DATA BOOK

Optoelectronic

Dec. 1986

HITACHI

HITACHI OPTOELECTRONIC SEMICONDUCTORS DATA BOOK

HITACHI

Introduction

With the rapid progress that has been made in recent years, optoelectronic semiconductor applications have become commonplace in such optical systems as transmission equipment, information terminals, video/audio disc players, measurement equipment, medical apparatuses, and much more. Hitachi, for its part, has contributed to optimization of these systems by developing superior optoelectronic semiconductors that demonstrate compact size, light weight, low power consumption, high collimating efficiency, excellent monochromaticity, and high speed direct modulation capability. This data book contains product lineups, operational features as well as device characteristics, application hints, and data sheets for Hitachi laser diodes (LDs), infrared emitting diodes (IREDs) and photodiodes.

Safety Considerations

Be sure to avoid direct exposure of human eyes to high power laser beams emitted from laser diodes. Even though barely visible to the human eye, they can be quite harmful. In particular, avoid looking directly into a laser diode or collimated beam along its optical axis when the diode is activated. One simple way to determine the optical path is to use a phosphor plate or infrared sensitive camera.

Hitachi certifies compliance with US Safety Regulations (21 CFR Subchapter J) on laser products, as stipulated by the U.S. Department of Health and Human Services. The Hitachi products shown here correspond to the category "CLASS IIIb LASER PRODUCT" in this regulation.

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Product Lineup

Product Descriptions

Laser Diodes

Infrared Emitting Diodes

Photodiodes

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ge	Applied products	Errors	Correction

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Errors

Correction

DANGER

„Invisible laser radiation-avoid direct exposure to beam"

Peak power 30 mW
Wave lenght 760 ~ 1350 nm
„Class III b Laser Product"

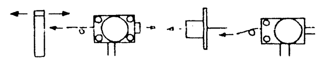
This product conforms to FDA regulations 21 CFR SUBCHAPTER J.

AVOID EXPOSURE ——— Laser invisible radiation is emitted from glass window and monitor output guide, or from fiber pigtail end and monitor output guide, or from laser chip mounted on top of header. Before use, consult appropriate catalogs or manuals.

LASER SAFETY

This Laser device in operation produces invisible laser radiation which may be harmful to the human eye. Avoid directly looking into the device or the collimated beam along its optical axis when the device is in operation.

Beam Direction



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ge	Applied products	Errors	Correction
	HL1321BF HL1321DL HL1341BF HL1341DL HL1541BF HL1541DL	Storage temperature −40 to +80°C	Storage temperature −40 to +70°C

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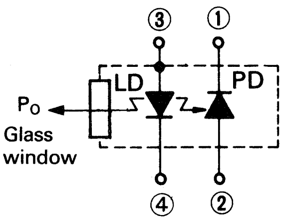
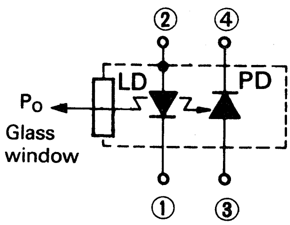
ge	Applied products	Errors	Correction
	HL1321FG HL1341FG HL1541FG	Internal Circuit	Internal Circuit

Errors



1. Photodiode cathode
2. Photodiode anode
3. Laser diode anode (case)
4. Laser diode cathode

Correction



1. Laser diode cathode
2. Laser diode anode (case)
3. Photodiode anode
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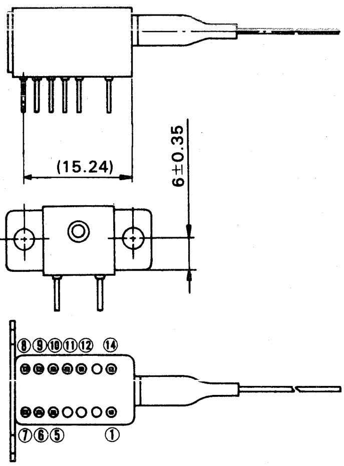
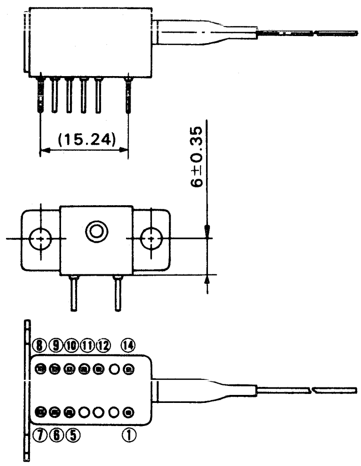
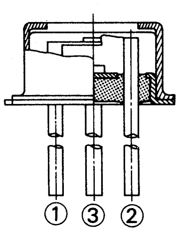
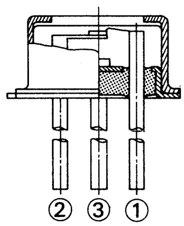
Page	Applied products	Errors	Correction
161 163 174 176 188 190	HL1321BF HL1321DL HL1341BF HL1341DL HL1541BF HL1541DL	**Absolute Maximum Ratings** Storage temperature −40 to +80°C	**Absolute Maximum Ratings** Storage temperature −40 to +70°C
163 176 190	HL1321DL HL1341DL HL1541DL	Package Dimensions  	Package Dimensions 
236 238 242 244 246	HR1101 HR1102 HR1103TG HR1104TG HR1105TG	Package Dimensions  	Package Dimensions 

<Mar. 1987>

Product Lineup

Part no.
Product lineup
Main characteristics
Package variations

Part no.

1. Hitachi optoelectronic device part nos. indicate the following:

H □ □□ □□ □

- Package type
- Chip structure, characteristics
- Emitting wavelength
  - Ex.; 780 nm band: 78
  - 1300 nm band: 13
- Product type
  - Laser diode: L
  - Infrared emitting diode: E
  - Photodiode: R

2. Sample part nos. are given below.

(1) Laser diode example

H L 1 3 2 1 A C

- AC-type package
- Chip structure, characteristics
- 1300 nm light emitted from the device
- Laser diode

(2) Infrared emitting diode example

H E 8 4 0 3 M L

- ML-type package
- Chip structure, characteristics
- 840 nm light emitted from the device
- Infrared emitting diode

(3) Photodiode example

H R 1 1 0 2 C X

- CX-type package
- Chip structure, characteristics
- Photodetectable wavelength range
  - Short wavelengths: 8
  - Long wavelengths: 1
- Photodiode

Product lineup

	Part no.	Structure	Wavelength (nm) 600 800 1000 1200 1400 1600	Characteristics
Laser diodes	HL7801E	GaAlAs double heterojunction	├┤	P_O = 5 mW max.
	HL7801G		├┤	P_O = 5 mW max.
	HL7802E		├┤	P_O = 10 mW max.
	HL7802G		├┤	P_O = 10 mW max.
	HL7806G		├┤	P_O = 5 mW max.
	HL7831G		├┤	P_O = 5 mW max.
	HL7832G		├┤	P_O = 5 mW max.
	HL7838G		├┤	P_O = 20 mW max.
	HL8311E		├┤	P_O = 15 mW max.
	HL8311G		├┤	P_O = 15 mW max.
	HL8312E		├┤	P_O = 20 mW max.
	HL8312G		├┤	P_O = 20 mW max.
	HL8314E		├┤	P_O = 30 mW max.
	HL8314G		├┤	P_O = 30 mW max.
	HL8315E		├┤	P_O = 20 mW max.
	HLP1400		├┤	P_O = 15 mW max.
	HLP1500		├┤	P_f = 6 mW max.
	HLP1600		├┤	P_O = 15 mW max.
	HL1221A	InGaAsP double heterojunction	├┤	P_O = 5 mW max.
	HL1221AC		├┤	P_O = 5 mW max.
	HL1221B		├┤	P_f = 1.2 mW max.
	HL1221C		├┤	P_O = 5 mW max.
	HLP5400		├┤	P_O = 5 mW max.
	HLP5500		├┤	P_f = 1.2 mW max.
	HLP5600		├┤	P_O = 5 mW max.
	HL1321AC		├┤	P_O = 5 mW max.
	HL1321FG		├┤	P_O = 5 mW max.
	HL1321P		├┤	P_f = 1.2 mW max.
	HL1321SP		├┤	P_f = 1.2 mW max.
	HL1321BF		├┤	P_f = 1.2 mW max.
	HL1321DL		├┤	P_f = 1.2 mW max.
	HL1322A		├┤	P_O = 10 mW max.
	HL1322AC		├┤	P_O = 10 mW max.
	HL1521A		├┤	P_O = 5 mW max.
	HL1521AC		├┤	P_O = 5 mW max.
	HL1341A	InGaAsP double heterojunction, distributed feedback (DFB)	├┤	P_O = 5 mW max.
	HL1341AC		├┤	P_O = 5 mW max.
	HL1341FG		├┤	P_O = 5 mW max.
	HL1341BF		├┤	P_f = 1.2 mW max.
	HL1341DL		├┤	P_f = 1.2 mW max.

(Continued)

	Part no.	Structure	Wavelength (nm) 600 800 1000 1200 1400 1600	Characteristics
Laser diodes	HL1541A	InGaAsP double heterojunction, distributed feedback (DFB)		P_O = 5 mW max.
	HL1541AC			P_O = 5 mW max.
	HL1541FG			P_O = 5 mW max.
	HL1541BF			P_f = 1.2 mW max.
	HL1541DL			P_f = 1.2 mW max.
Infrared emitting diodes	HLP20R	GaAlAs single heterojunction		P_O = 15 mW min.
	HLP30R			P_O = 25 mW min.
	HLP40R			P_O = 35 mW min.
	HLP50R			P_O = 45 mW min.
	HLP60R			P_O = 55 mW min.
	HLP20RG			P_O = 7 mW min.
	HLP30RG			P_O = 12 mW min.
	HLP40RG			P_O = 17 mW min.
	HLP50RG			P_O = 22 mW min.
	HLP60RG			P_O = 27 mW min.
	HE8402F	GaAlAs double heterojunction		P_f = 60 μW typ.
	HE8403R			P_f = 80 μW typ.
	HE8403SG			P_f = 80 μW typ.
	HE8403ML			P_f = 80 μW typ.
	HE8801	GaAlAs single heterojunction		P_O = 20 mW typ.
	HE8805VG			P_O = 20 mW typ.
	HE8806VG			P_O = 20 mW typ.
	HE8807SG			P_O = 20 mW typ.
	HE8807SL			P_O = 15 mW typ.
	HE8811	GaAlAs double heterojunction		P_O = 30 mW typ.
	HE1301R	InGaAsP double heterojunction		P_f = 15 μW min.
	HE1301SG			P_f = 15 μW min.
	HE1301ML			P_f = 15 μW min.
	HE1302ML			P_f = 30 μW min.
Photodiodes	HR8101	Si PIN		Photodetectable area: 0.8×0.8 mm□
	HR8102			φ300 μm*
	HR8202TG	Si avalanche		φ300 μm*
	HR1101	InGaAsP PIN		φ100 μm*
	HR1102			φ300 μm*
	HR1102CX			φ300 μm*
	HR1103TG	InGaAs PIN		φ100 μm*
	HR1103CX			φ100 μm*
	HR1104TG			φ300 μm*
	HR1104CX			φ300 μm*
	HR1105TG			φ80 μm*

* Photodetectable diameter

Main characteristics

Laser diodes ($T_C = 25°C$)

Part no.		Absolute maximum ratings: Optical output power, P_o (mW)	Reverse voltage, $V_{R(LD)}$ (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Lasing wavelength, λ_p (nm) min.	typ.	max.	Beam divergence, $\theta_{//} \times \theta_{\perp}$ (deg.) typ.	Test condition P_o (mW)	Reference page
HL7801 series	HL7801E	5	2	−10 to +60	−40 to +80	760	780	800	15×30	3	83
	HL7801G										85
HL7802 series	HL7802E	10	2	−10 to +50	−40 to +80	770	785	800	11×30	10	87
	HL7802G										89
HL7806 series	HL7806G	5	2	−10 to +60	−40 to +85	775	785	795	14×27	5	91
HL7831 series	HL7831G	5	2	−10 to +60	−40 to +85	770	785	795	13×35	3	94
HL7832 series	HL7832G	5	2	−10 to +60	−40 to +85	770	785	795	13×35	3	97
HL7838 series	HL7838G+	20	2	−10 to +60	−40 to +80	770	780	795	10×26	20	100
HL8311 series	HL8311E	15	2	−10 to +60	−40 to +80	800	830	850	10×27	10	101
	HL8311G										104
HL8312 series	HL8312E	20	2	−10 to +50	−40 to +80	810	830	850	10×27	10	107
	HL8312G										110
HL8314 series	HL8314E	30	2	−10 to +50	−40 to +80	810	830	850	10×27	30	113
	HL8314G										116
HL8315 series	HL8315E	20	2	−10 to +50	−40 to +80	800	830	850	10×27	10	119
HLP1000 series	HLP1400	15	2	0 to +60	0 to +80	800	830	850	10×25	10	122
	HLP1500	6*			−40 to +70					4*	125
	HLP1600	15			−40 to +80				10×25	10	127
HL1221 series	HL1221A	5	2	0 to +50	0 to +60	1170	1200	1230	30×40	3	130
	HL1221AC	5			0 to +60				30×40	3	133
	HL1221B	1.2*			−40 to +60					0.5*	136
	HL1221C	5			−40 to +60				30×40	3	139
HLP5000 series	HLP5400	5	2	0 to +50	0 to +60	1270	1300	1330	30×40	3	142
	HLP5500	1.2*			−40 to +60					0.5*	145
	HLP5600	5			−40 to +60				30×40	3	148
HL1321 series	HL1321AC	5	2	0 to +60	0 to +80	1270	1300	1330	30×40	3	151
	HL1321FG++	5	2	0 to +60	−40 to +80	1290	1310	1330	30×40	3	154
	HL1321P	1.2*	2	0 to +50	−40 to +60	1270	1300	1330		0.5*	155
	HL1321SP	1.2*	2	0 to +50	−40 to +60	1270	1300	1330		1.0*	158
	HL1321BF+	1.2*	2	0 to +60	−40 to +80	1290	1310	1330		1.0*	161
	HL1321DL+	1.2*	2	0 to +60	−40 to +80	1290	1310	1330		1.0*	163
HL1322 series	HL1322A	10	2	0 to +60	0 to +80	1290	1310	1330	30×40	6	165
	HL1322AC										168
HL1341 series	HL1341A+	5	2	0 to +60	0 to +80	1280	1310	1340	30×40	3	171
	HL1341AC+				0 to +80						172
	HL1341FG++				−40 to+80						173
	HL1341BF++	1.2*	2		−40 to +80					0.5*	174
	HL1341DL++				−40 to +80						176
HL1521 series	HL1521A	5	2	0 to +60	0 to +80	1530	1550	1570	30×40	3	178
	HL1521AC										181
HL1541 series	HL1541A+	5	2	0 to +60	0 to +80	1520	1550	1580	30×40	3	184
	HL1541AC+				0 to +80						185
	HL1541FG++				−40 to +80						186
	HL1541BF++	1.2*	2		−40 to +80					0.5*	188
	HL1541DL++				−40 to +80						190

