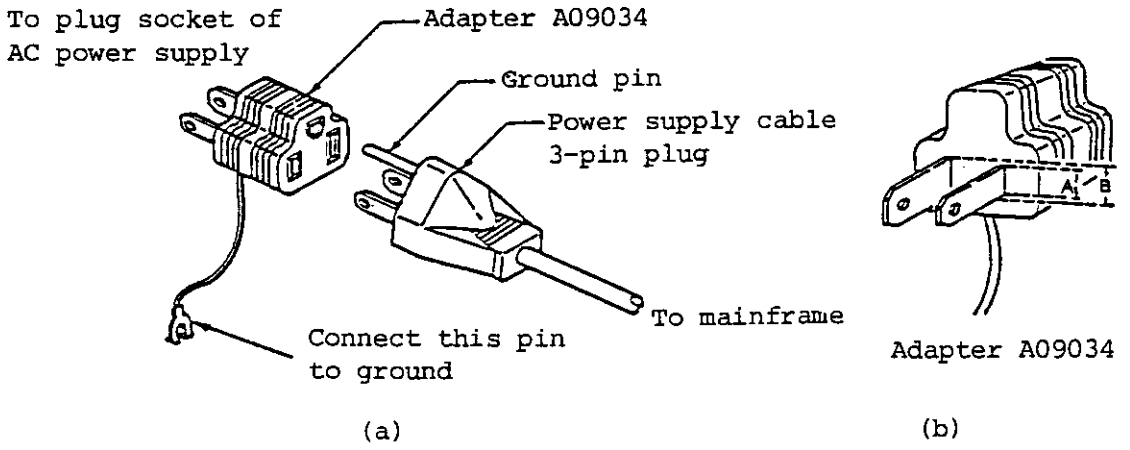


Figure 1 - 2 Plug and Adapter of Power Supply Cable

(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°C to +40°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.

1.3 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.

1.3.1 Explanation of Front Panel

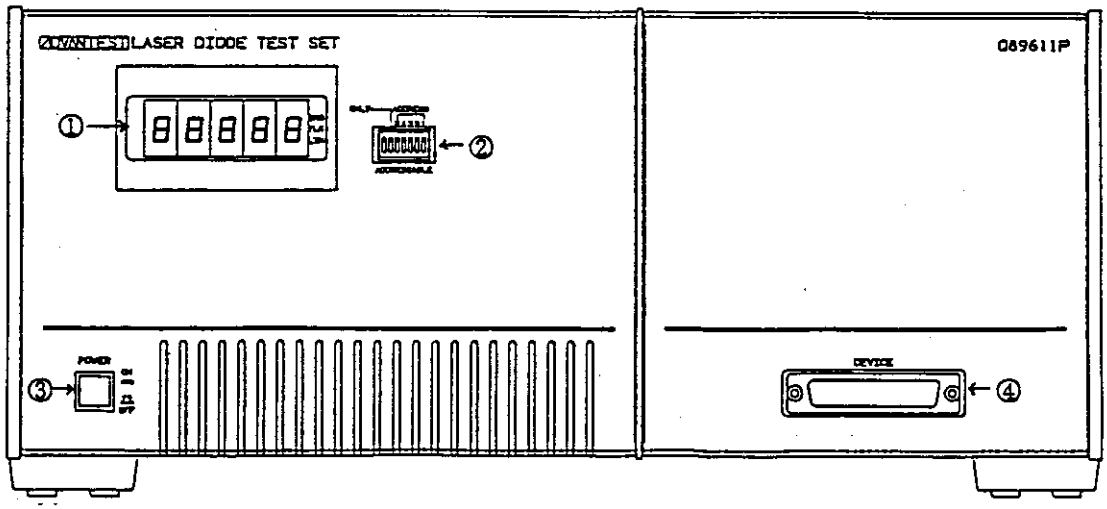


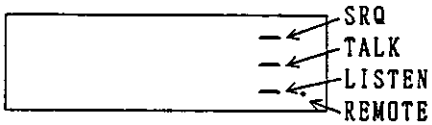
Figure 1 - 3 Front Panel

(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.

Ready display

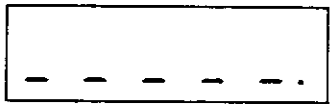
When the power supply switch is turned on, all LEDs light, and the display indicates rd (ready) after displaying the ROM version and the header ON/OFF status.



GPIB status lamp

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.



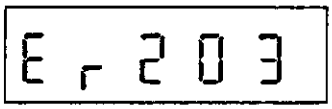
Display during measurement

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.

Operation status

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.



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.

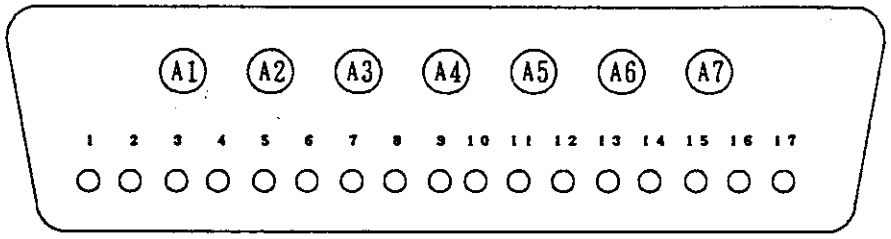
③ Power Supply Switch

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



A1 to A7 : Coaxial cable
1 to 14 : Shielding wire
15 to 17 : Twisted wire

1.3.2 Explanation of Rear Panel

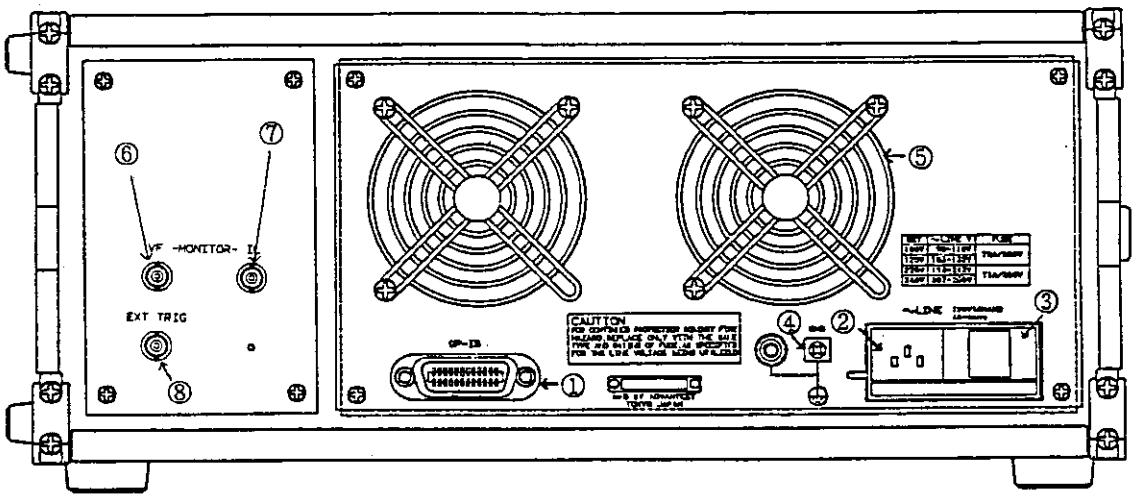


Figure 1 - 4 Rear Panel

① Connector for GPIB Cable

② Connector for power supply cable

③ Fuse holder

④ Ground terminal

⑤ Fan

⑥ VF monitor output terminal

Monitors the laser diode drive wave.

⑦ IL monitor output terminal

Monitors the optical wave of the laser diode converted by O/E operation.

⑧ External trigger input terminal

Synchronizes the external pulse to drive the laser diodes.

Input condition : TTL level (positive logical value)
Pulse width - More than 0.4µs
Repeating synchronous time - More than 0.6µs

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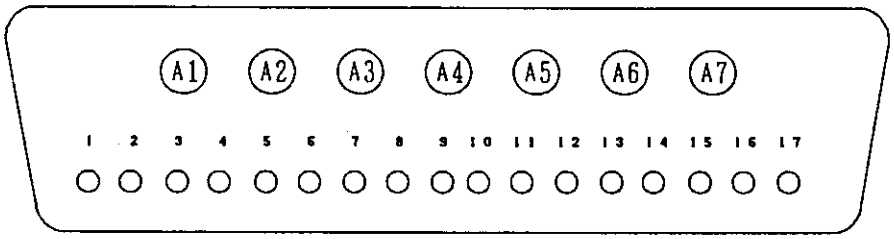
2. CONNECTION OF DEVICE

2.1 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

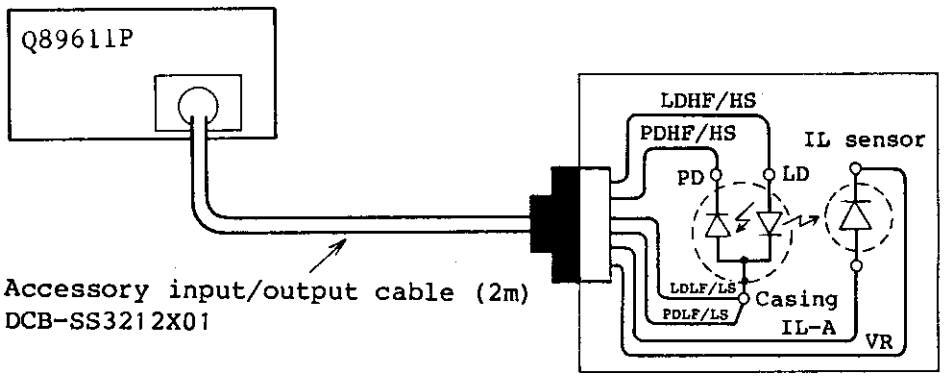
No.	Signal name	Description	No.	Signal name	Description
A1	LDHF	Laser side High-force	6	PDLF (shielding)	
A2	LDHS	Laser side High-sense	7	PDLS	Monitor side Low-sense
A3	PDHF	Monitor side High-force	8	PDLS (shielding)	
A4	PDHS	Monitor side High-sense	9	NC	Not used
A5	IL-A	Photodiode anode (CH-A)	10	NC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

IL-B, VR-A, and VR-B are used when two photodiodes are used in common.

2.2 Procedures for Connecting Devices

(1) Connecting with Fixture

When the laser diode is operated in th pulse drive mode, the connecting method of the signal transmitting cables greatly influences the measuring precision. Arrange the cables as follows to satisfy the specification of Q89611P.