+ Preliminary specifications ++ Under development * Fiber optical output power, P_f

Infrared emitting diodes ($T_C = 25°C$)

Part no.		Absolute maximum ratings: Reverce voltage, V_R (V)	Tolerable power dissipation, P_d (mW)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Optical output power, P_O (mW) min.	Peak wave-length*, λ_p (nm) (A B C D)	Spectral width, $\Delta\lambda$ (nm) typ.	Test condition I_F (mA)	Capaci-tance, C_t (pF) typ.	Test condition	Reference page
HLP series	HLP20R	3	600	−20 to +40	−40 to +60	15	○ (A)	30	200	30	V_R = 0 V, f = 1 MHz	195
	HLP30R					25	○ ○ ○ ○ (A B C D)					
	HLP40R					35	○ ○ ○ ○ (A B C D)					
	HLP50R					45	○ ○ ○ (B C D)					
	HLP60R					55	○ ○ ○ (B C D)					
	HLP20RG	3	600	−20 to +60	−40 to +80	7	○ (A)	30	200	30	V_R = 0 V, f = 1 MHz	198
	HLP30RG					12	○ ○ ○ ○ (A B C D)					
	HLP40RG					17	○ ○ ○ ○ (A B C D)					
	HLP50RG					22	○ ○ ○ (B C D)					
	HLP60RG					27	○ ○ ○ (B C D)					
HE8402F		3	350	−20 to +60	−40 to +90	40μ**	800 to 900	50	100	10	V_R = 0 V	201
HE8403R		3	350	−20 to +40	−40 to +60	50μ**	800 to 900	50	100	10	f = 1 MHz	203
HE8403SG		3	350	−20 to +60	−40 to +90	40μ**	800 to 900	50	100	10		205
HE8403ML		3	350	−20 to +60	−40 to +90	50μ**	800 to 900	50	100	10		207
HE8801		3	400	−20 to +60	−40 to +90	6	800 to 900	30	150	10		209
HE8805VG		3	300	−20 to +60	−40 to +90	6	800 to 900	30	150	10		211
HE8806VG		3	300	−20 to +60	−40 to +90	12	800 to 900	30	150	10		213
HE8807SG +		3	350	−20 to +80	−40 to +100	10	800 to 900	30	150	10		215
HE8807SL +		3	350	−20 to +80	−40 to +100	5	800 to 900	30	150	10		217
HE8811		3	400	−20 to +60	−40 to +90	20	780 to 900	50	150	10		219
HE1301R		1.0	300	−20 to +40	−40 to +60	15μ**	1260 to 1340	140	100	30		221
HE1301SG		1.0	300	−20 to +60	−40 to +90	15μ**	1260 to 1340	140	100	30		223
HE1301ML		1.0	300	−20 to +60	−40 to +90	15μ**	1260 to 1340	140	100	30		225
HE1302ML +		1.0	300	−20 to +60	−40 to +90	30μ**	1260 to 1340	140	100	30		227

+ Preliminary specifications   * HLP series grouped with peak wavelength   ** Fiber optical output power, P_f

Grade	λ_p (nm) min.	typ.	max.
A	735	760	785
B	775	800	825
C	815	840	865
D	855	880	905

Main characteristics

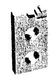
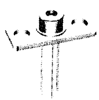
Photodiodes ($T_C = 25°C$)

Part no.	Absolute maximum ratings: Reverse voltage, V_R (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Dark current, I_{DARK} (nA) typ.	Test condition: V_R (V)	Capacitance, C_t (pF) typ.	Test condition	Sensitivity, S (mA/mW) min.	Test condition	Reference page
HR8101	100	−40 to +80	−45 to +100	2	10	10	V_R = 10 V, f = 1 MHz	0.4	V_R = 10 V, λ_p = 830 nm	231
HR8102	100	−40 to +80	−45 to +100	0.5	10	1.5		0.4		233
HR8202TG+		−40 to +80	−45 to +100	0.5	0.9×V_B	1.5	V_R = 150 V, f = 1 MHz			235
HR1101	20	−40 to +80	−45 to +100	7	10	2.0	V_R = 10 V, f = 1 MHz	0.45	V_R = 10 V, λ_p = 1300 nm, P_{in} = 1.0 mW	236
HR1102	15	−40 to +80	−45 to +100	20	10	9		0.45		238
HR1102CX	15	−40 to +80	−40 to +100	20	10	10		0.6		240
HR1103TG+	20	−40 to +80	−45 to +100	1	5	1.0	V_R = 5 V, f = 1 MHz	0.9 typ.	V_R = 5 V, λ_p = 1550 nm	242
HR1103CX+	20	−40 to +80	−40 to +100	1	5	1.2		0.9 typ.		243
HR1104TG+	20	−40 to +80	−45 to +100	5	5	5	V_R = 5 V, f = 1 MHz	0.9 typ.	V_R = 5 V, λ_p = 1550 nm	244
HR1104CX+	20	−40 to +80	−40 to +100	5	5	6		0.9 typ.		245
HR1105TG++	20	−40 to +80	−45 to +100	1	5	0.8		0.9 typ.		246

+ Preliminary specifications ++ Under development

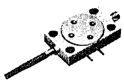
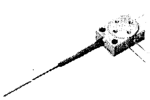
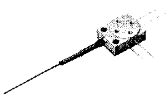
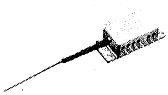
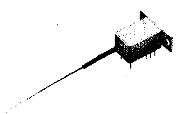
Package variations

Laser diodes

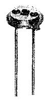
	Packages	Features	Applicable products
Open-air type	 A-type	• For experimental use • For module assembly	HLP1400, HL1221A, HLP5400, HL1322A, HL1341A, HL1521A, HL1541A
	 AC-type	• For module assembly • Chip carrier stem	HL1221AC, HL1321AC, HL1322AC, HL1341AC, HL1521AC, HL1541AC
Hermetically-sealed type	 C-type	• With monitor guide	HLP1600, HL1221C, HLP5600
	 E-type	• With built-in monitor-photodiode • Three leads	HL7801E, HL7802E, HL8311E, HL8312E, HL8314E, HL8315E
	 G-type	• With built-in monitor-photodiode • Three leads	HL7801G
	 G-type	• With built-in monitor-photodiode • Three leads	HL7802G, HL7806G, HL7831G, HL7832G, HL7838G, HL8311G, HL8312G, HL8314G

(Continued)

Package variations

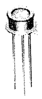
	Packages	Features	Applicable products
Hermetically-sealed type	 FG-type	• With built-in monitor-photodiode • Four leads	HL1321FG, HL1341FG, HL1541FG
Fiber-pigtail type	 B-type	• With multimode fiber • With monitor guide	HLP1500, HL1221B, HLP5500
	 P-type	• With multimode fiber • With built-in monitor-photodiode	HL1321P
	 SP-type	• With single-mode fiber • With built-in monitor-photodiode	HL1321SP
	 BF-type	• For high frequency • Butterfly-type package • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321BF, HL1341BF, HL1541BF
	 DL-type	• Dual-in-line type package • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321DL, HL1341DL, HL1541DL

Infrared emitting diodes

	Packages	Features	Applicable products
Open-air type	 R-type	• For experimental use • For module assembly	HLP20R, HLP30R, HLP40R, HLP50R, HLP60R, HE8403R, HE1301R
Hermetically-sealed type	 RG-type	• Flat glass window • Longer cap than SG-type's	HLP20RG, HLP30RG, HLP40RG, HLP50RG, HLP60RG
	 SG-type	• Flat glass window	HE8403SG, HE8801, HE8807SG, HE8811, HE1301SG
	 VG-type	• Flat glass window	HE8805VG, HE8806VG
	 ML-type	• With microball lens	HE8403ML, HE1301ML, HE1302ML
	 SL-type	• With lens cap	HE8807SL
	 F-type	• With built-in optical fiber rod	HE8402F

Package variations

Photodiodes

	Packages	Features	Applicable products
Open-air type	 CX-type	• For module assembly • Chip carrier stem	HR1102CX, HR1103CX, HR1104CX
Hermetically-sealed type	 QG-type	• Flat glass window • Two leads	HR8101
	 TG-type	• Flat glass window • Three leads	HR8102, HR8202TG, HR1101, HR1102, HR1103TG, HR1104TG, HR1105TG

Product Descriptions

I. Symbols and definitions
II. Fundamental characteristics
III. Handling instructions
IV. Operation principles and characteristics
V. Application hints

I. Symbols and definitions

1. The absolute maximum ratings

The absolute maximum ratings specified in this data book are the values which should not be exceeded under any condition. They are defined at the case temperature, T_C, of 25°C unless otherwise specified.

The absolute maximum ratings of laser diodes (LDs), infrared emitting diodes (IREDs) and photodiodes are defined individually as follows.

Table I-1. Absolute Maximum Ratings

Items	Applicable devices: LDs	IREDs	Photo-diodes	Definitions
Optical output power, P_O, P_f	o			Maximum tolerable output power under CW operation. The value with no kink phenomenon in light vs. current characteristics (Fig. I-1). The power of device with fiber pigtail is shown as fiber optical output power, P_f.
Forward current, I_F		o	o	Maximum tolerable current under CW operation.
Reverse voltage, V_R	o	o	o	Maximum tolerable reverse bias applied to a device. For the LDs with built-in photodiode, the reverse voltages of photodiode, $V_{R(PD)}$, and LD, $V_{R(LD)}$, are specified respectively.
Tolerable power dissipation, P_d		o		Maximum tolerable power dissipation of diode under CW operation.
Operating temperature, T_{opr}	o	o	o	Case temperature range under which a device can safely operate. This value differs according to package type, open air vs. hermetic type.
Storage temperature, T_{stg}	o	o	o	Ambient temperature range under which a device can be safely stored. This value also differs according to package type.

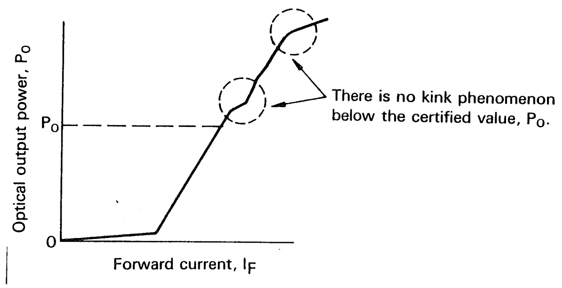


Figure I-1. Light vs. Current Characteristics

2. Optical and electrical characteristics

The limit values and the typical values of optical and electrical characteristics are described in this data book as much as possible for user's convenience at the application to electrical circuits and optics.

The definitions of optical and electrical characteristics are listed below.

Table I-2. LD Optical and Electrical Characteristics

Items	Definitions
Optical output power, P_O, P_f.	Optical output power under the specified forward current, I_F. I_F is defined as the sum of I_{th} and a specified current value for each type. This value, I_F, varies depending on each device because of difference of I_{th} (Fig. I-2). The powerof device with fiber pigtail is shown as fiber optical output power, P_f.
Monitor power, P_m	Optical output power for monitoring at the specified forward current, I_F, or optical output power, P_O.
Threshold current, I_{th}	Forward current at which a diode starts to lase (Fig. I-2). Practically, this value is specified as the crossing point of x axis and the extension of line B, where "A" is spontaneous emission region and "B" lasing region.
Lasing wavelength, λ_p	Maximum intensity wavelength in a spectral distribution (Fig. I-3).
Beam divergence parallel to the junction, $\theta_{//}$ Beam divergence perpendicular to the junction, $\theta_{\perp}$	Divergence of light beam emitted from a laser diode is described in Fig. I-4 (a). $\theta_{//}$ is the full angle at a half of the peak intensity in the parallel profile (Fig. I-4 (b)). $\theta_{\perp}$ is the full angle at a half of the peak intensity in the perpendicular profile (Fig. I-4 (c)).
Slope efficiency, η	Optical output power increment per unit drive current in lasing region (B region) of Fig. I-2.
Monitor current, I_S	Current of photodiode operated at the specified optical output power, P_O or P_f. It applies only to a device with built-in photodiode.
Dark current, I_{DARK}	Leakage current of photodiode when the specified reverse voltage is applied without any light input to a photodiode chip.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when drive current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum output power when current is switched off. (Fig. I-5)
Spectral width, $\Delta\lambda$	Full width at half maximum when the spectrum pattern has been approximated to Gaussian.
Capacitance, C_t	Junction capacitance when specified reverse bias voltage is applied.

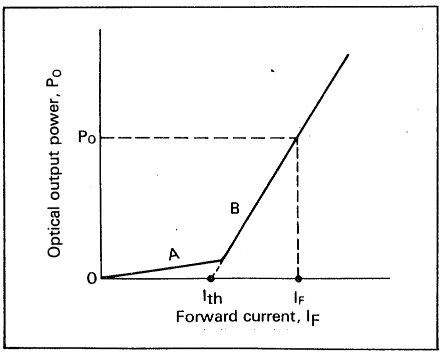


Figure I-2. Light vs. Current Characteristics

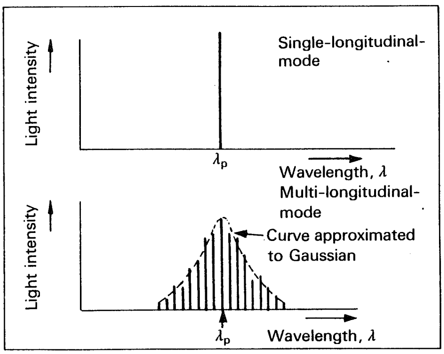


Figure I-3. Lasing Spectrum

Table I-3. IRED Optical and Electrical Characteristics

Items	Definitions
Optical output power, P_O, P_f	Total optical output power emitted from chip at specified forward current (Fig. I-6). The power of device used in fiberoptic transmission is shown as fiber optical output power, P_f.
Peak wavelength, λ_p Spectral width, $\Delta\lambda$	Maximum intensity wavelength in a spectral distribution (Fig. I-7). Wavelength width at half the peak intensity of the peak wavelength (Fig. I-7). This differs according to junction structure, single vs. double heterojunction structure.
Beam divergence, θ_H	Full angle at a half of maximum peak intensity.
Forward voltage, V_F	Forward voltage at specified forward current input.
Reverse current, I_R	Leakage current when specified reverse voltage is applied.
Capacitance, C_t	Junction capacitance when specified reverse bias voltage is applied.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum power when current is switched off (Fig. I-5).

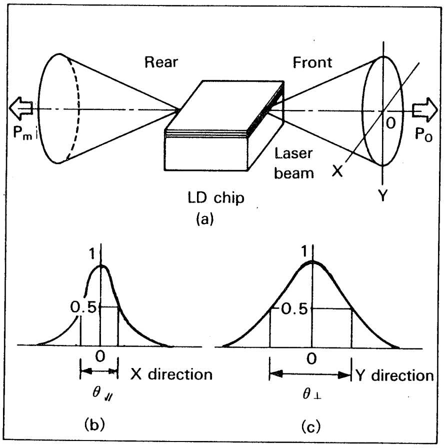


Figure I-4. Beam Divergence

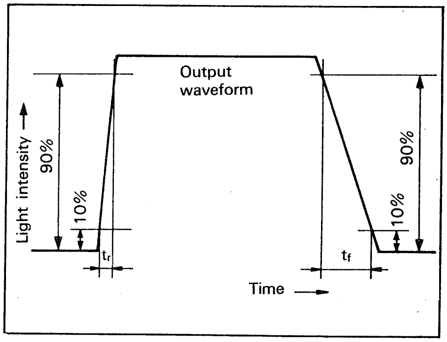


Figure I-5. Definition of Rise & Fall Time

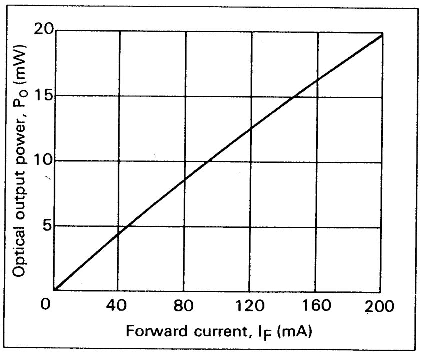


Figure I-6. Light vs. Current Characteristics

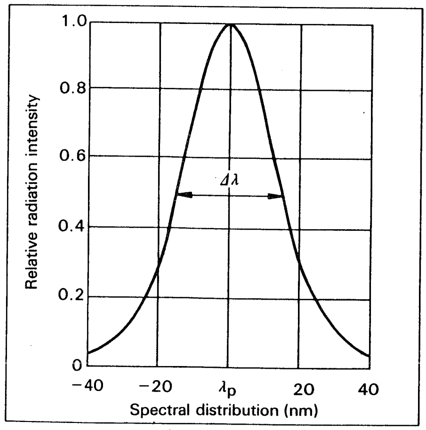
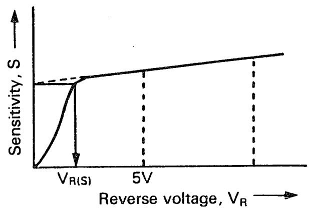


Figure I-7. Spectral Characteristics for HLP30RG

Table I-4. Photodiode Optical and Electrical Characteristics

Items	Definitions
Dark current, I_{DARK}	Leakage current of photodiode when the specified reverse voltage is applied without any light input to photodiode chip.
Capacitance, C_t	Junction capacitance when specified reverse voltage is applied.
Sensitivity, S	Photovoltaic current increment per unit light power input.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when drive current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum output power when current is switched off. (Fig. I-5)
Photosensitivity saturation voltage, $V_{R(S)}$	Reverse voltage value corresponding to the point where the straight line connecting V_R = 5 V and V_R = 10 V crosses the S axis. 

II. Fundamental characteristics

1. LD fundamental characteristics

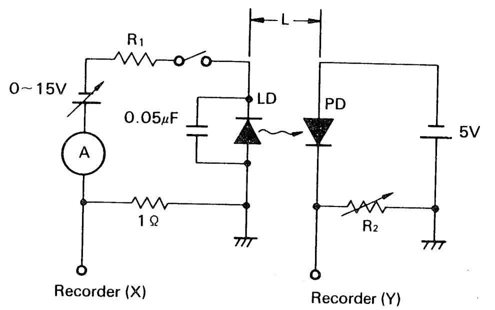
1.1 Light vs. current characteristics under CW operation

One of the fundamental parameters of LDs is optical-output-power vs. forward-current (light vs. current) characteristic. Figure II-1 shows a measuring setup for light vs. current characteristic under CW operation.

The photodetector with proper response and effective photosensitive area is first required for measuring LD's optical characteristics.

The measuring setup for light vs. current characteristics under CW operation is shown in Fig. II-1.

A photocell of more than 20 mm dia. is recommended which is provided with enough photosensitive area to take-in full light power without a lens. The suitable distance between a photocell and an LD chip is 5 to 10 mm. Since photovoltaic sensitivity varies with devices, each photocell must be calibrated with a standard cell and R_2 must be adjusted accordingly before this setup is actually used. A device must be mounted on a copper or aluminum heat radiator of about 30 × 40 × 2 mm^3 especially for CW testing. Because the heat generated from a chip itself degrades the device characteristics and life time.



PD : Large area Si-solar cell for short-wavelength range LD
: Large area Ge-photodiode for long-wavelength range LD
R_1 = 10 to 50 Ω for short-wavelength range LD
= 100 to 300 Ω for long-wavelength range LD
R_2 ≃ 20 Ω for 10 mV output at 1 mW optical power
L ≃ 10 mm for short-wavelength range LD
≃ 6 mm for long-wavelength range LD

Figure II-1. Measuring Setup for Light vs. Current Characteristics under CW Operation

Fundamental characteristics

Light vs. current characteristics and dL/dI vs. I characteristics for the HL1322A are shown in Figs. II-2 and II-3 respectively.

Temperature dependencies of I_{th} and η for the HL1322A are shown in Figs. II-4 and II-5 respectively.

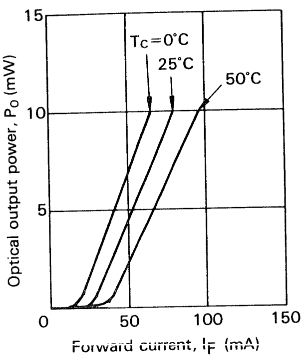


Figure II-2. Light vs. Current Characteristics for HL1322A

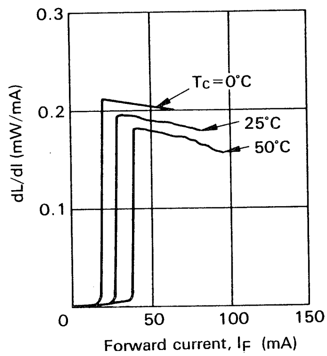


Figure II-3. dL/dI vs. I Characteristics for HL1322A

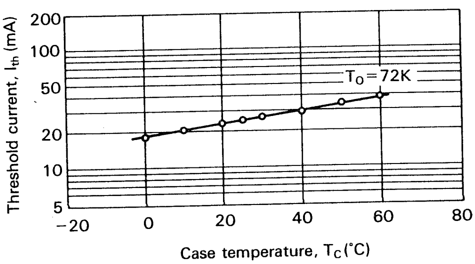


Figure II-4. Temperature Dependency of I_{th} for HL1322A

1.2 Light vs. current characteristics under pulse operation

A measuring setup example for light-current characteristics under low frequency up to several 10 kHz with low duty (about 1%) pulse operation is shown in Fig. II-6, which employs a PIN photodiode as a photodetector. Sampling measurement of photovoltaic current should be made when it becomes stabilized.

Figure II-7 shows pulse light vs. current characteristics for the HL1322A.

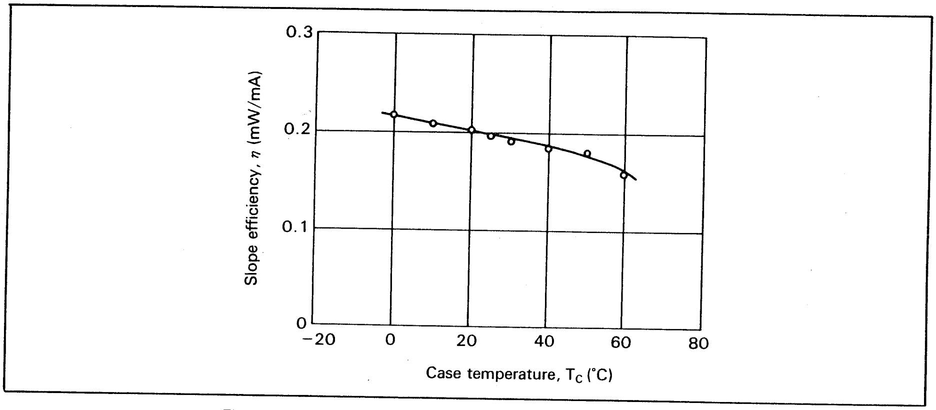


Figure II-5. Temperature Dependency of η for HL1322A

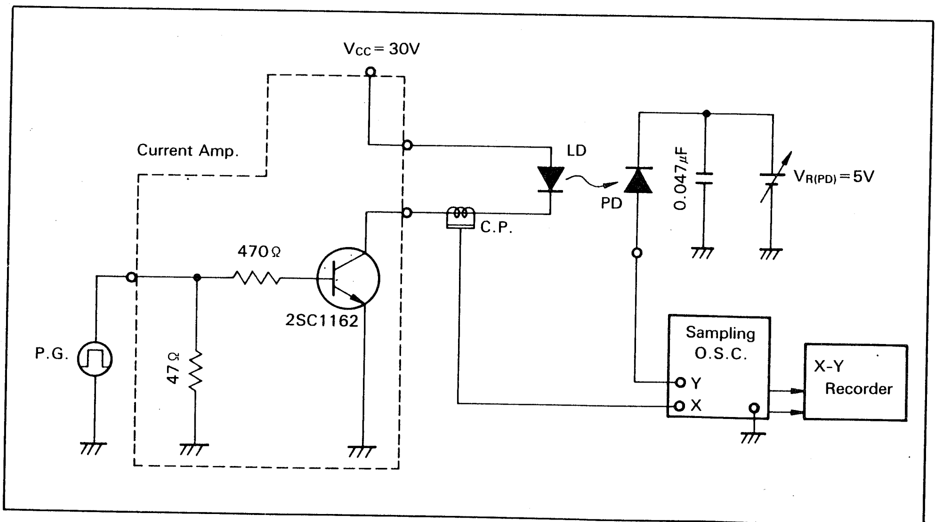


Figure II-6. Measuring Setup for Light vs. Current Characteristics under Low-frequency Pulse Operation

1.3 Lasing spectrum

Lasing spectrum (longitudinal mode) is one of LD fundamental characteristics. Spectrum at modulation is an important factor of LDs for transmission use; particularly, modulation-frequency dependency of spectral width, Δλ, is important. A measuring setup for spectrum at modulation is shown in Fig. II-8.

Figure II-9 shows temperature dependency of lasing spectrum for the HL1322A. The temperature coefficient of wavelength is about 0.3 nm/°C.

Optical-output power dependency of lasing spectrum for the HL1322A is shown in Fig. II-10.

Figure II-11 shows modulation dependency of spectral width, Δλ. The higher bit rate is, the larger Δλ becomes.