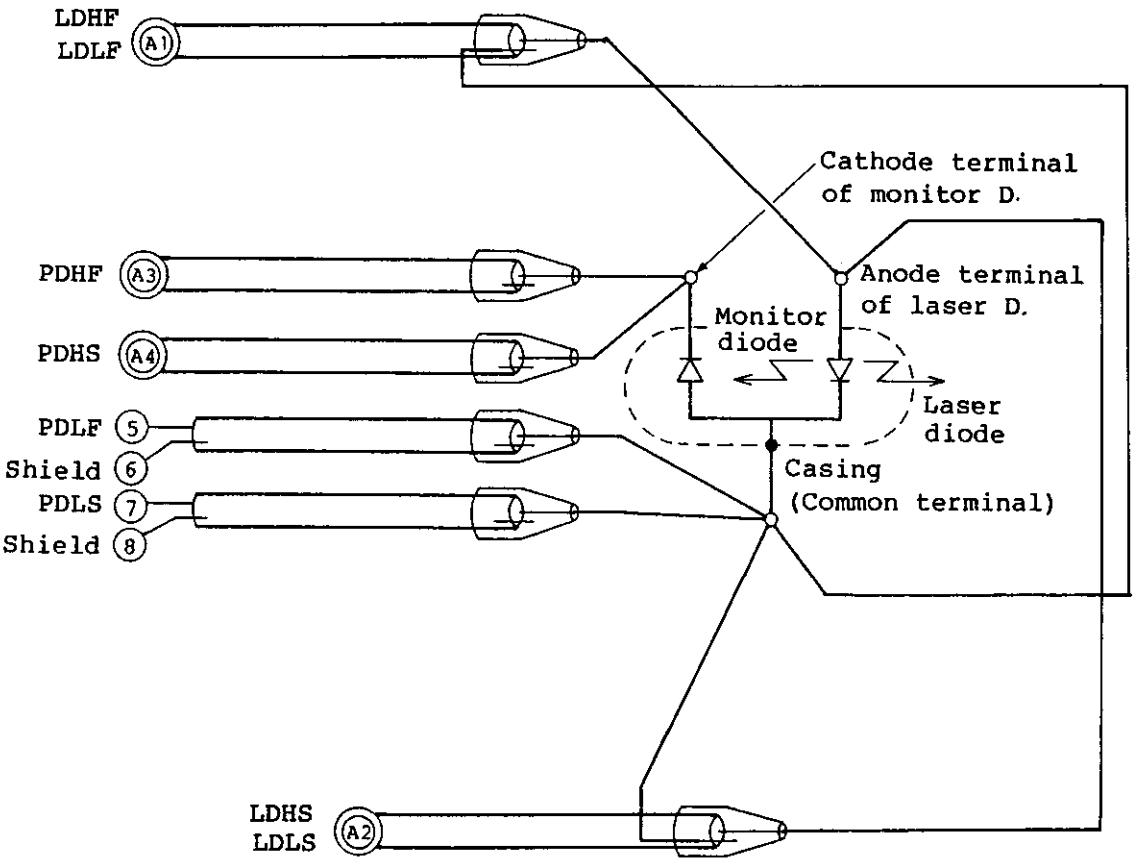
(Note)

- o Attach the following connector inside of the fixture to connect the input/output cable:
  - D-sub socket connector DDM-24W7S
  - Coaxial contact DM53742-5001 (Seven contacts are used.)
- o The length of the cable in the fixture should be less than 20cm. Use coaxial cable for detector and laser cable of the device.

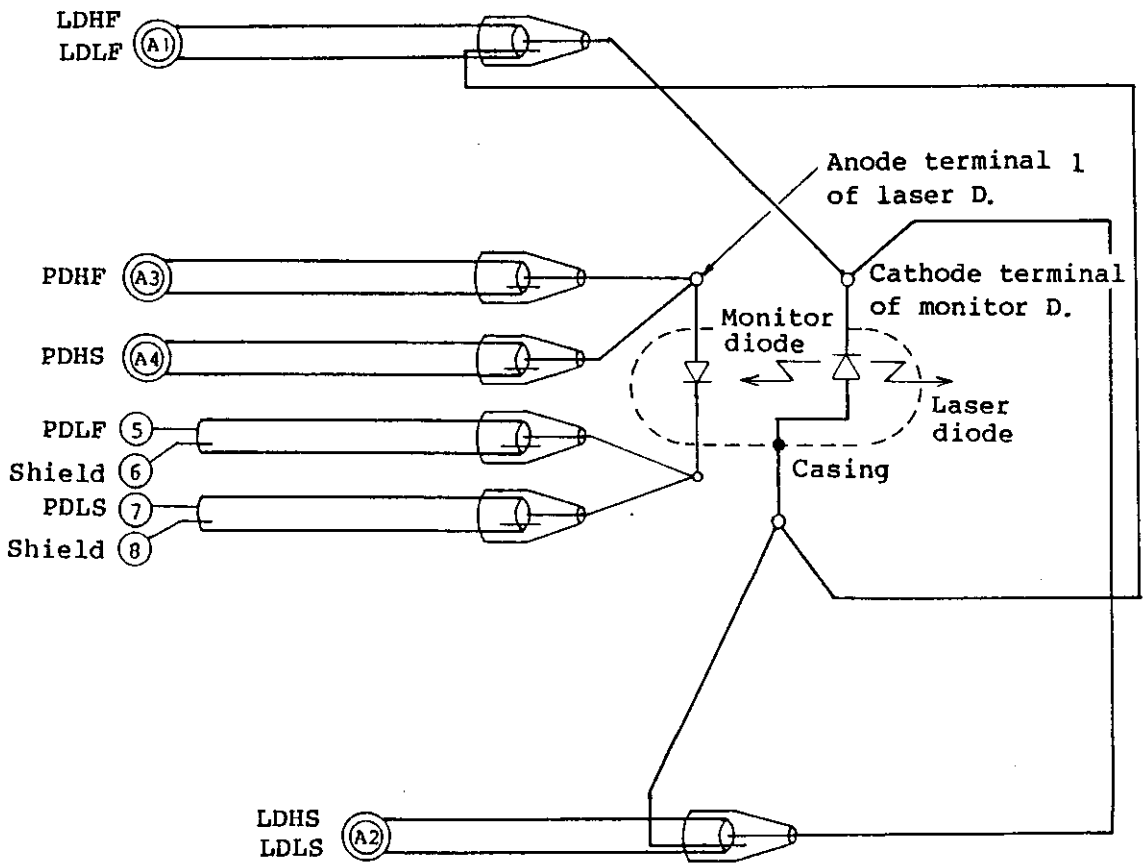
(2) Connecting Device

Example of connection

- Connection of three-terminal type device (Example)



- Connection of four-terminal type device (Example)



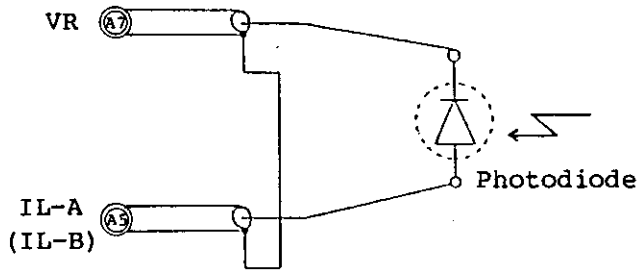
CAUTION

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 and monitor doide. Add the symbols to the measuring program data for indicating the direction of the current. (See section 3.3)

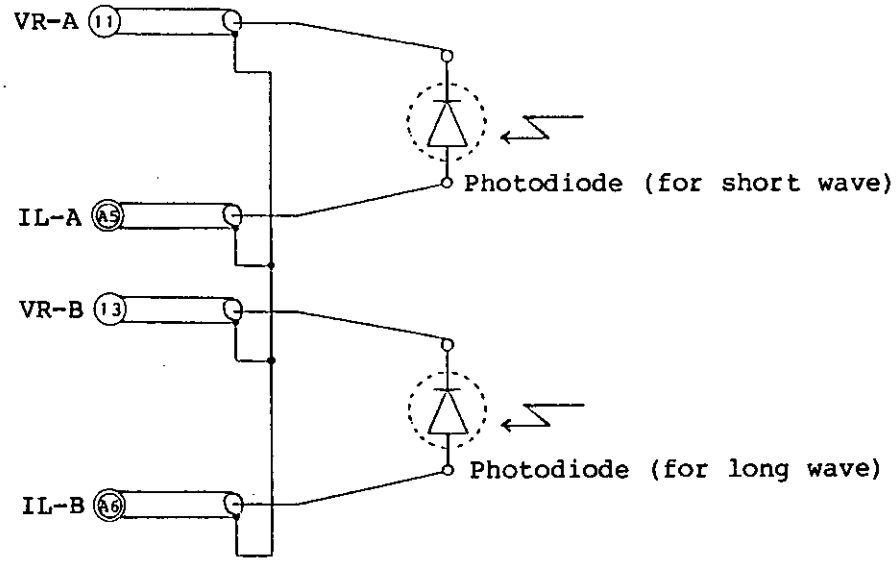
2. Do not connect the shielded side of the shield wire, connected to the monitor diode, to the fixture casing etc. If the above connection is made, the noise increases and the measuring precision may decrease.

(3) Connection of IL Sensor

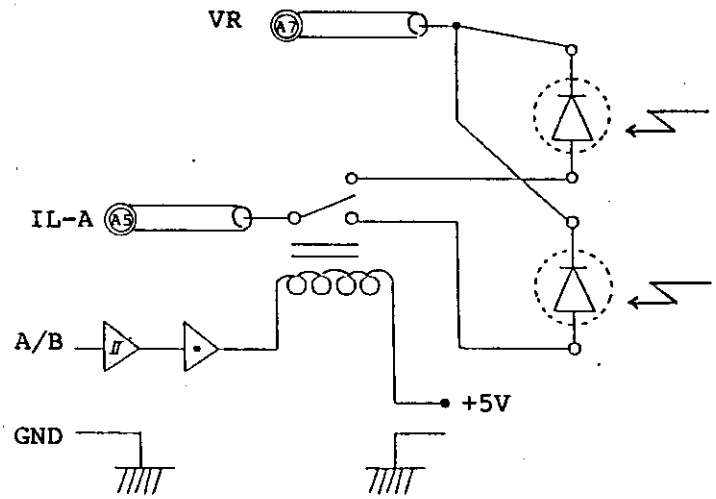
Example of photodiode connection (One photodiode is used)



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)



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3. GPIB INTERFACE

3.1 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.

3.2 Standards

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

- Interface function : Table 3-1 lists the interface functions of this device and their descriptions.

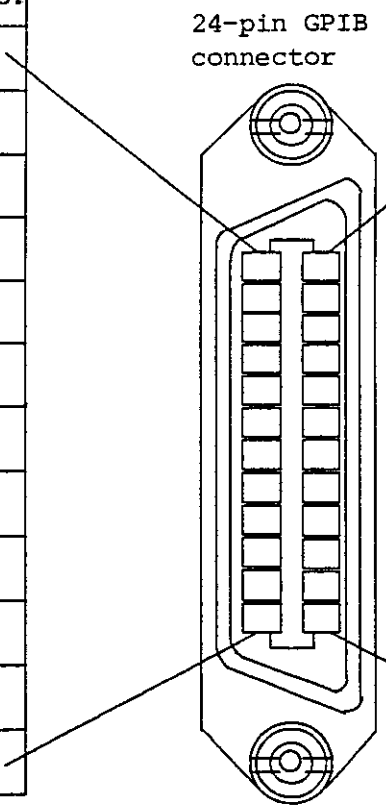
Table 3 - 1 Interface Functions

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



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 3 - 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.

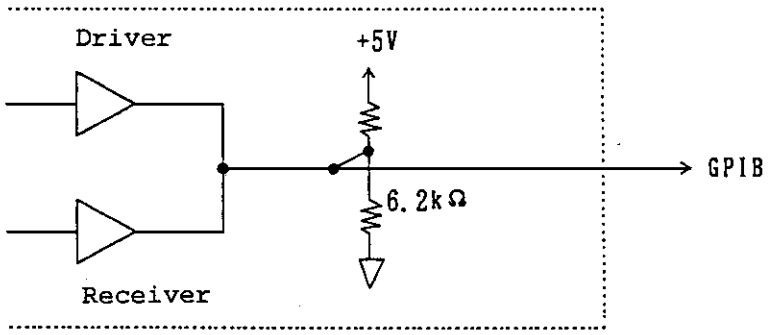


Figure 3 - 2 Termination of Signal Line

- 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.

3.3 GPIB Commands

Table 3 - 2 Current, Voltage, Forcing/Measurement Range

	LD-driver portion			PO-measure portion		PD-measure portion			
Code	If/Im CW	If PULSE	Vf/Vm	Im	Differential efficiency (AC)	If	Im	Vf	Vm
1	4μA	-	4V	-	0.075*KP W/A	-	0.2μA	-	4V
2	40μA	-	40V	-	0.15 *KP W/A	2μA	2μA	10V	-
3	400μA	-	-	2mA	0.3 *KP W/A	20μA	20μA	100V	100V
4	4mA	-	-	4mA	1.5 *KP W/A	200μA	200μA	-	-
5	40mA	-	-	8mA	-	2mA	2mA	-	-
6	200mA	200mA	-	16mA	-	20mA	20mA	-	-
7	-	400mA	-	32mA	-	-	-	-	-
8	600mA	-	-	-	-	400mA	-	-	-
9	-	800mA	-	-	-	-	-	-	-

If: Current forcing
Im: Current measurement
Vf: Voltage forcing
Vm: Voltage measurement
KP: The value to be input by the KP command.

3.3.1 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(Fa,b,c,d Dnnn , Twidth, repeat, DEnnn)"
*1 *2 *3 *4

LD: Laser diode measuring header

② Monitor diode measurement

"PD(Fa,b,c,d Dnnn , DEnnn)"
*1 *2 *3

PD: Monitor diode measuring header

③ Optical output measurement

"RPO(Fa,d, Dnnn , Twidth, repeat, DEnnn)"
*1 *2 *3 *4

RPO: Optical output measuring header

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

*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.

Input the generation data with each unit of [V] and [A].

*3 T: Header (pulse timing)
This T can be omitted for pulse operation and CW operation.

Width : Pulse width
0.4 µsec to 10 msec 0.2 µsec step
Repeat: Pulse width
0.6 µsec to 12 msec 0.2 µsec step
The same format as generated data (However, width < repeat.)

*4 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, Twidth, repeat, DEd)PO(Fe,f,Dg,Lh)PD(Fi,j, DK))"
*1 *2 *3 *4 *5 *6 *7 *8 *9

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
2, Ext. trigger
b : LD current generation range
c : LD voltage measurement range ... See Table 3-2.

*2 D: Header (data)
Start: Measurement start current Set unit [A]
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 T: Header (pulse timing)
This T can be omitted for pulse operation and CW operation.

Width : Pulse width
0.4 µsec to 10 msec, 0.2 µsec step
Repeat: Pulse cycle
0.6 µsec to 12 msec, 0.2 µsec step
The same format as the generation data (However, width < repeat.)

*4 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.

*5 F: Header (function)
e: Current range (optical output)
f: Differential efficiency range ... See Table 3-2

*6 D: Header (data)
g: Photodiode, bias voltage [V]

*7 L: Header (Max. optical output)
h: Max optical output data ... The same format as the generation data. [W]

*8 F: Header (function)
i: Monitor diode voltage generation range
j: Monitor diode current measuring range ... See Table 3-2

*9 D: Header (data)
k: Monitor diode voltage generation data [V]

(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.

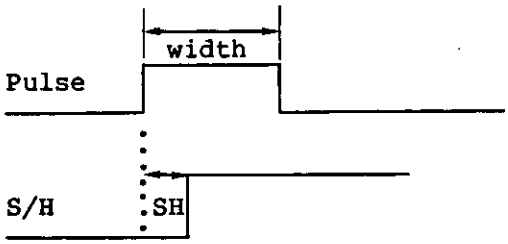
"Kennn": For ACO, coefficient of η. (Refer to appendix 2)

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

- $\underline{KE}$ — Correction factor
- $\underline{\eta}'$ — Differential efficiency measured
- $\underline{\eta}$ — Differential efficiency compensated

"SHTnn" : The measuring timing after leading edge of pulse (Sample hold timing)

nn = 0.0000 to 1.0000 200 nsec resolution



$$SHT = \frac{SH}{width}$$

When nn = 0 or 1 is set, SH timing is set to the inside of pulse width by 200 nsec.

Input the generation data with SI unit system.
(However, input DE [delay] with msec.)

(5) APC drive command

The laser diode drives APC(Auto Power Control).
APC drive in Q89611P measures the monitor current of the laser diode and controls the drive current of the laser diode, to set monitor current in constant value. These controls are calculated digitally.

"AP(IV(Fa, D start, 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 forcing range Refer to Table 3-2.

*2 D : Header (data)
start : LD initial forcing current
stop : LD maximum forcing current
step : Increase and decrease current step
Set each data with the unit of [A].

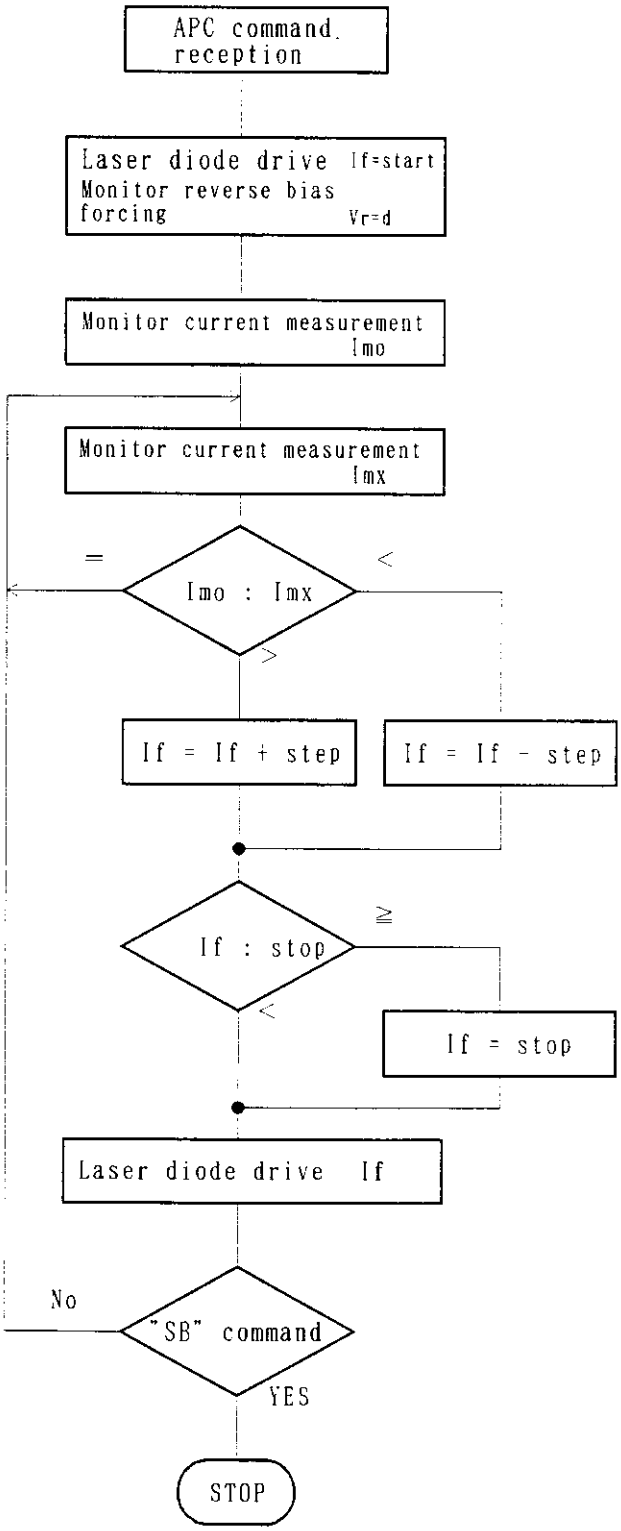
*3 F : Header (function)
b : Monitor diode voltage forcing range
c : Monitor diode current measurement range
} Refer to Table 3-2.

*4 D : Header (data)
d : Monitor diode voltage forcing data [V]

The end of APC control is executed by the SB command.

- Flowchart

The operation of this instrument after APC command is received by GPIB is shown as follows.



Imo is regarded as the reference current

Compare with Imo and Imx, and select the drive current of the laser diode.

When "If" goes to the maximum current, make control as not to provide the current further.