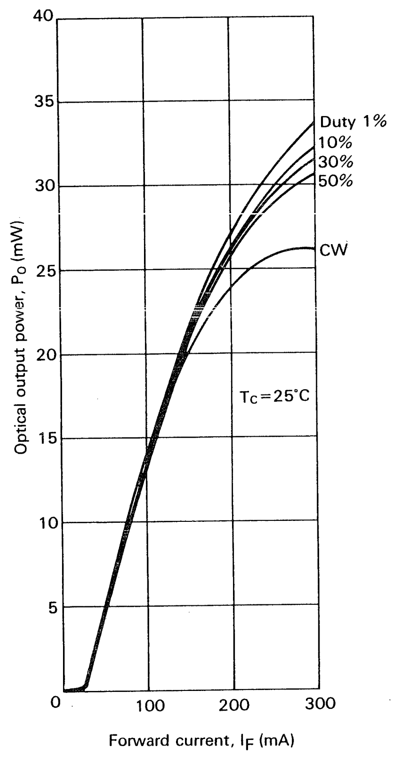


Figure II-7. Pulse Light vs. Current Characteristics for HL1322A

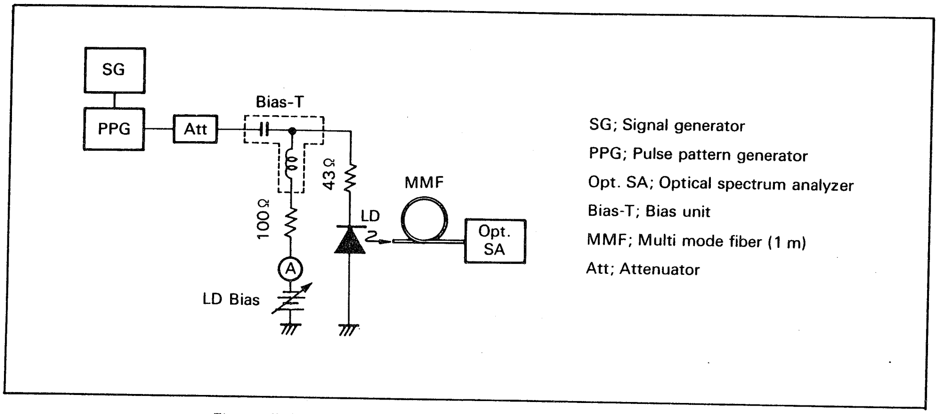


Figure II-8. Measuring Setup for Spectrum at Modulation

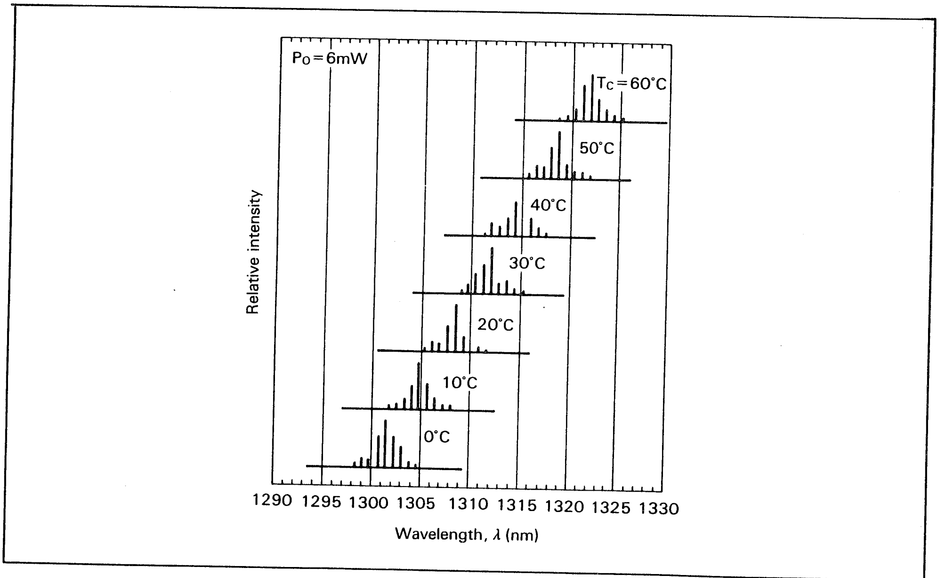


Figure II-9. Temperature Dependency of Wavelength for HL1322A

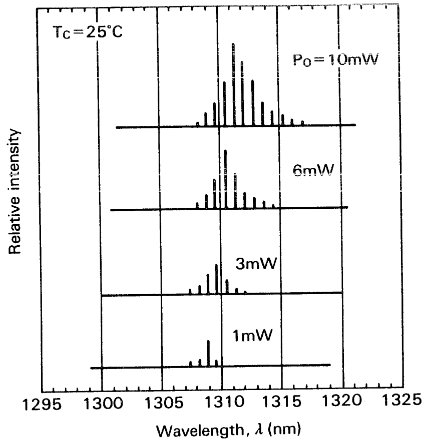


Figure II-10. Optical-output-power Dependency of Wavelength for HL1322A

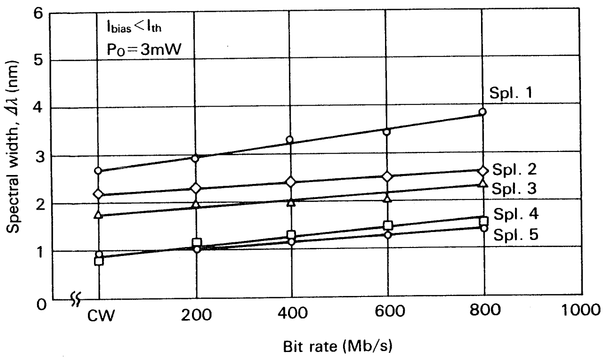


Figure II-11. Spectral Width vs. Transmission Bit Rate for HL1322A

1.4 Far field pattern (FFP)

FFP is the light intensity profile measured in two directions as function of angle: parallel and perpendicular to a device (the active layer of an LD and arbitrary for IRED). The measuring setup for FFP is shown in Fig. II-12, which employs the same drive circuit as that for light vs. current characteristics measurement under CW operation. Use a PIN photodiode with small photosensitive area or an APD as a photodetector. The distance between the detector and an LD is about 10 cm. Set the emitting point of LD at the center of the turn table. Use of a potentiometer is effective to translate the rotation angle to voltage.

FFP of HL8311 series is shown in Fig. II-13 for various power output.

They lase at stable transverse fundamental mode, namely with single peak in FFP approximated to the gaussian curve. FFP grows its height proportionally to optical output power and has no peak point steering or no light distribution width change within the maximum ratings.

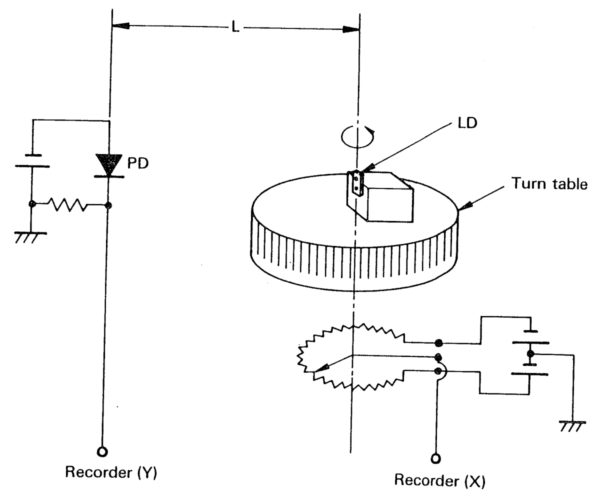


Figure II-12. Measuring Setup for Far Field Pattern

1.5 Pulse-response characteristics

A measuring setup for pulse-response characteristics is shown in Fig. II-14. Pulse signals are generated with a PPG. A fast-pulse-response PIN photodiode or APD (avalanche photodiode) is suitable for this setup.

Figure II-16 shows an example of eye patterns for the HL1322A. As seen from this figure, the HL1322A responds enough up to 1.4 Gb/s.

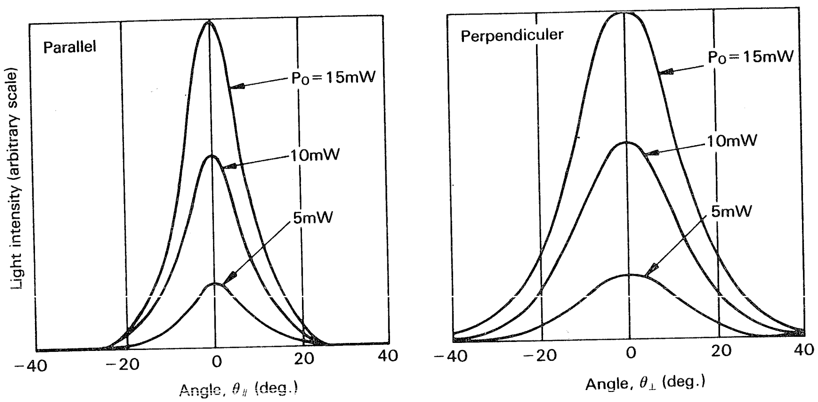


Figure II-13. Optical-output-power Dependency of Far Field Pattern for HL8311 Series

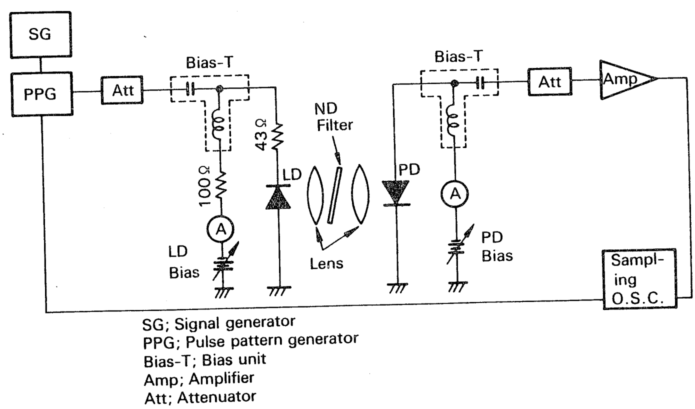


Figure II-14. Measuring Setup for Pulse-response Characteristics

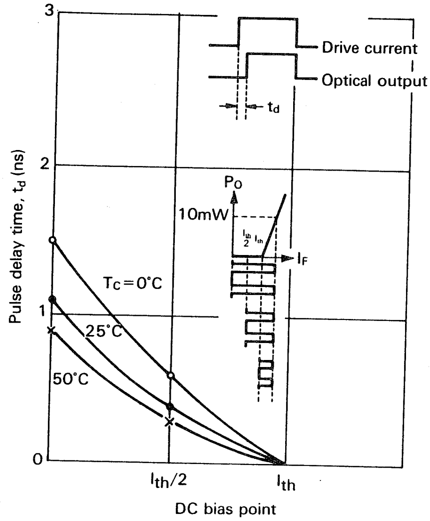


Figure II-15. Bias Point Dependency of Pulse Delay Time for HLP1400

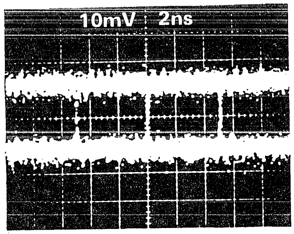
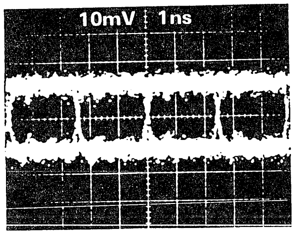
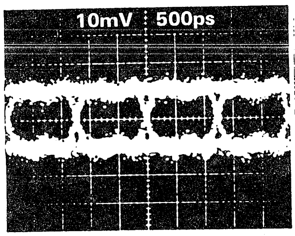
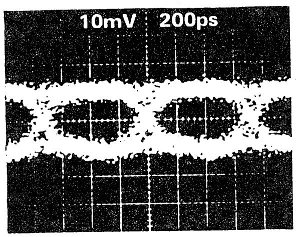
Transmission speed	Eye patterns for HL1322A
200 Mb/s	
400 Mb/s	
800 Mb/s	
1400 Mb/s	

Figure II-16. Eye-pattern Characteristics at Pulse Modulation for HL1322A

1.6 Frequency characteristics

A measuring setup for frequency characteristics is shown in Fig. II-17. A measurement example of frequency for the HL1322A is shown in Fig. II-18.

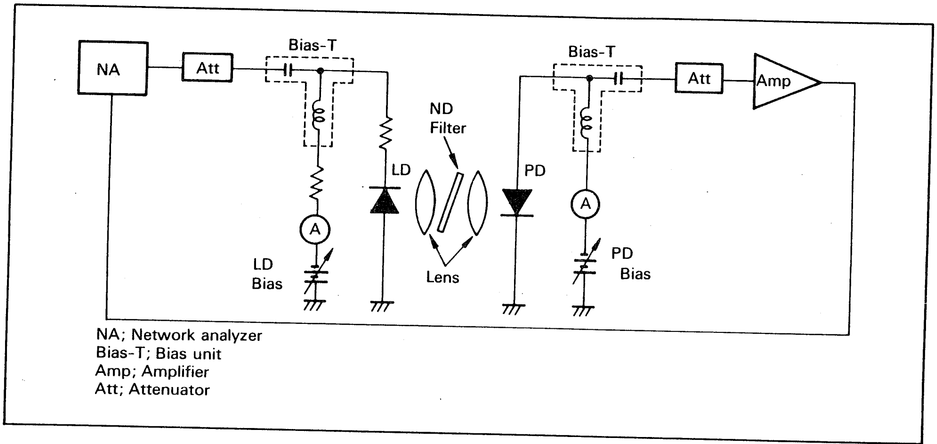


Figure II-17. Measuring Setup for Frequency-response Characteristics

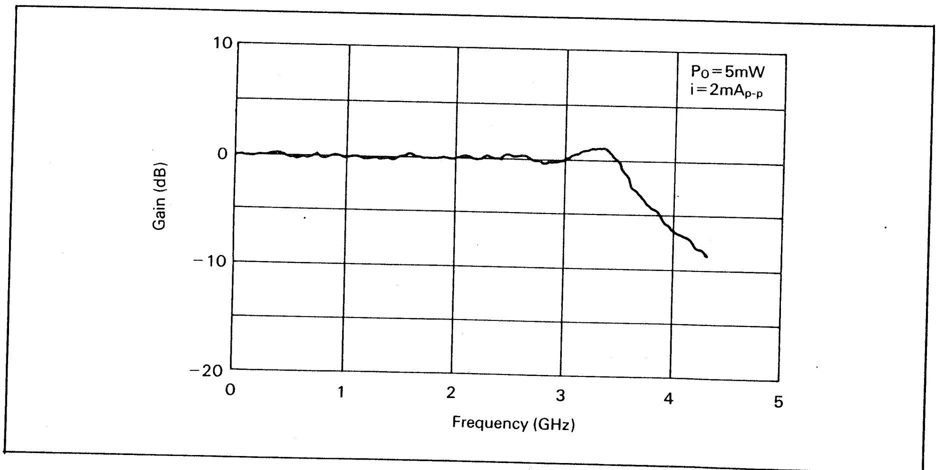


Figure II-18. Frequency Characteristic for HL1322A

1.7 Mode hopping noise

A measuring setup for LD noise is shown in Fig. II-19. Set the frequency range to be measured as suitable for each device application.

Measurement should be carried out after getting rid of external noise. For measurement under temperature below the room temperature, take care not to cut off the optical path due to condensation. Measurement in dry air or dry nitrogen is recommended.

Figure II-20 shows an example of noise vs. case temperature.