3.3.2 Operation Parameter Setting Command

Table 3 - 3 Operation Parameter Setting Command

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

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

(1) Definition of Operation

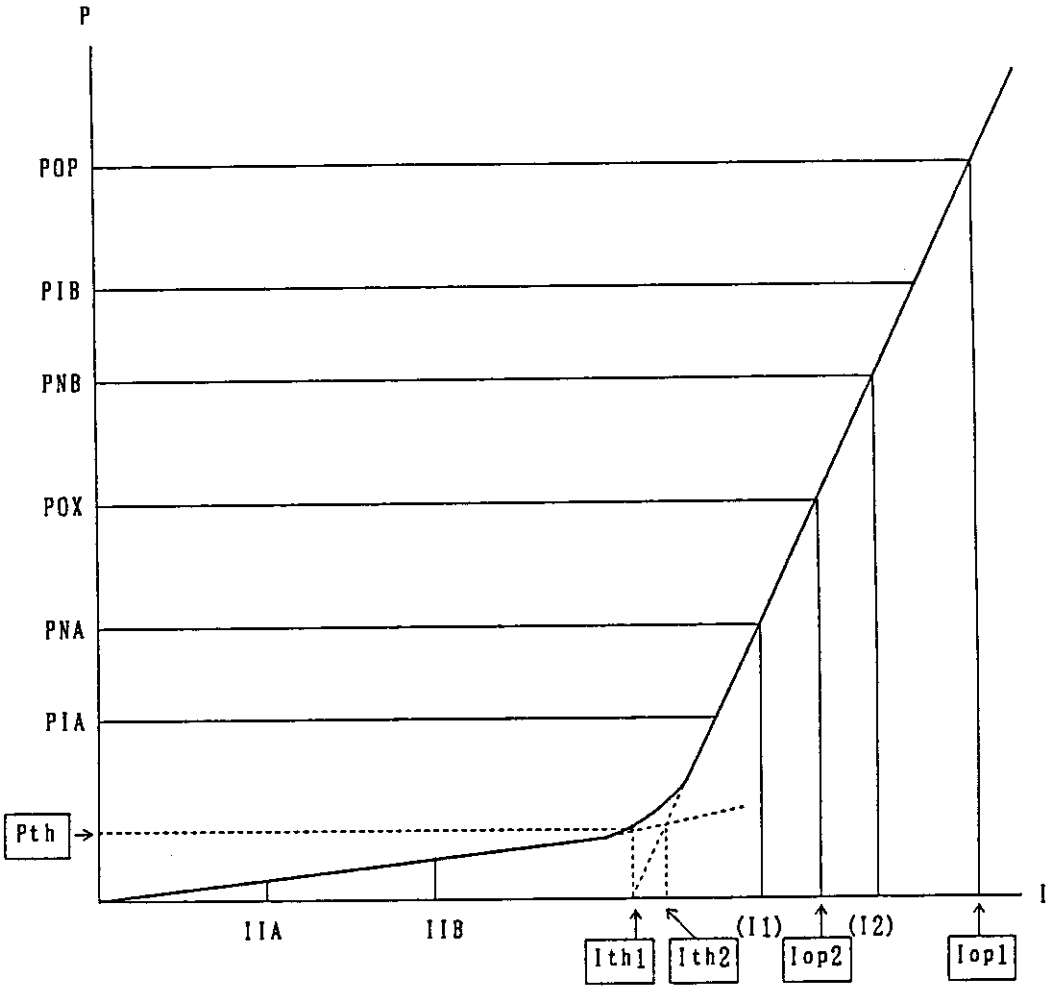


Figure 3 - 3 Definition of Operation of Current Value and Differential Efficiency

Iop1: The operating current for specified optical output (POP)
Iop2: The operating current for specified optical output (POX)
Ith1: The intersection of the straight line connecting two points of optical outputs (PIA, PIB) and the current axis (x axis)
Ith2: The current value of the intersection of the straight line obtained in Ith1 and the straight line connecting two points of current value (IIA < IIB)
η: The inclination of the straight line connecting two points of optical outputs (PNA, PNB)

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

Pth : The optical output for the laser diode threshold current (Ith1).

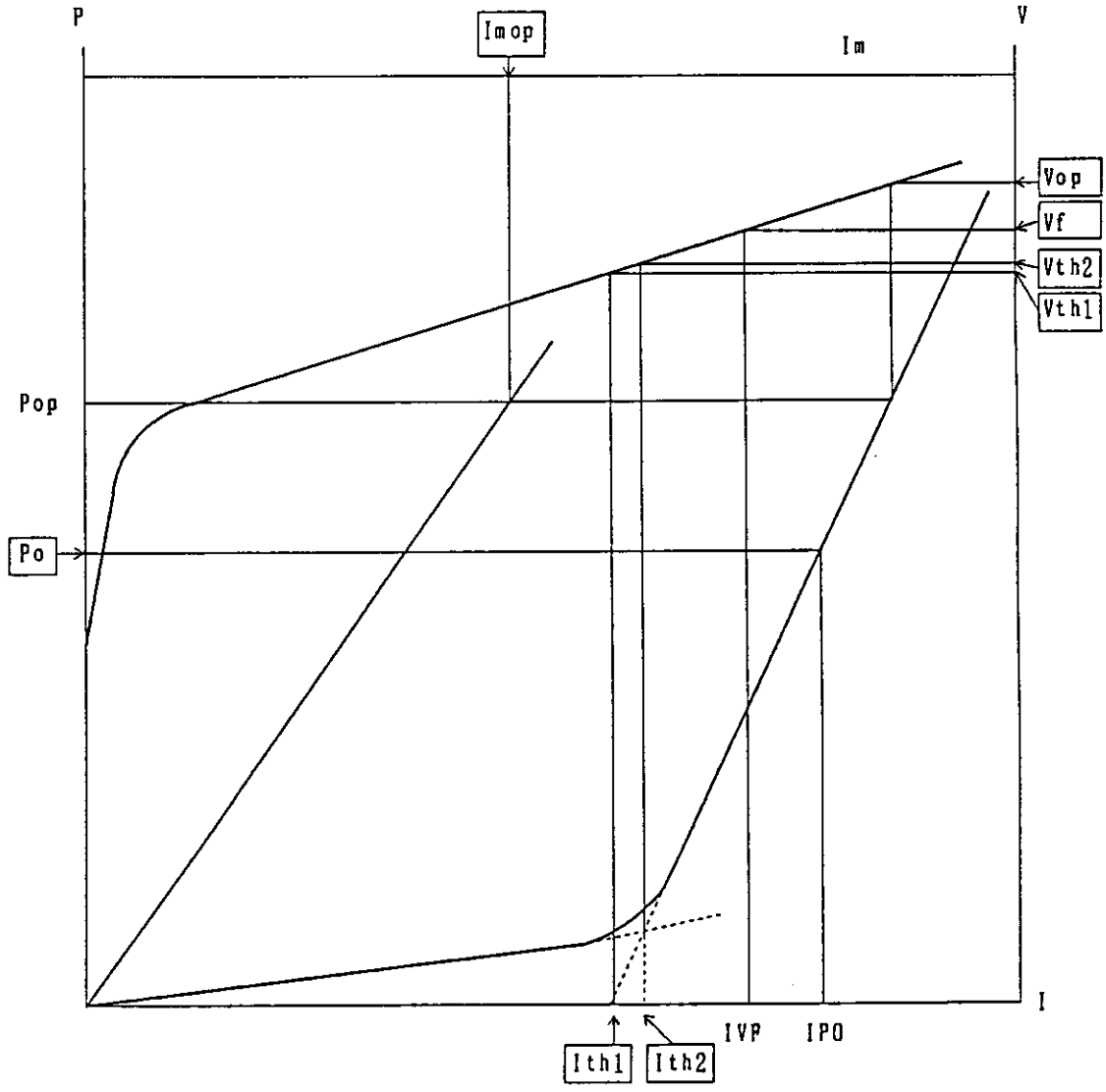


Figure 3 - 4 Definition of Operation of Voltage Value, Optical Output and Monitor Current Value

Vop : The operating voltage for specified optical output (Pop)
Imop: The monitor current value for specified optical output (Pop)
Vf : Voltage in forward direction by means of specified current (IVF)
Po : The optical output by means of specified current (IPO)
Vth1: Voltage in forward direction for laser diode threshold current (Ith1)
Vth2: Voltage in forward direction for laser diode threshold current (Ith2)

3.3.3 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 3 - 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

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

*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 3 - 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 3 - 6 All Measured Data Output Request Command

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

Output format

DCNT *1 <nnn> *2 <bd> *3 <data1-1> *4 <,> *6 <data1-2> *4 <,> *6 ..... <data1-6> *4 <sd> *5

<data2-1> *4 <,> *6 ..... <dataN-6> *4 <bd> *3

*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

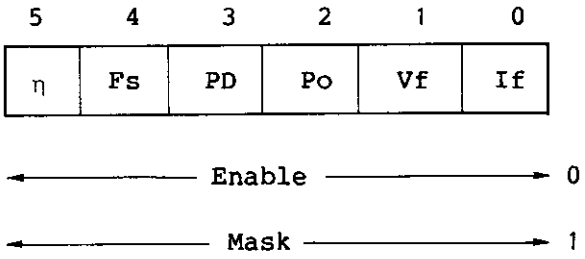
*5: String delimiter (However, for n ≠ 1, the position shown by *5 becomes the string delimiter for every nth number, and others become commas.)
*6: Comma

(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 3 - 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.)}



(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 3 - 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 3 - 9 Request Command for Operation Data Package Output

Commands	Contents
BODT	Request command for operation data package output

DCNT <nnn> <bd> <Hd> <data1> <sd> <Hd> <data2> <sd> .....
*1 *2 *3 *4 *5 *6 *4 *5 *6

.... <sd> <hd> <data9> <bd>
*6 *4 *5 *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: 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)

3.3.4 Specified Commands of Block Delimiter/String Delimiter

Table 3 - 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.

3.3.5 Other Commands

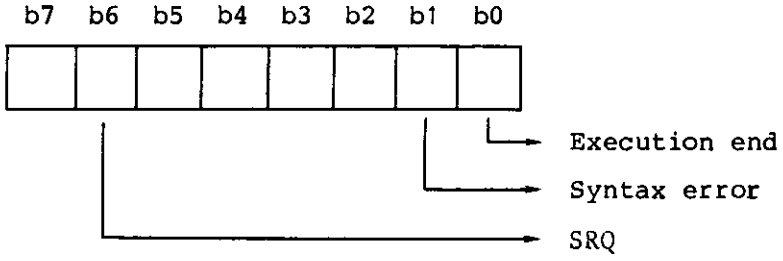
Table 3 - 11 Other Commands

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.

3.3.6 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".)



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.

SRQ 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.

3.4 Error Code

Table 3 - 12 Error Code Table (1 of 4)

Codes	Contents
000 001 002 003	* * * * } System error
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" η. Rs is not suitable.
309	Operation command after the end of "CAL" I-1 measurement is not suitable.
310	Setting command of "AC" η. 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" η is not suitable.
321	Setting of optical output data (high output side) of "PNB" η 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 3 - 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 3 - 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 3 - 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 error 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.