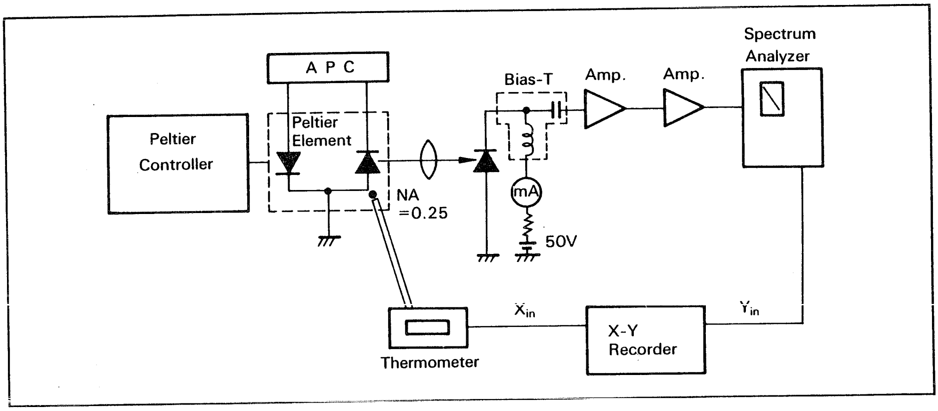


Figure II-19. Measuring Setup for Noise

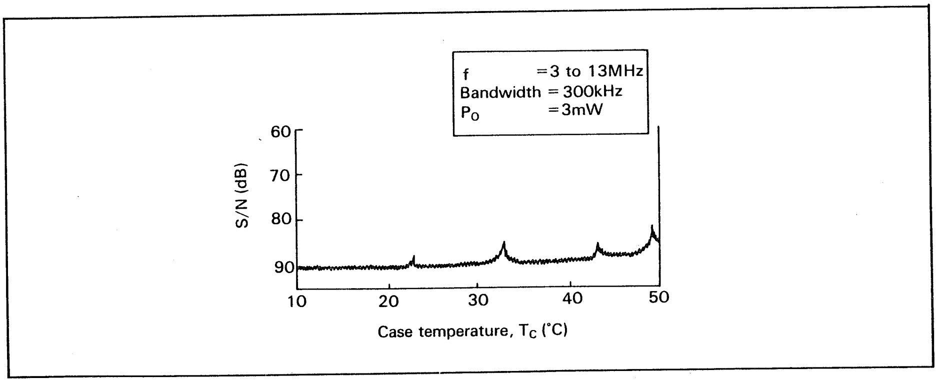


Figure II-20. Noise Measurement Example

1.8 Polarization ratio of LDs

The measuring setup for polarization ratio is shown in Fig. II-21. An objective lens collimates the light emitted from an LD to form parallel beam. In this case, use of an infrared phosphor plate is helpful to detect light. Choose the measurement equipment with appropriate aperture and photosensitive area not to disturb the parallel beam input. Polarization ratio is calculated with the maximum and minimum values of a power meter while turning a polarization prism.

Polarization phenomenon of an LD is illustrated in Fig. II-22. Electric field oscillates in parallel to the active layer, and magnetic field in perpendicular.

Polarization ratio depends on optical output power and numerical aperture. The polarization ratio vs. power output for the HL7801 series and HLP1400 are shown in Fig. II-23 (a) and (b) respectively. Polarization ratio is larger when optical output power is higher or NA (numerical aperture) of an objective lens is smaller. For the C-type package, polarization ratio is still kept high due to its optical isotropic window glass.

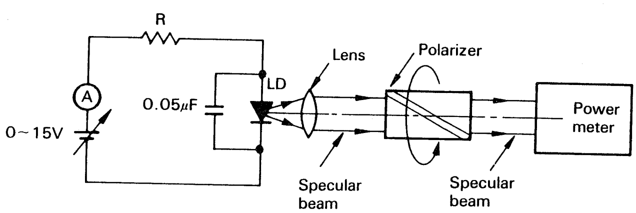


Figure II-21. Measuring Setup for Polarization Ratio

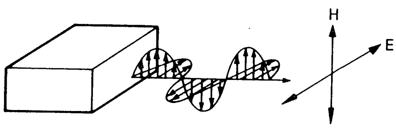


Figure II-22. Polarization Ratio of LD

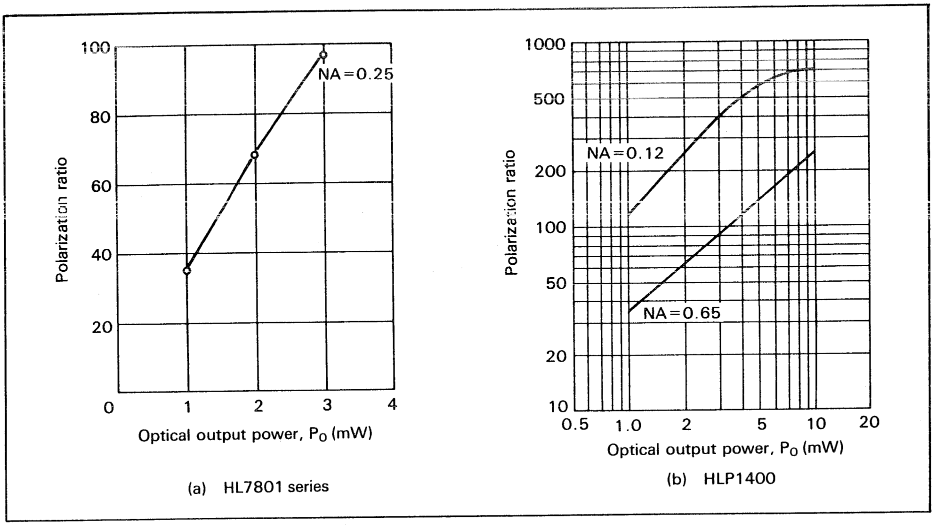


Figure II-23. Optical-output-power Dependency of Polarization Ratio

2. IRED fundamental characteristics

2.1 Optical output power

Optical output-power measuring method under CW operation

An optical cone is used for measuring optical output power under CW operation. The optical cone gathers all light from the IRED and leads it to a photocell (see Fig. II-24). Photocells should be calibrated beforehand against a standard cell, since their photovoltaic current will vary from cell to cell. Since under CW operation, optical output will fluctuate significantly during the measurement due to heat generated by the chip, a copper or aluminum heat radiator of larger than 30 × 40 × 2 mm^3 should be attached to IREDs before testing. An example of the optical output-power measuring setup is shown in Fig. II-25.

Optical output-power measuring method under pulse operation

An example of the measuring setup for optical output-power under low pulse operation (some kHz to some 10 kHz) is illustrated in Fig. II-26. The light vs. current characteristics of the HLP30RGD are shown in Fig. II-27.

Under pulse operation, light vs. current linearity and peak values of optical output power are more favorable than under CW operation, because of lower average current and less temperature increase at the junction. However, attention should be given not to exceed maximum ratings during operation, measuring or mounting.

A measurement setup example for high-speed pulse response is given in Fig. II-28. It is recommended that a high-speed PIN photodiode or avalanche photodiode able to respond to a several GHz order be used as the photodetector in this measurement. Figure II-29 shows a measurement example of high-speed response characteristics.

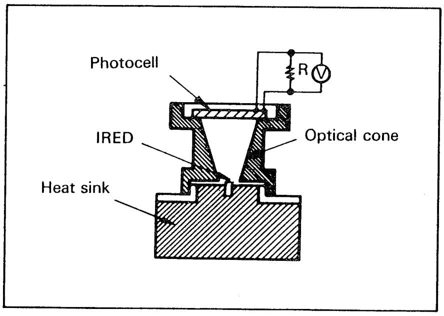


Figure II-24. Optical Output-power Measuring Method under CW Operation

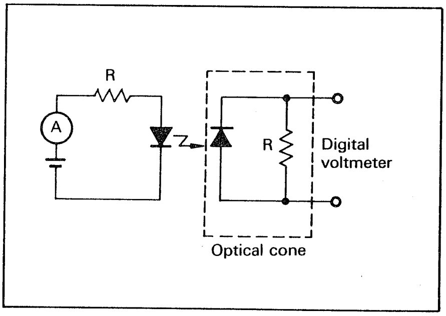


Figure II-25. Measuring Setup for Optical Output Power under CW Operation

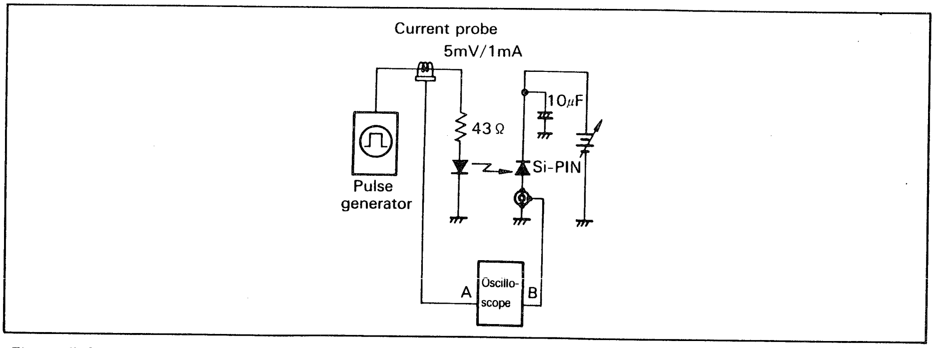


Figure II-26. Measuring Setup for Light vs. Current Characteristics under Low Frequency Pulse Operation

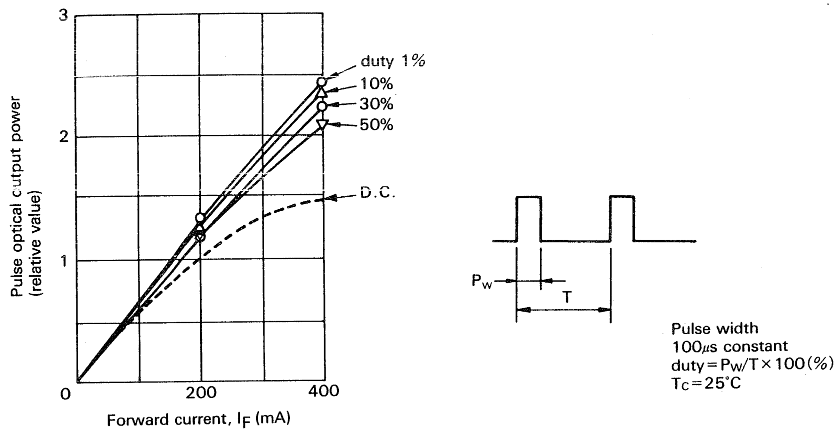


Figure II-27. Light vs. Current Characteristics for HLP30RGD

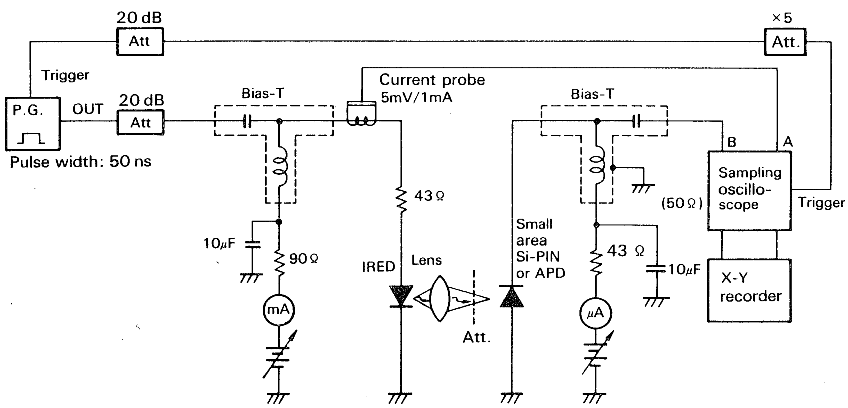


Figure II-28. Measuring Setup for Fast Pulse Response Characteristics

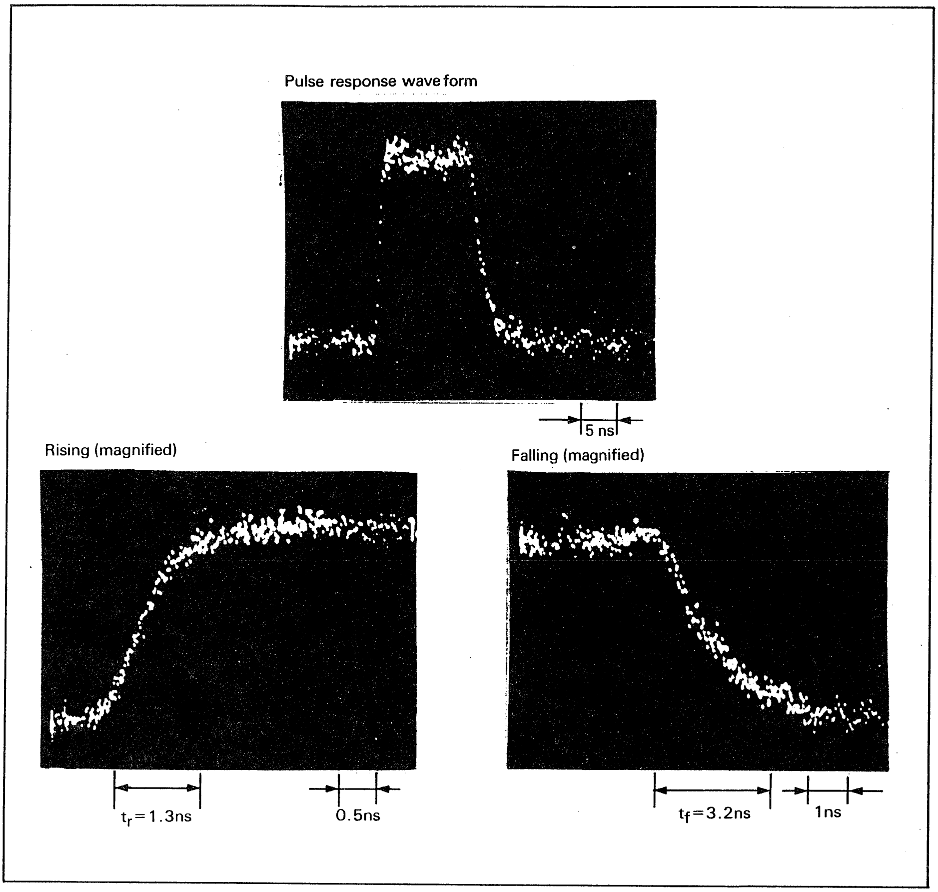


Figure II-29. High-speed Response Example for HE1301SG

Optical output-power measuring method for fiber-ends

Figure II-30 shows the measuring method for optical output-power at fiber-ends under CW operation.

Figure II-31 shows an example of the light vs. current characteristics for the HE1301R.

The main methods for coupling fiber to an IRED are the direct coupling method and parabolic-rod-lens coupling. The former is suitable for measuring fiber-end optical output power in R-type (open-air type) packages, and the latter in SG-types (hermetic-seal, glass-window types). This will be explained in more detail in Section 2.7, "Optical fiber coupling efficiency."

Temperature dependency of optical output power

Optical output power from IREDs fluctuates along with temperature change in the p-n junction. Figure II-32 gives a measurement example of optical output fluctuation when IRED case temperature was varied. Temperature coefficients of optical output power are −0.8%/°C (typ.) for the HE8801, HE8805, HE8806 and HLP series, −0.5%/°C (typ.) for the HE8811 and HE8403 series and −0.4%/°C (typ.) for the HE1301 series.