3.5 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.) Set the program
240 : Starts measurement
250 to 270: Read serial poll and wait the end of measurement* (See the program examples 5)
290 : Stand-by output

Note) * : Each bit in the status byte is reset by the CS(clear status). Execute the SWEEP command. Read SR Q-signal by serial polls (SPOLL) in 260 lines. The status byte at this time is as follows.

When measurement is completed, the status byte bits b0 and b6 is set to "1".

b7	b6	b5	b4	b3	b2	b1	b0
0	1	0	0	0	0	0	1

Value 65 by which this binary number is converted into decimal is taken into S on 260 lines. If measurement is not completed (s≠65), either of the following error is occurred. The status byte remains being cleared (s=0). The error occurs (S=66). (Refer to 3.3.6 service requests)

Therefore, the situation of the device can be confirmed by referring to variable S at this time.

(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  !                    Q89611P sample program
30  !       Laser Diode Forward Voltage Measurement  (LD-VF)
40  !*************************************************************************
50        A89611p=710                                  ! GP-IB address
60        OUTPUT A89611p;"LD(F0,3,6,1,D,05)"           ! Vf:50mA , Vm:4V range
70         ENTER A89611p;Dd
80        PRINT Dd
90  END
```

<Program example 2>

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !       Laser Diode Reverse Current Measurement  (LD-IR)
40  !*************************************************************************
50        A89611p=710                                  ! GP-IB address
60        OUTPUT A89611p;"LD(F0,1,2,3,D-1,DE500)" ! Vf:1V , Im:400μA range
70         ENTER A89611p;Dd
80        PRINT Dd
90  END
```

<Program example 3>

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !       Monitor Diode Dark Current Measurement    (Idark)
40  !*************************************************************************
50        A89611p=710                                  ! GP-IB address
60        OUTPUT A89611p;"PD(F0,1,2,1,D-5,DE500)" ! Vf:5V ,Im:.2μA range
70         ENTER A89611p;Dd
80        PRINT Dd
90  END
```

< Program example 4 >

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !       Photo Diode Dark Current Measurement for I-L
40  !*************************************************************************
50        A89611p=710                                ! GP-IB address
60        OUTPUT A89611p;"PDSL0"                     ! PD select 0
70        OUTPUT A89611p;"KP1,IID0"
80        OUTPUT A89611p;"RPO(F0,3,D1)"              ! Vf:1V ,Im:2mA range
90         ENTER A89611p;Dd                          ! set PD offset
100       OUTPUT A89611p;"IID";Dd
110       PRINT Dd
120 END
```

< Program example 5 >

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                       I-L Measurement
40  !*************************************************************************
50        A89611p=710                                ! GP-IB address
60        Kpd=0.56                                   ! Kpd  [A/W]
70        Pmax=0.005                                 ! Power limit: 5mW
80        OUTPUT A89611p;"PDSL0"                     ! PD select 0
90        OUTPUT A89611p;"KP1,IID0"                  !
100       OUTPUT A89611p;"RPO(F0,3,D1)"              ! Vf:1V  ,Im:2mA range
110        ENTER A89611p;Dd
120       OUTPUT A89611p;"IID";Dd                    ! offset
130       OUTPUT A89611p;"KP";1/Kpd
140       OUTPUT A89611p;"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
220       !
230       OUTPUT A89611p;"SW(IV(F0,6,1,D0,,1,,0005)PO(F";Imr;",3,D0,L";Pmax;"
)PD(F2,6,D0))"
240       OUTPUT A89611p;"ST"
250Loop1:!
260       S=SPOLL(A89611p)
270       IF S<>0 THEN Loop1
280       !
290       OUTPUT A89611p;"SB,CS"                     ! Q89611P Stand-by
300 END
```

<Program example 6>

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                 Caliblation parametor set
40  !*************************************************************************
50        A89611p=710                                  ! GP-IB address
60        OUTPUT A89611p;"POP.003"                     ! Pop :3mW
70        OUTPUT A89611p;"PIA1E-3,PIB.004"             ! P1:1mW,P2:4mW for Ith1
80        OUTPUT A89611p;"PNA.002,PIB3E-3"             ! P1:2mW,P2:3mW for Se
90        OUTPUT A89611p;"IIA.01"                      ! I1:10mA for Ith2
100       OUTPUT A89611p;"IIB.02"                      ! I2:20mA
110 END
```

<Program example 7>

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                  Read Caliblation Result
40  !*************************************************************************
50        A89611p=710                                  ! GP-IB address
60        OUTPUT A89611p;"RIOP"                        ! Iop
70         ENTER A89611p;Iop
80        OUTPUT A89611p;"RITH"                        ! Ith1
90         ENTER A89611p;Ith1
100       OUTPUT A89611p;"RNSX"                        ! Sloop eff.
110        ENTER A89611p;Se
120       OUTPUT A89611p;"RITX"                        ! Ith2
130        ENTER A89611p;Ith2
140       PRINT Iop,Ith1,Se,Ith2
150 END
```

< Program example 8-1 >

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                   Read Measurement Result  I
40  !*************************************************************************
45  OPTION BASE 1
50  DIM Sd_buff(2000),Vf_buff(2000),Po_buff(2000),Im_buff(2000)
60        A89611p=710                                ! GP-IB address
70        OUTPUT A89611p;"DL0,SL2"                   !
80        !
90        OUTPUT A89611p;"BOSD"
100        ENTER A89611p;Cnt
110        REDIM Sd_buff(Cnt)
120        ENTER A89611p;Sd_buff(*)
130       !
140       OUTPUT A89611p;"BOVF"
150        ENTER A89611p;Cnt
160       FOR I=1 TO Cnt
170        ENTER A89611p;Vf_buff(I)
180       NEXT I
190 END
```

< Program example 8-2 >

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                   Read Measurement Result II
40  !*************************************************************************
50  OPTION BASE 1
60  DIM Sd_buff(2000),Vf_buff(2000),Po_buff(2000),Im_buff(2000)
70        A89611p=710
80        OUTPUT A89611p;"DL0,SL2"
90        !
100       OUTPUT A89611p;"BOMS60"
110       OUTPUT A89611p;"BOAL1"
120        ENTER A89611p;Cnt
130        REDIM Sd_buff(Cnt),Vf _buff(Cnt)
140       FOR I=1 TO Cnt
150        ENTER A89611p;Sd_buff(I),Vf _buff(I)
160       NEXT I
170 END
```

Note) Program examples of 8-1 and 8-2 handle the same data.
In program example 8-1, each measurement data is individually read and put in arrangement.
In program example 8-2, the output request command of the all measurement data are used.

The output data is Ascii data. When the data is negative, minus sign (-) is added.

Explanation of program example 8-2

Line No.

80	:	Setting of block/string delimiter
100	:	Mask processing of the output request data Request of the If/Vf data $nn = 2^5 * 1 + 2^4 * 1 + 2^3 * 1 + 2^2 * 1 + 2^1 * 0 + 2^0 * 0$ $= 60$
110	:	Output requesting of the If/Vf data
120	:	Reading of the data number
140 to 160	:	Reading of the If/Vf data

< Program example 9 > : Binary output format

The BOSD/BOVF command is executed like program example 8.

```
10  !*************************************************************************
20  !                    Q89611P sample program
30  !                   Read Measurement Result Ⅲ
40  !*************************************************************************
50  OPTION BASE 1
60  DIM Sd_buff(2000),Vf_buff(2000),Po_buff(2000),Im_buff(2000)
70        A89611p=710
80        OUTPUT A89611p;"DL0,SL2"
85        OUTPUT A89611p;"FMAT1"
90        !
100       OUTPUT A89611p;"BOSD"
110        ENTER A89611p;Cnt
120        REDIM Sd_buff(Cnt)
130        ENTER A89611p;K
140        ENTER A89611p USING "W";Sd_buff(*)
150       FOR I=1 TO Cut
160        Sd_buff(I)=Sd_buff(I)*K
170       NEXT I
180       !
190       OUTPUT A89611p;"BOVF"
200        ENTER A89611p;Cnt
210        ENTER A89611p;K
220       FOR I=1 TO Cnt
230        ENTER A89611p USING "W";Vf_buff(I)
240        Vf_buff(I)=Vf_buff(I)*K
250       NEXT I
260  END
```

```
ENTER A89611p USING "W";XXXXX
 "W"  : Read one word of 16 bits.
```

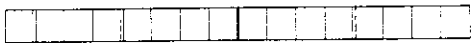
< Explanation of program example 9 >

Line No.

80	:	Setting of block/string delimiter
85	:	Set to the binary format.
100	:	Output requesting of the If data
110	:	Reading of the data number
130	:	Reading of coefficient value
140	:	Reading of the If data
150 to 170	:	Conversion into the measurement data value
190	:	Output requesting of the Vf data
200	:	Reading of the data number
210	:	Reading of coefficient value
220 to 250	:	Reading of the Vf data Conversion into the measurement data value

The data is generated as unsigned and binary 16 bits on the unit side.
The most significant bit of the data is read as sign binary digit on HP side.

Q89611P side 0 to 65535
Unsigned 16 bits



HP side ±0 to 32767
16 bits by which most significant bit is assumed to be sign bit

- Note) Execute the BOPO command as follows.

```
FOR I=1 TO Cnt
 ENTER A89611p USING "W";Po_buff(I)
 IF Po_buff(I)<0 THEN Po_buff(I)=Po_buff(I)+65536
 Po_buff(I)=Po_buff(I)*K
NEXT I
```

- At Po_buff(I)<0

The data is changed if the most significant bit is read as sign bit on HP side. To return this data to the same value as former transmission data of, 65536 is added.

3.6 Creating of program

3.6.1 Caution on programming

The program is created by the following orders.

1. Initialization : The offset of the photodiode and the operation parameter are set.

2. Measurement : The measurement range etc. are set and are measured.

3. Request of the data: The measurement data and the operation data are requested.

4. Output of the data, others

Note at programming

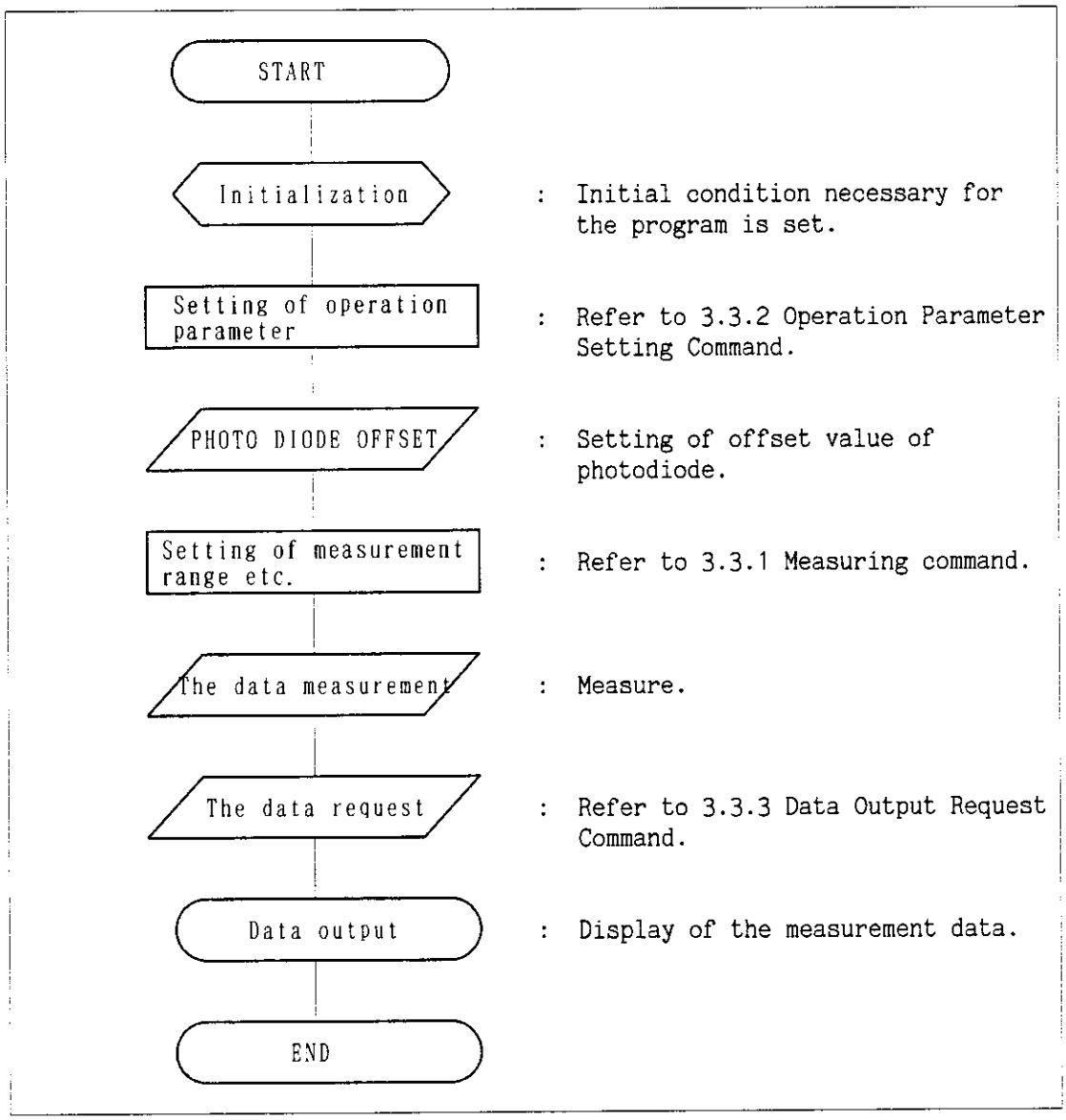
- In the request of the data, two kinds of Ascii format or the binary format are prepared as an output format. Use Ascii format first.

- When the output data is negative, minus sign (-) is added. Convert the data into the absolute value if necessary.
(The ABS instruction is executed on BASIC)

- The data is generated with each unit of [A], [V], [W] and [OMEGA].

- If setting is not changed or the power is not turned off, the operation parameter and the output format set one time will be memorized. Therefore, recreate the format when the correct data is required or the program differed from the output format is executed after a current used program.

3.6.2 Flowchart of programming



3.6.3 Initial State

Each setting after power-on is as follows.

Command	Initial value	Command	Initial value
'KPnnn' 'PDSLn' 'KEnnn'	nnn=0 n=0 nnn=1	'IIDnnn' 'ACn' 'SHTnn'	nnn=0 n=1 nnn=0
'POPnnn' 'PIAnnn' 'IIAnnn' 'PNAnnn' 'IVFnnn' 'POXnnn'	nnn=0	'PIBnnn' 'IIBnnn' 'PNBnnn' 'IPOnnn' 'PMXnnn'	nnn=0
'BOMSnn' 'DLn'	nn=0 n=0	'FMATn' 'SLn'	n=0 n=0
'BZn' 'Sn' 'MSnn'	n=0 n=1 n=0	'NSn' 'Hn' 'CALn'	n=0 n=0 n=0

Error 203 will occur when n is omitted if setting is changed.
Refer to the item of each command for set value range.

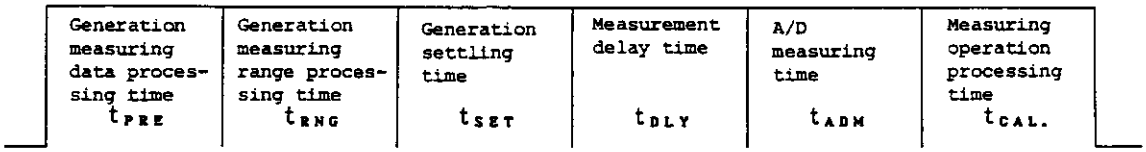