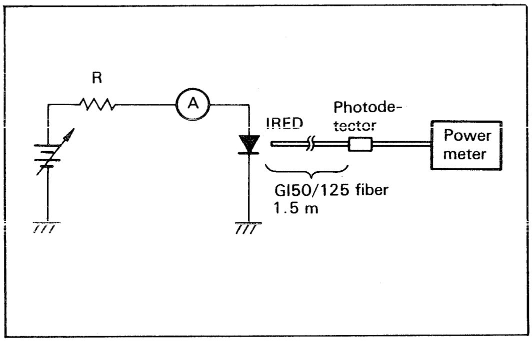


Figure II-30. Measuring Setup for Optical Output-power at Fiber-ends

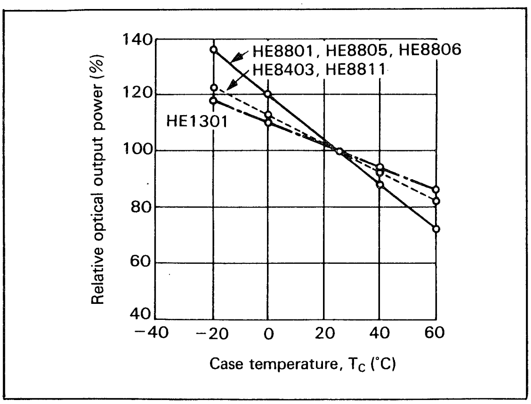


Figure II-32. Temperature Dependency of Optical Output Power

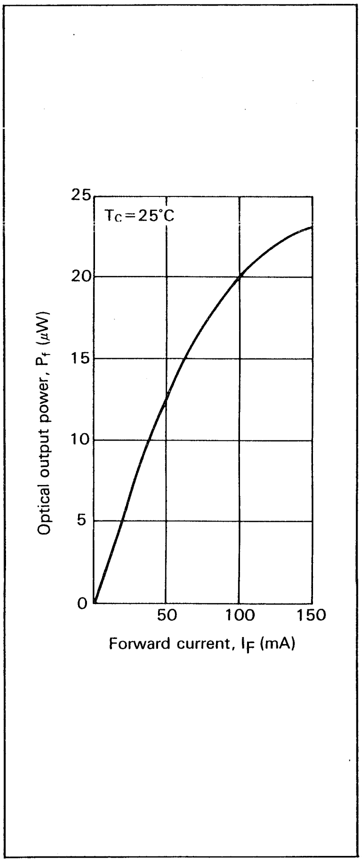


Figure II-31. Light vs. Current Characteristics for HE1301R

2.2 Emitting wavelength

Spectral distribution measuring method

A spectroscope is normally used to measure the spectrum of the emitted wavelength. To draw light emitted from the IRED into the spectroscope, either a bundle fiber is used or light is coupled with a condenser lens. Figure II-33 shows the measuring method using a bundle fiber.

Temperature dependency of wavelength

In the same way as with optical output power, temperature changes cause the wavelength distribution to fluctuate. Therefore, sufficient attention should be paid to releasing heat from the device. Figure II-34 shows temperature dependency of the wavelength for the HLP30RGD.

As shown in Fig. II-35, the peak wavelength becomes longer, spectral width wider and optical output power lower when the temperature rises.

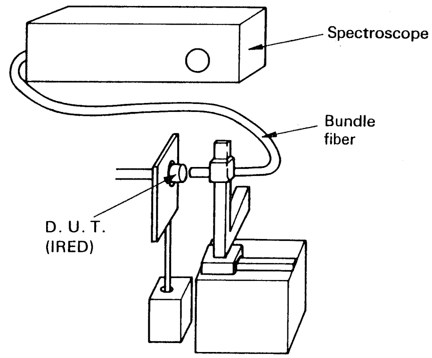


Figure II-33. Spectral Distribution Measuring Method

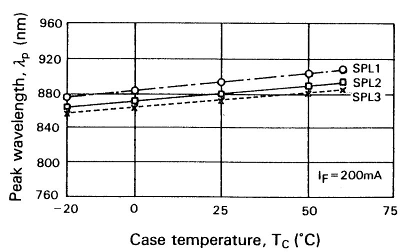


Figure II-34. Temperature Dependency of Wavelength for HLP30RGD

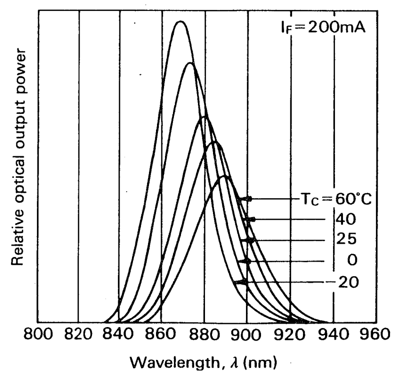


Figure II-35. Temperature Dependency of Optical Output Power for HLP30RGD

2.3 Far field pattern (FFP)

An FFP is the light intensity profile used to obtain the relation between the angle and optical output by placing a photodetector far enough distance away that the size of the IRED emitting area can be neglected. Figure II-36 illustrates the FFP measuring method. It employs the same driving circuit as the measuring setup for light-current characteristics under CW operation. It uses a PIN photodiode or an avalanche photodiode (APD) with a minute sectional area as its photodetector. The IRED is fixed so that emitting area is aligned with the center of the turntable. Light intensity input into the photodetector is measured by rotating the turntable, and the relation between the light intensity and the turning angles is obtained.

Since the chip surface of Hitachi IREDs is dome-shaped, uniform optical output is maintained at each angle. However, devices in RG and SG packages have different light intensity profiles than those in R packages due to interference or reflection from their sidewalls. FFP measurement examples are shown in Fig. II-37.

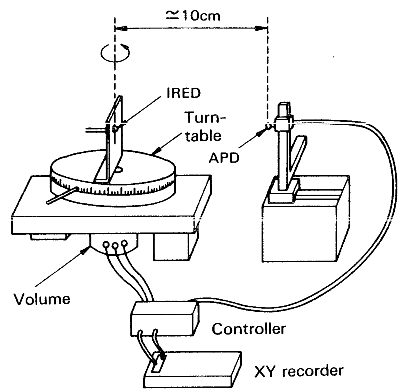


Figure II-36. FFP Measuring Method

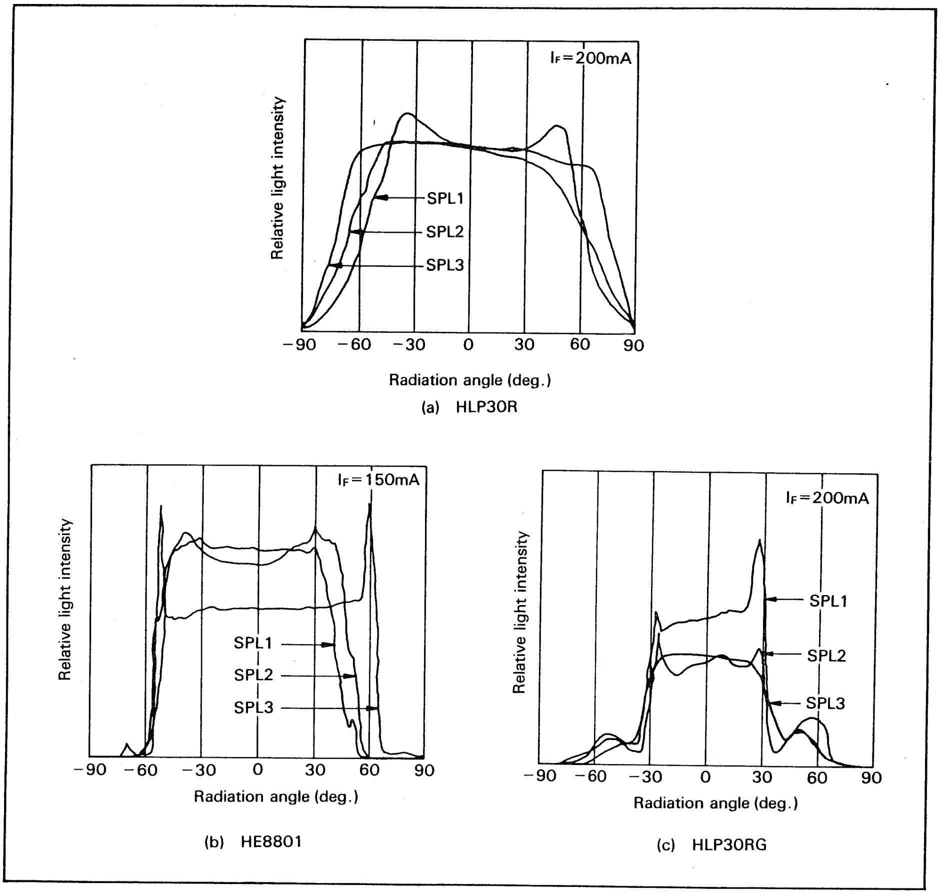


Figure II-37. FFP Examples

2.4 Near field pattern (NFP)

An NFP can be observed with an infrared camera by operating the IRED under continuous waves (CW) and collimating the emitted light to a parallel beam with a lens (see Fig. II-38). The amount of incident light into the infrared camera should be controlled with an optical attenuator, since too much incident light causes halation.

The emitting area is magnified from the upper surface of the IRED chip and observed wider than actual size, due to the lens effect of the dome-shaped GaAlAs crystal layer. At this time, the apparent diameter (effective diameter) will differ according to chip structure. Effective diameter is defined as half of the peak light intensity of the NFP, as shown in Fig. II-39. The effective diameters are 520 μm (typ.) for the HLP series of 600 μm dome (chip) diameter and 360 μm (typ.) for the HE8801 and HE8811 of 400 μm dome diameter. And 150 μm for current confinement types such as the HE8402F, HE8403 and HE1301 series. Figure II-40 shows a measurement example of effective diameters for the HE8801.

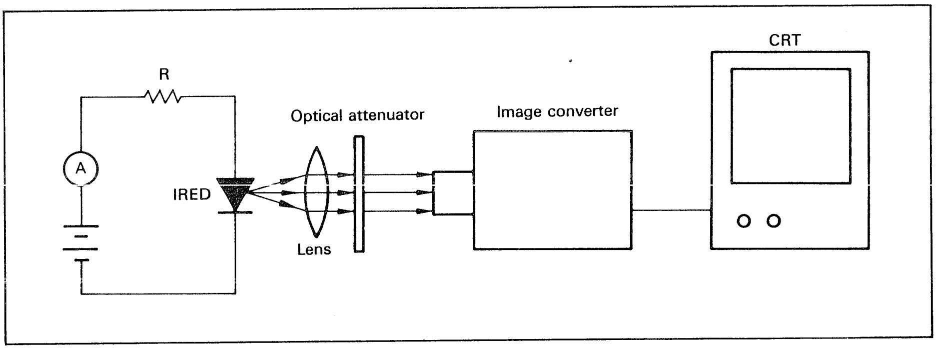


Figure II-38. NFP Measuring Method

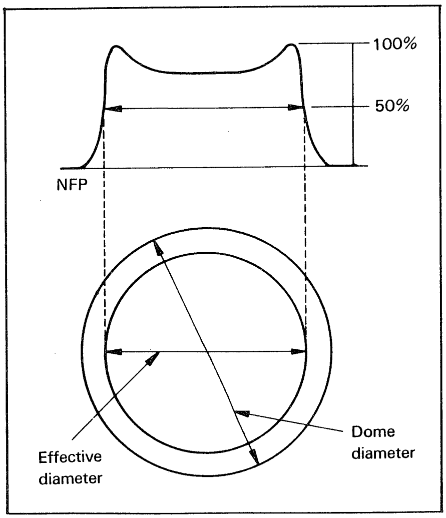


Figure II-39. Effective Diameter and NFP

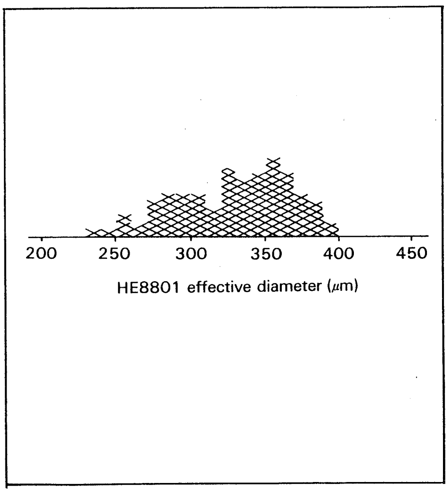


Figure II-40. Effective Diameter Examples for HE8801

2.5 Current destruction

Sufficient care should be taken when switching on the power or carrying out pulse operation to not create an excessive current flow that may destroy the IRED. Measurement values of current destruction are shown in Fig. II-41. IREDs should be operated at value below half this destruction current and in a region where the light-output-current characteristic is not saturated.

A serial protection resistor, R_s, should be inserted in the drive circuit for CW operation to prevent excessive current flow (see Fig. II-42). When using a constant voltage supply, the supply voltage, V_{CC}, should be set as high as possible to avoid current fluctuation due to forward voltage variation from device to device and temperature changes. When using a constant current supply, be careful to set the resistance value, R_S, high enough that excessive current does not flow before the current limitter starts functioning after the power source is switched on.

Figure II-43 shows a destructive-current measurement example when forward or reverse excessive current (surge current) is applied to the IRED.

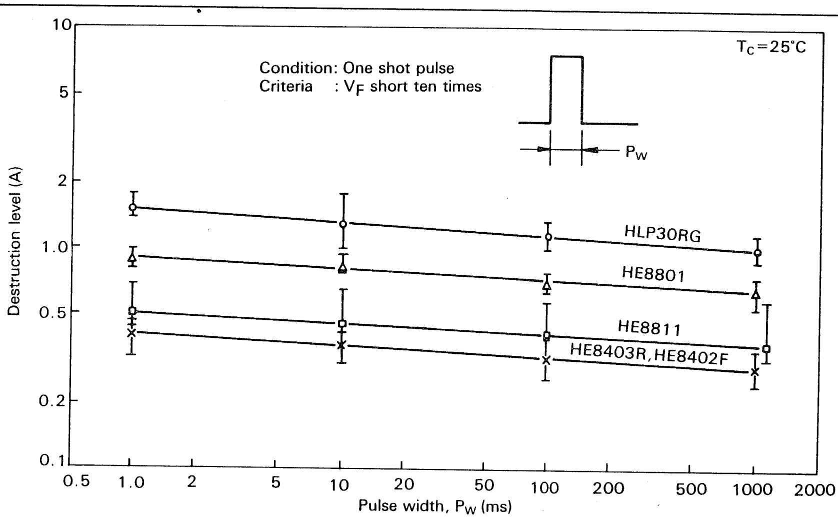
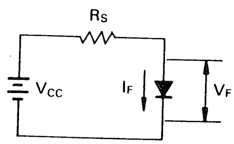


Figure II-41. Destructive Current



a) When using constant voltage supply

$$R_S = \frac{V_{CC} - V_F}{I_F} \quad (\Omega)$$

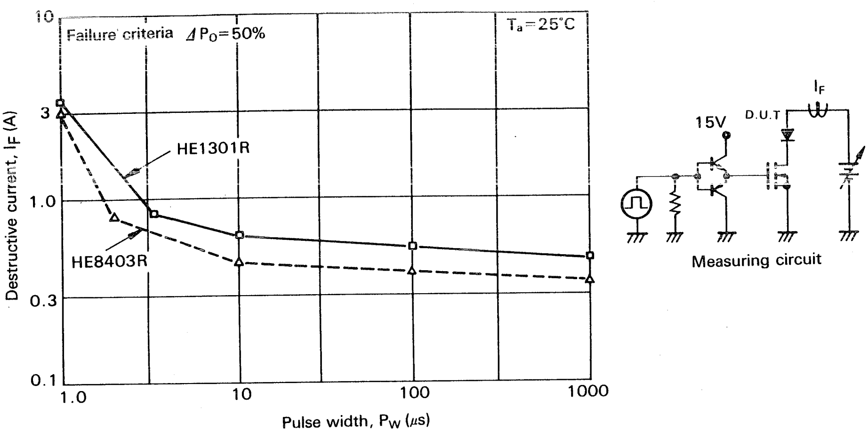
V_{CC} : Supply voltage (V)
V_F : Forward voltage (V)
I_F : Forward current (A)

b) When using constant current supply

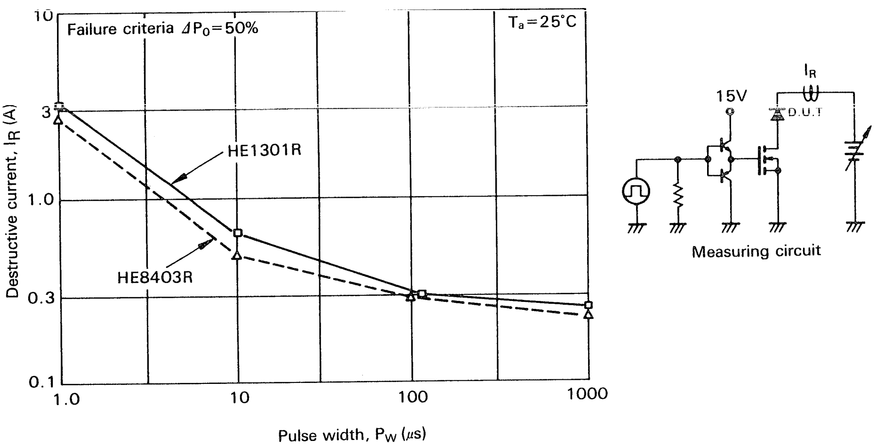
$$R_S = \frac{V_{CO} - V_F}{I_F \text{ max.}}$$

V_{CO} : Unloaded supply voltage (V)
V_F : Forward voltage (V)
I_F max : Forward current maximum rating (A)

Figure II-42. Power Supply for CW Operation



(a) Forward current applied



(b) Reverse current applied

Figure II-43. Durability against One-pulse Surge

2.6 Transient thermal resistance

The life time of IREDs depends heavily on their junction temperature. Adequate heat release should be designed. Figure II-44 shows examples of transient thermal resistance characteristics.

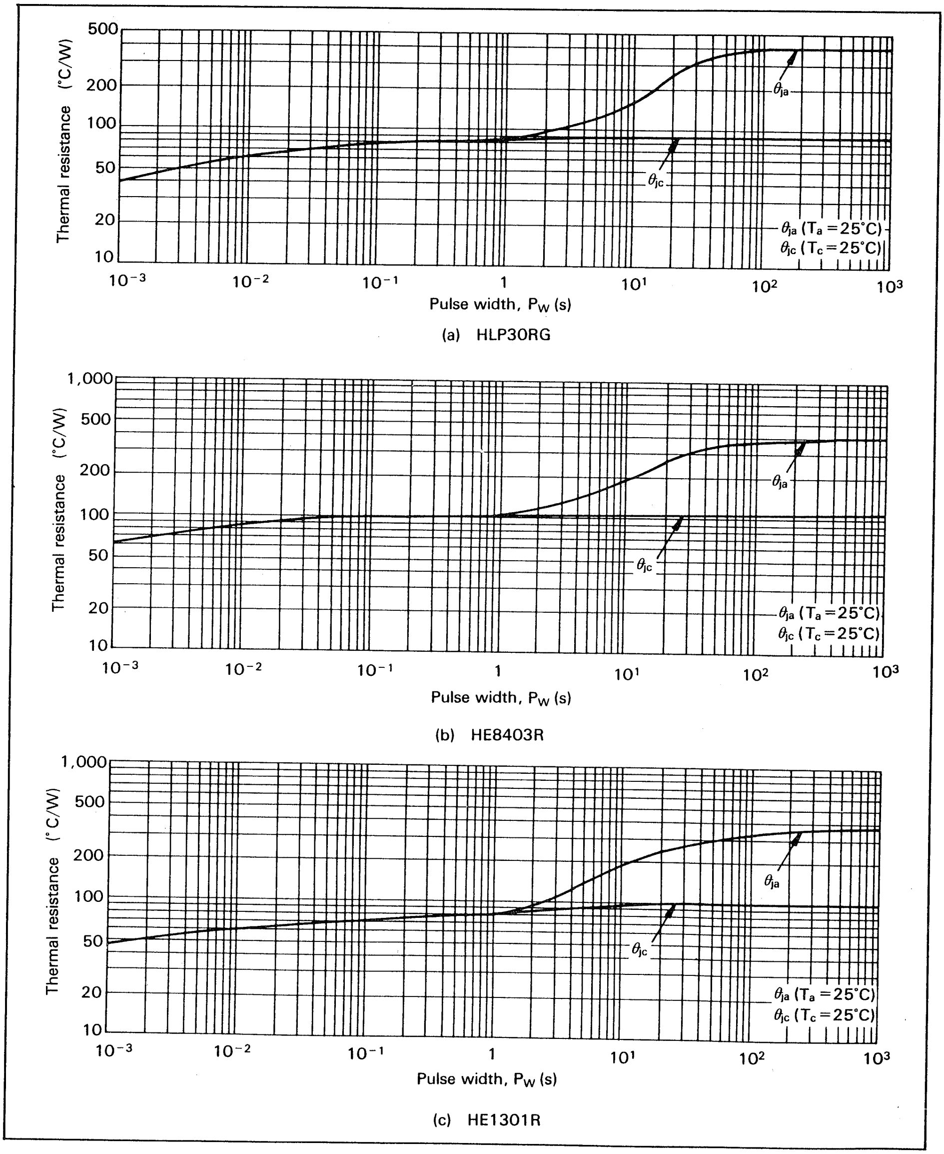


Figure II-44. Transient Thermal Resistance Examples

2.7 Optical fiber coupling efficiency

Figure II-45 shows the coupling efficiency when connecting various types of optical fiber with IREDs. Figure II-46 shows changes of light input into optical fiber when varying the distance from the chip surface to the fiber tip. The reduction rate of optical fiber output is about 12 to 24%/ 100 μm at distance Z. Figure II-47 shows the fiber coupling reproducibility of HE8402F which accommodates fibers with standard connectors. Reproducibility and device rotation show good performance within an output variation of ±0.5 dB.

The fiber can either be processed or a lens used to obtain larger optical output. Optical output can be increased as much as 1.2 times by using fibers with tips made hemispherical through an electric discharge process.

By using a parabolic-rod or similar lens (see Fig. II-48), almost the same fiber output can be obtained as with direct coupling method (see Fig. II-49) even when some distance separates the chip surface and the fiber tip. Therefore, SG-type devices with caps are expected to realize about the same fiber output as the R-types. Figure II-50 shows the relation between the fiber output of IRED chips in R packages measured through the direct coupling method and that of IRED chips in capped SG packages measured through the parabolic-rod-lens coupling method.

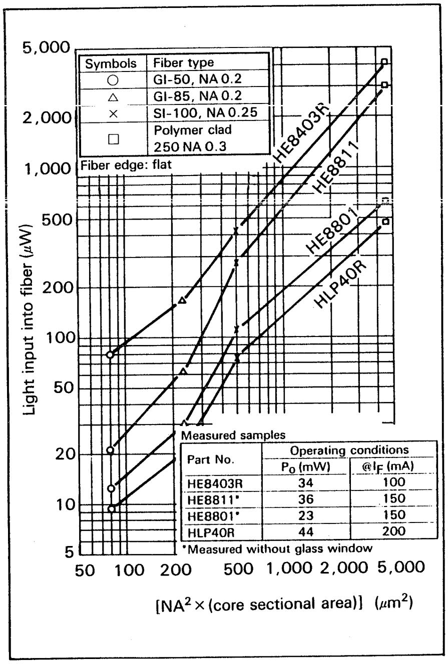


Figure II-45. Optical Fiber Coupling Efficiency

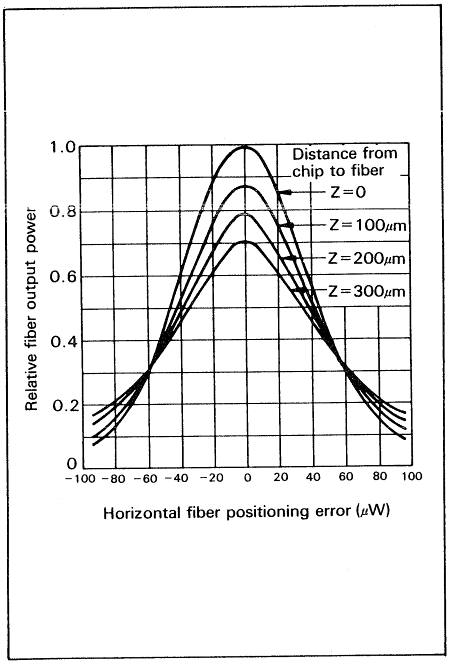


Figure II-46. Fiber Output Deviation due to Fiber Positioning Error with HE8403R

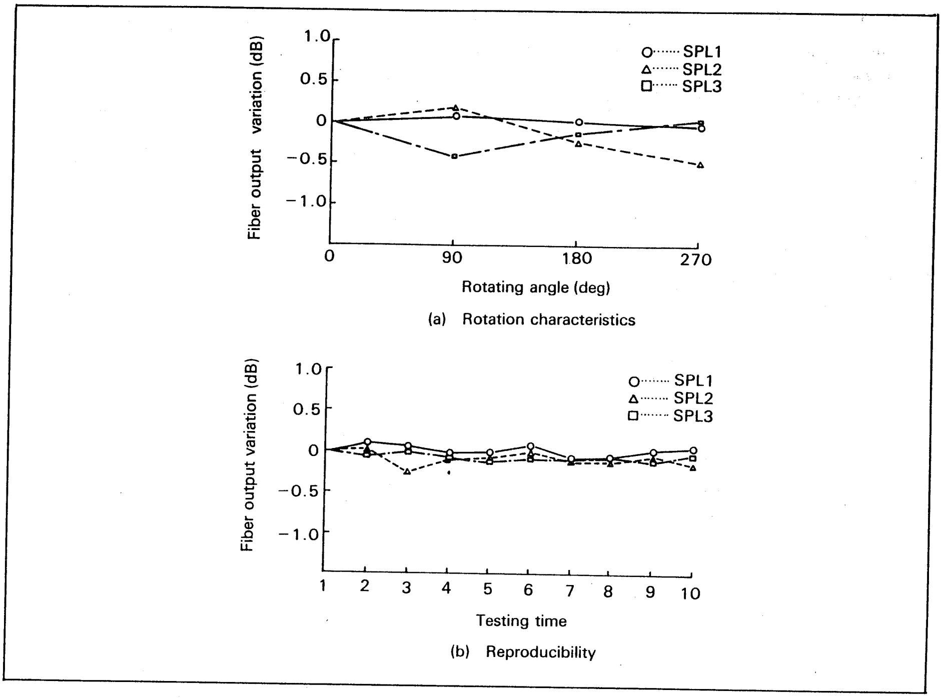


Figure II-47. Fiber Connecting Reproducibility for HE8402F

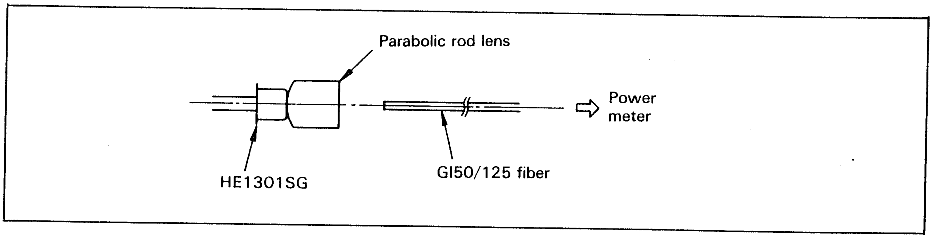


Figure II-48. Parabolic Rod-lens Coupling Method

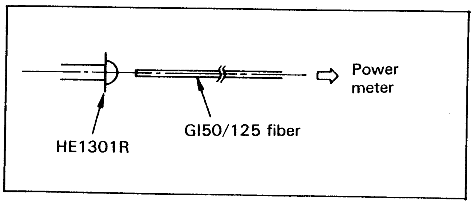


Figure II-49. Direct Coupling Method

2.8 Precision of chip position

In most practical applications, the optical output of an IRED is condensed by placing a lens over its face. At that time, it is important to adjust relative position of the light source and the center of the lens to a point where no practical problem arises. Figure II-51 gives the amount of chip position offset to the center of the stem, as useful data for designing this type of optical system. Figure II-52 shows the distances between glass window of the cap and the chip.