MEMO

4. OPERATION TIME

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

4.1 Generation Measuring Time

(1) Spot Measurement



(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	Approx. 5 msec
40mA	
200mA	
600mA	

PD measurement

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

PO measurement

t_{SET}
Approx. 5 msec

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

Setting value (0 to 655.35 msec)

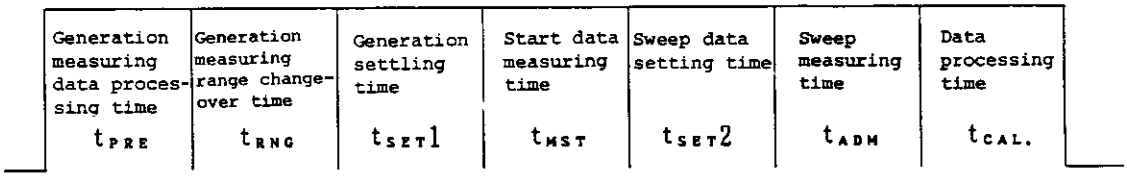
(e) A/D measuring time (t_{ADM})

Approx. 400 µsec

(f) Measuring operation processing time

Approx. 3 msec

(2) Sweep Measurement



	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

4.2 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

5. OPERATION

Figure 5-1 shows the block diagram of Q89611P. 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 Q89611P, and the control logic section is floated with the signal isolator.

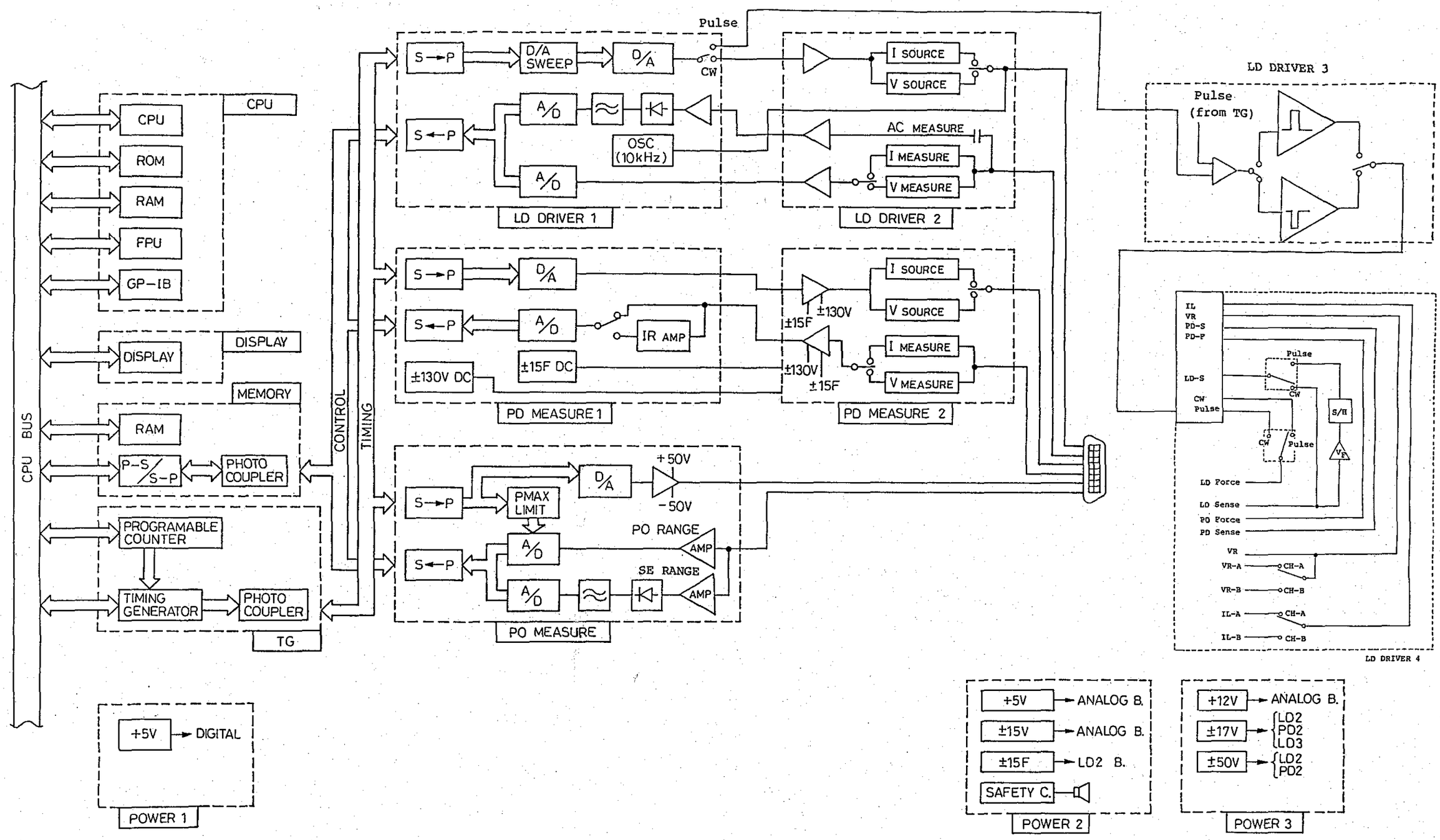


Figure 5 - 1 Q89611P Block Diagram

6. 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
	Pulse 200mA	50μA
	Pulse 400mA	100μA
	Pulse 800mA	200μA
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 wavelength sensitivity of an external photodiode for the optical power measurement is input with GPIB.

(Note 2)

The value converted into the current optical power is different depending on the wavelength sensitivity of the sensor.
The conversion value of optical power is mostly corresponding to the value divided by quantum efficiency of the photodiode used by the current measurement.

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

(5) Setting Pulse Condition

① Pulse width : 400ns to 10ms (200ns)

② Repeating cycle : 0.6μs to 12ms (200ns)

③ Duty ratio : Variable within the above range

(6) Pulse Wave Characteristics (at LD loading)

① Rise time : Less than 100ns (10 to 90% of the amplitude)

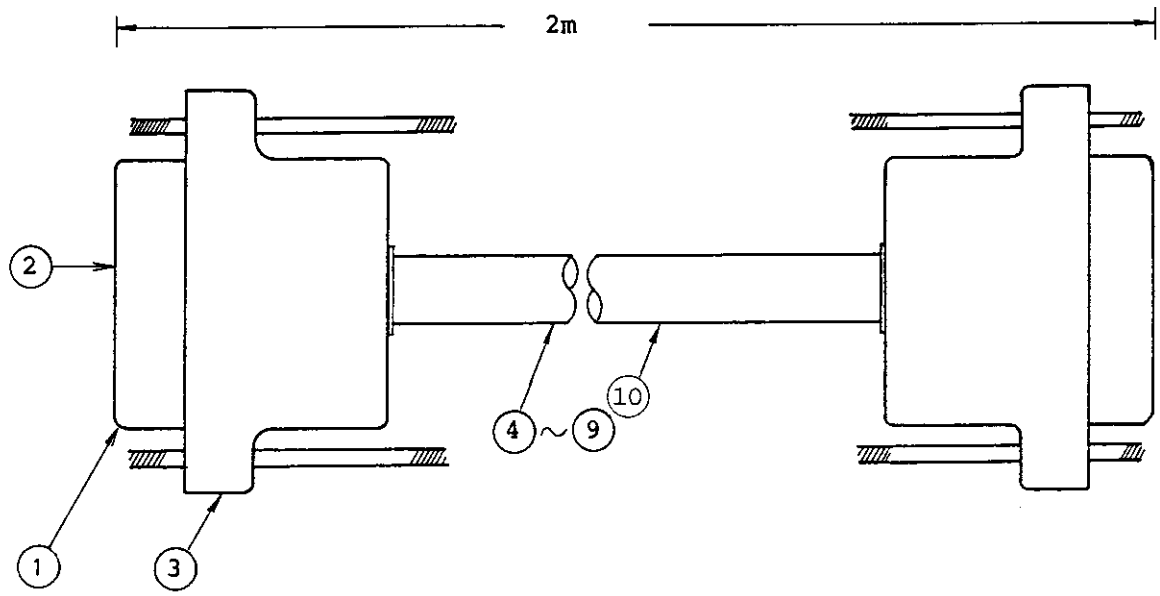
② Fall time : Less than 100ns (10 to 90% of the amplitude)

③ Overshoot ringing : Less than 15% of the pulse width and less than 200ns (including the rise time and fall time)

MEMO

APPENDIX 1 SPECIFICATIONS OF INPUT/OUTPUT CABLE

External view of cable section

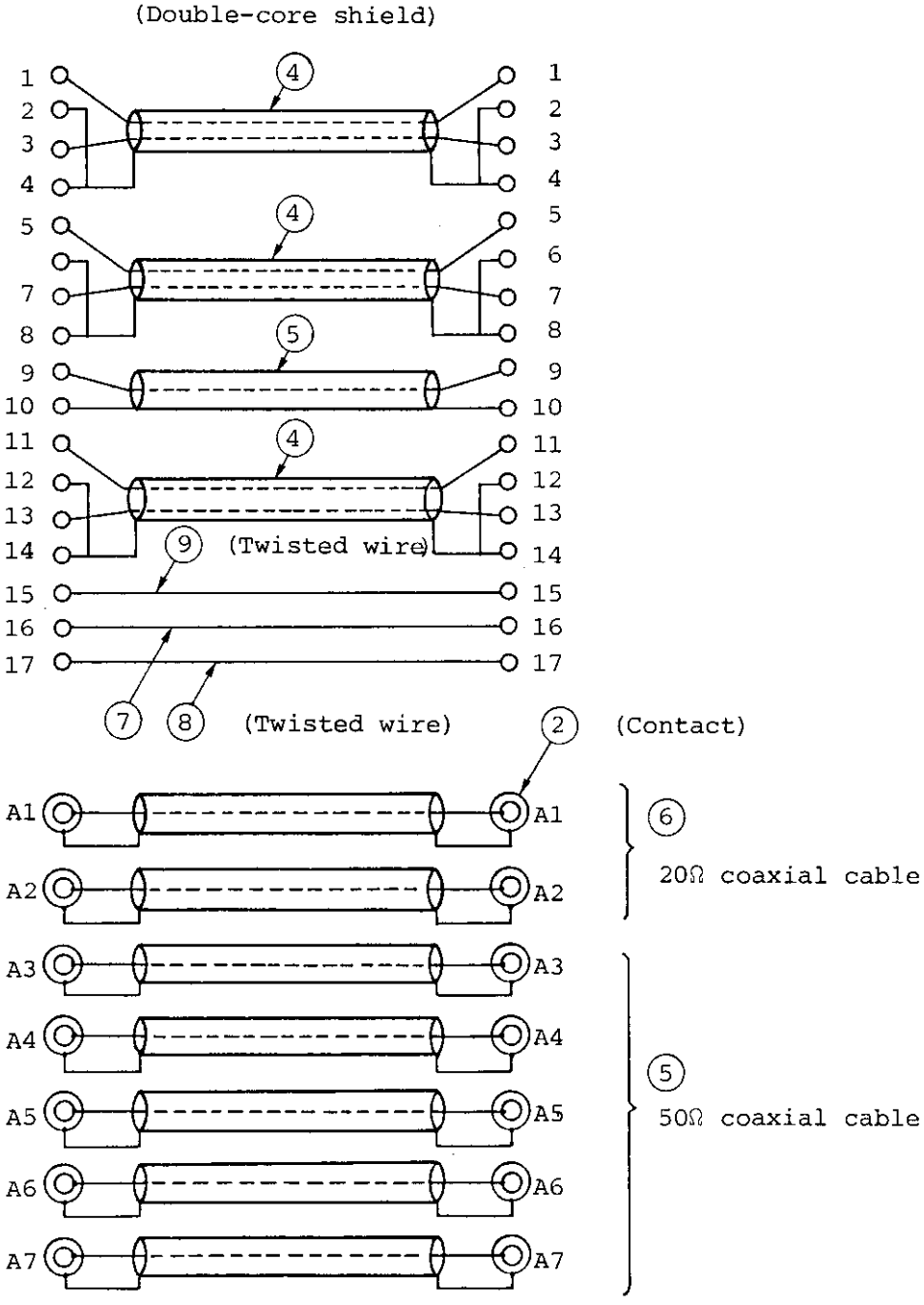


Components and cables

	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

Appendix 1 Specifications of Input/Output Cable

Connection diagram



APPENDIX 2 DIFFERENTIAL EFFICIENCY

When the differential efficiency is measured by the AC superposed method using Q89611P, the level will be low compared with the DC method (operation) due to the low response of the long wave sensor. (Figures A2-1 and A2-2) To compensate the level, use the command (KEnnn) of Q89611P 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)

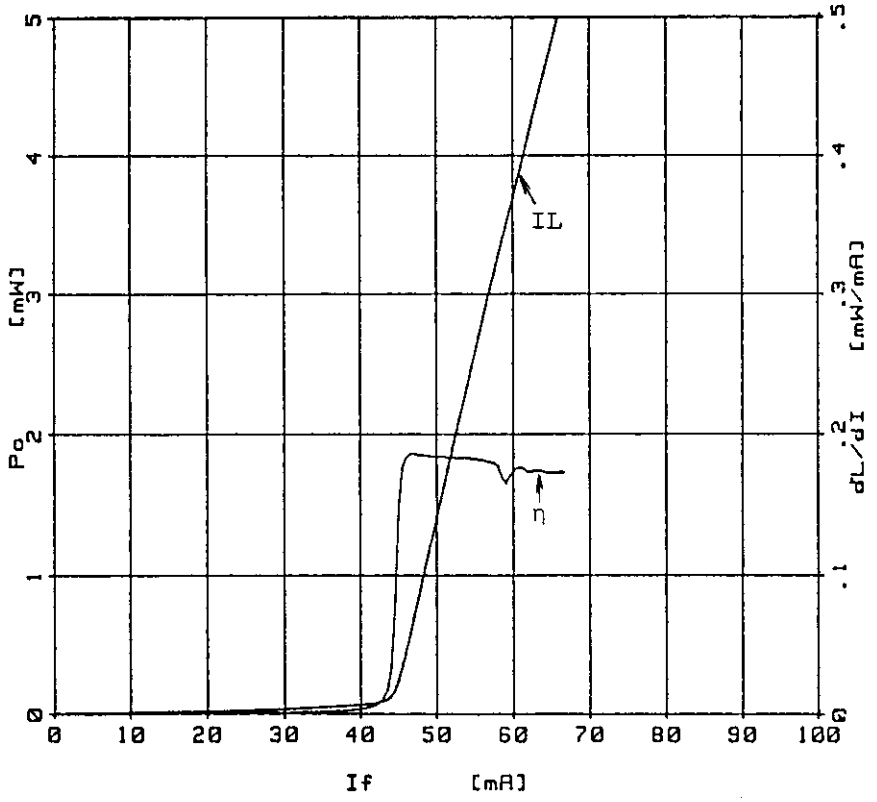


Figure A2 - 1 Measurement of I-L and Differential Efficiency with AC Superposed Method

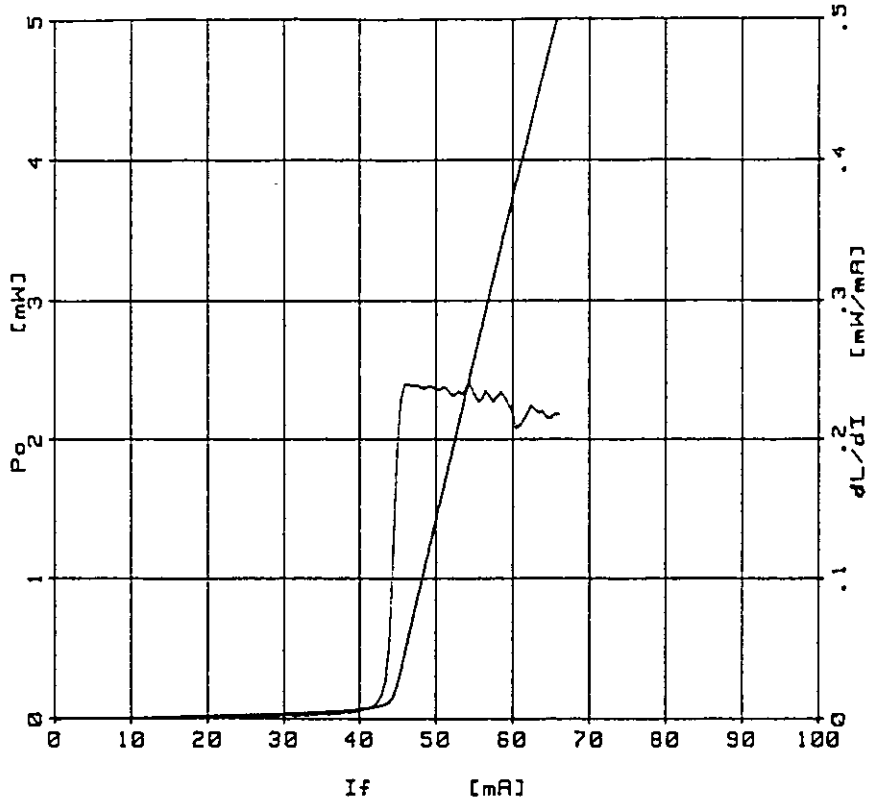


Figure A2 - 2 Measurement of I-L and Differential Efficiency with DC Superposed Method

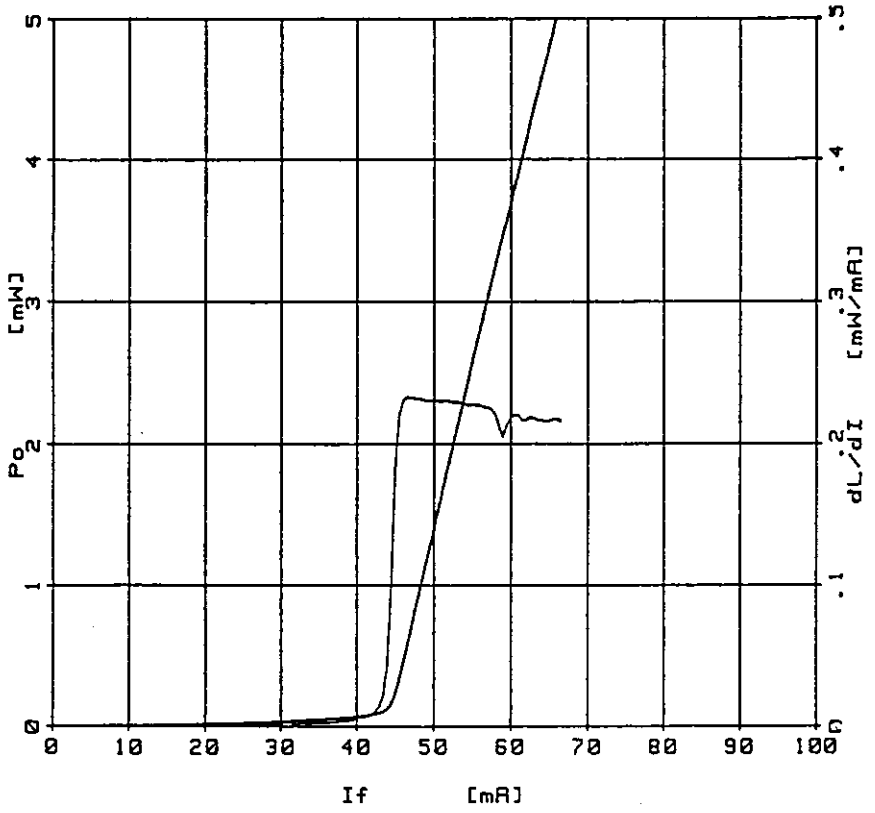
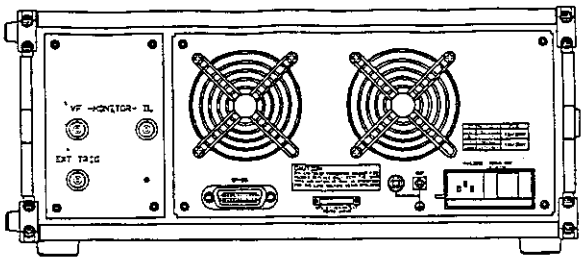
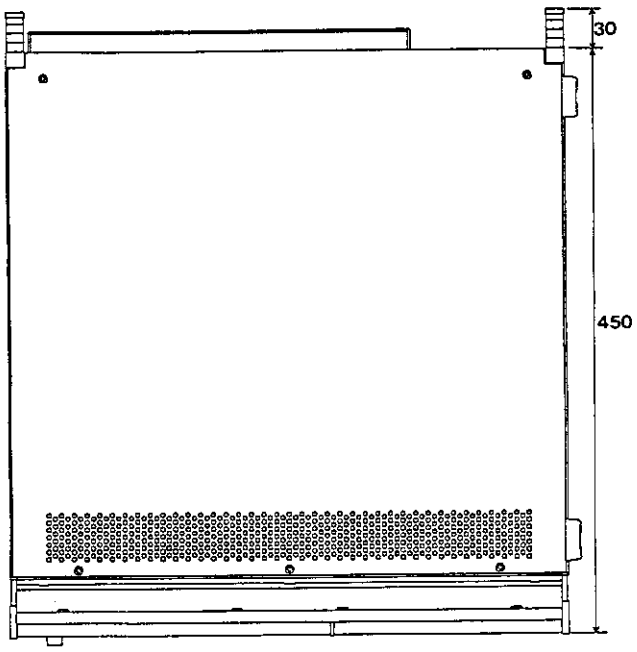


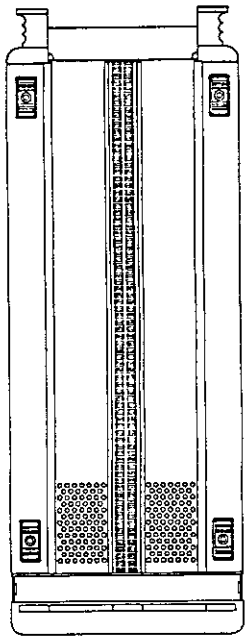
Figure A2 - 3 Measured Data of Differential Efficiency Compensated with KE Command

MEMO



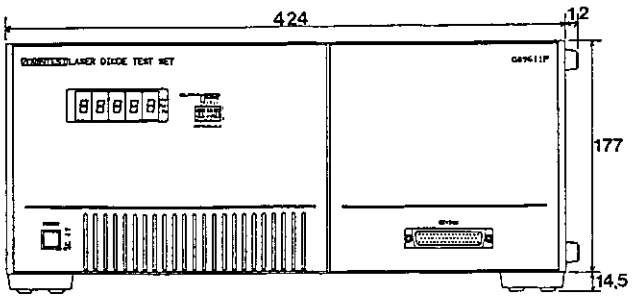
REAR VIEW





SIDE VIEW

TOP VIEW

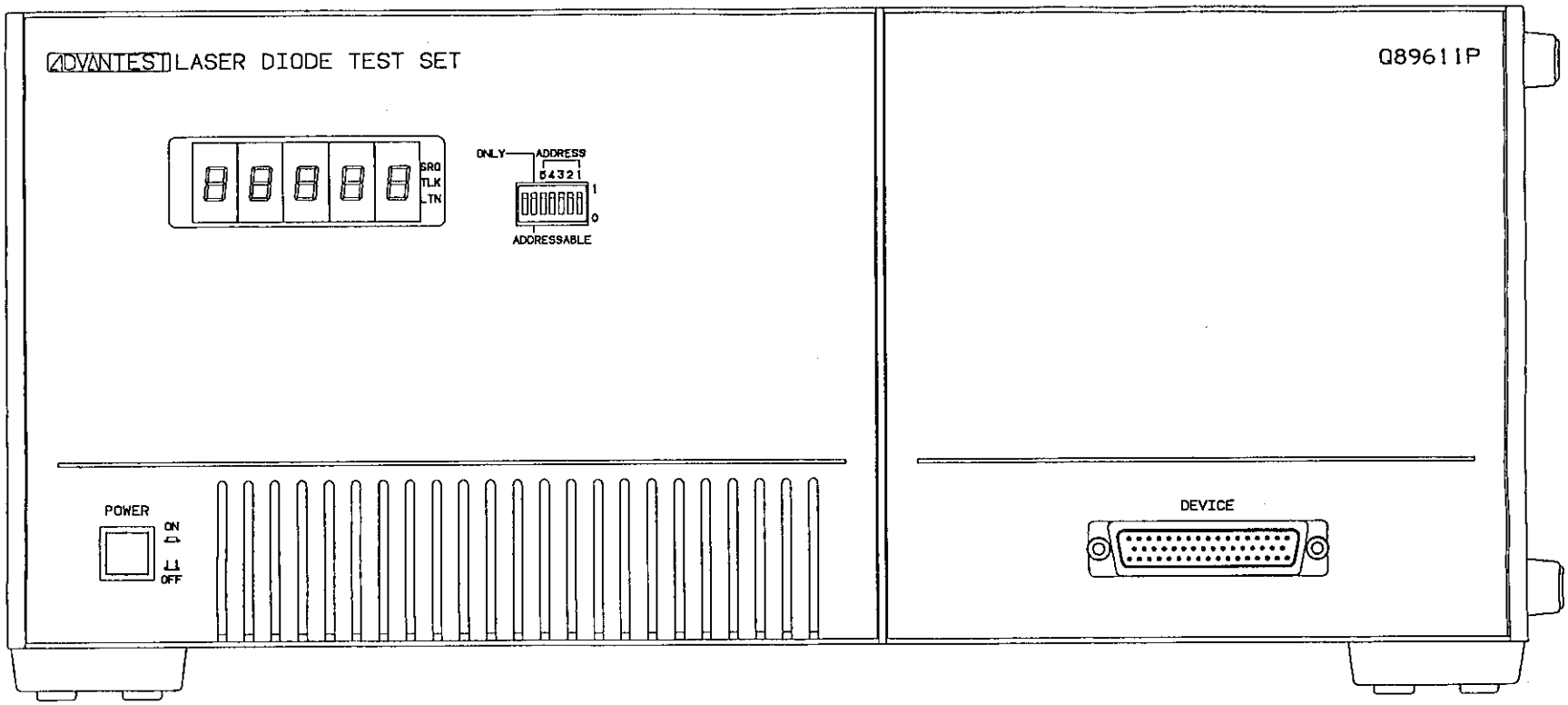


FRONT VIEW

Unit : mm

Q89611P

EXTERNAL VIEW



Q89611P FRONT VIEW

Q89611PEXT2-802-A

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   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

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

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

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

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

CUSTOMER SERVICE DESCRIPTION

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

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

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