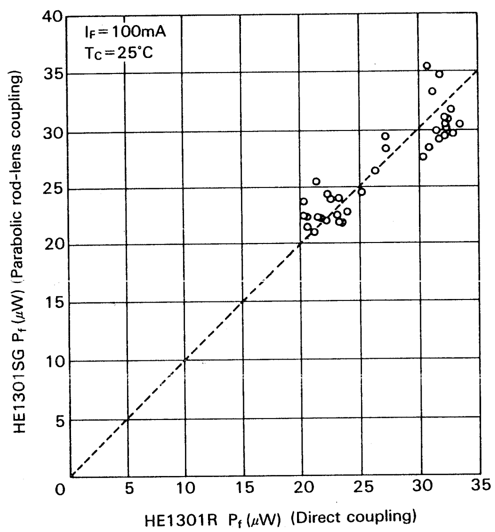


Figure II-50. Fiber Output Comparison for HE1301R and HE1301SG

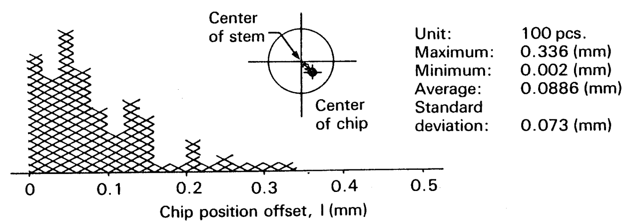


Figure II-51. Chip Position Offset Examples

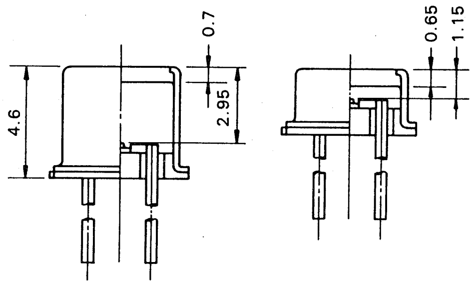


Figure II-52. Distances between Glass Window of Cap and Chip

3. Photodiode fundamental characteristics

3.1 Photo-detection sensitivity (S)

An example is given in Fig. II-53 of a method for measuring photo-detection sensitivity. A laser beam of specified wavelength is input from an LD into an optical fiber. The optical axis is adjusted so that the light quantity is maximum at the photodiode surface. The APC circuit is then adjusted so that there is a specified level, P_{in}, of optical input power into the photodiode. It is necessary at this time to adjust the position of the photodiode so as not to change the saturation current, I_S. The photo-detection sensitivity, S, can then be calculated using the formula:

$$S = I_S/P_{in} \ (mA/mW)$$

When measuring spectral sensitivity characteristics, values calculated for spectral sensitivity are usually compared against wavelengths. Here, several wavelengths that have issued from monochromatic light sources and have the same spectral width are usually employed.

Figure II-54 shows the relation between saturation current, I_S, and reverse voltage, V_R, for Si PIN and InGaAsP/InP PIN photodiodes. Spectral sensitivity characteristics are listed in the individual product data sheets.

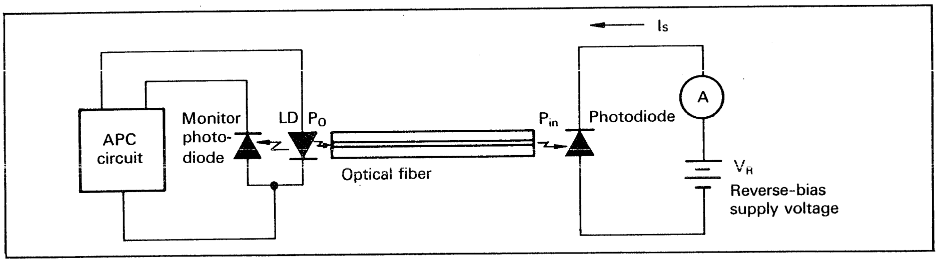


Figure II-53. System for Measuring Photo-detecting Sensitivity

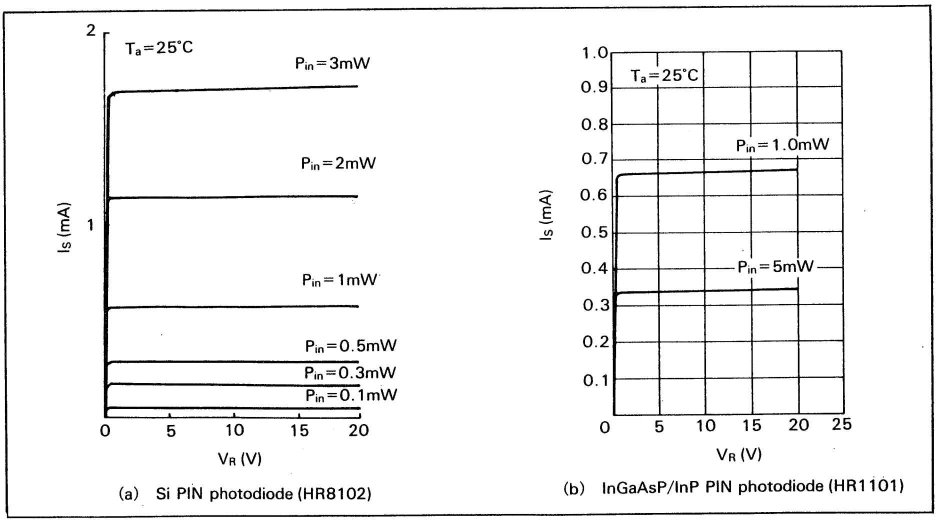


Figure II-54. Relationship between Saturation Current and Voltage

3.2 Photo-detection response characteristics

Photo-detection response can be observed by measuring rise time, t_r, and fall time, t_f, for a photodiode output-current pulse when a pulse is input into the photodiode (Fig. II-55). A measurement setup example is presented in Fig. II-56. A high-speed response capability is required for precise measurement of photodiode response when a monochromatic light source, LD, is employed. Optical power output from an LD is focused using a lens, and the axis of the LD and the photodiode is adjusted so the focused spot is within the photo-detection area of the photodiode. LD optical output power is then set by adjusting the pulse generator so that a specified volume of light is incident on the photodiode. A photo-detection response example is shown in Fig. II-57.

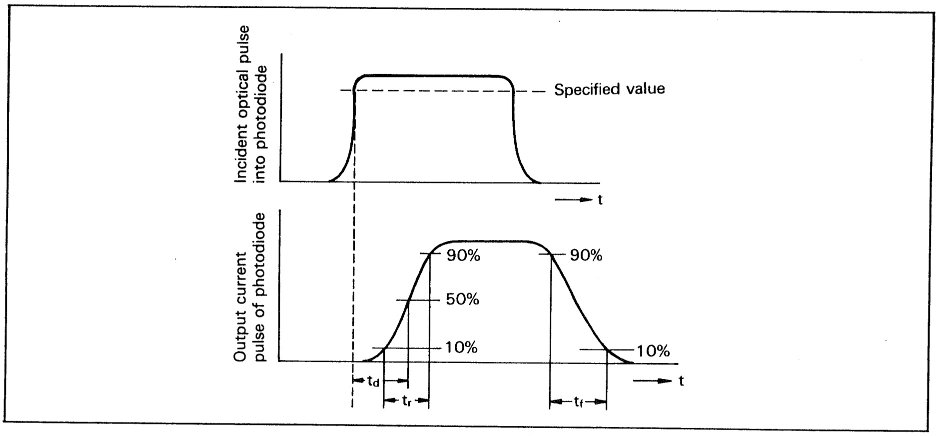


Figure II-55. Definition of Photo-detection Response Time

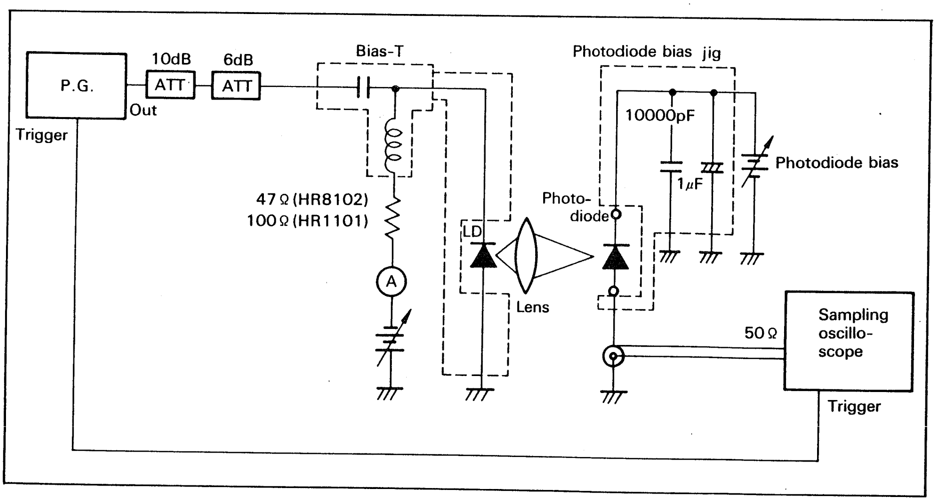


Figure II-56. Measuring Setup for Photo-detection Response

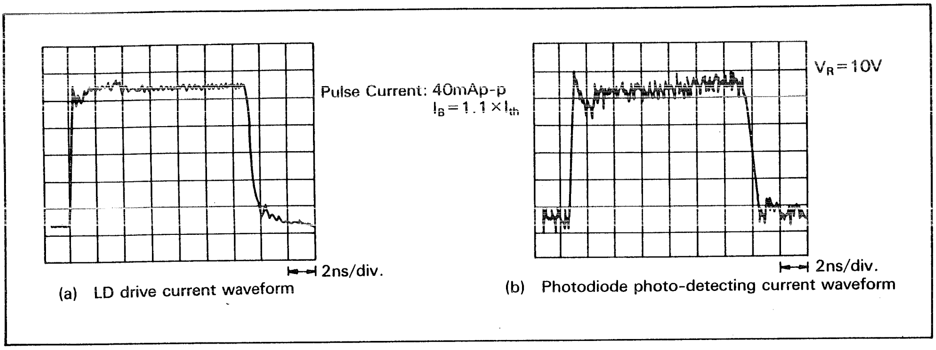


Figure II-57. Photo-detecting Response Wave for InGaAsP/InP PIN Photodiode (HR1101)

III. Handling instructions

Suitable handling precautions during device measurement and system design must be taken as described below for high performance of a device with high reliability.

1. The absolute maximum ratings

Be careful never to exceed, even momentarily, the absolute maximum ratings specified in the data sheets herein.

Pay particular attention to the following points.

(1) It is possible for diodes to be damaged by spike current, generated when switching the power ON or OFF or when adjusting its output voltage. Before activating diodes, check the transient state of the power supply to assure that it does not exceed the maximum voltage rating.

(2) Operate the diodes under the maximum optical output power rating in order to prevent mirror facet damage and resultant loss in reliability. Operation at under 2/3 of the maximum optical output power is recommended.

2. Derating

The reliability of laser diodes (LDs) and infrared emitting diodes (IREDs) largely depends on junction temperature during operation, as shown in Figs. III-1 and 2. As temperature rises, diodes deteriorate exponentially, therefore, the junction temperature should be kept as low as possible by derating, at the same time, effective heat sinking should be performed.

The reliability is also influenced greatly by optical output power. Therefore, diodes should be activated after they have been derated.

3. Surge energy

Electrostatic discharge and electric spike input which may damage the diodes should be prevented. The main causes of undesirable surge energy are static electricity on the human body, shipping containers made of unsuitable materials, abnormal pulses generated from test equipment, and voltage leakage from soldering irons.

Precautions below should be taken when using diodes.

(1) The human body should be grounded through a high resistance of 500 kΩ to 1 MΩ while handling diodes in order to prevent diode destruction due to static electricity contained in the body and clothes.

(2) Soldering irons should be grounded to prevent voltage leakage from transferring to the diodes.

(3) Suitable materials should be chosen for shipping containers and jigs so that they will not become charged with static electricity by rubbing during transportation. Use of electro-conductive materials or aluminum foil is effective.

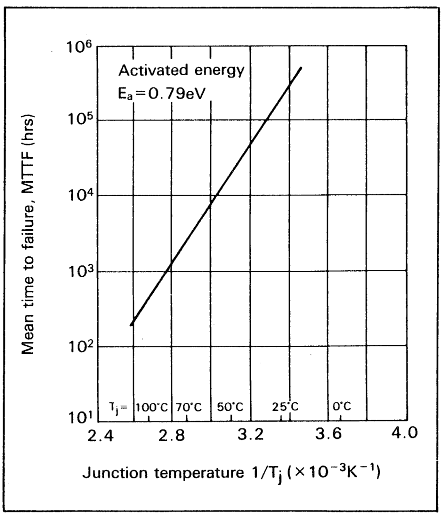


Figure III-1. Example of LD Junction Temperature Dependency of Mean Time to Failure

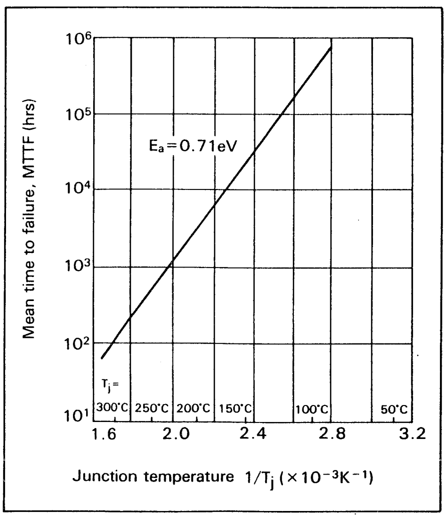


Figure III-2. IRED Junction Temperature Dependency of Mean Time to Failure

4. Storage

(1) Store diodes in temperature of between 5 and 30°C and relative humidity of below 40%. Lower values of both are preferable. Avoid sharp drops in temperature in order to prevent condensation. It is recommended to store diodes in an atmosphere of dry nitrogen with a dew point of −40°C.
(2) Assure that the storage atmosphere is void of dust and gases harmful to diodes.
(3) Use a storage case which can not easily be charged with static electricity.

5. Safety considerations

Even though barely visible to the human eye, laser beams can be harmful to the eye. Do not look at the beam through lenses when the diode is activated. When aligning the optical axis of a laser beam and an external optical system, use an ITV camera (e.g. a silicon-vidicon type) which can detect infrared rays to observe the laser beam.

6. LD-package handling

6.1 A- and AC-types

A-type is designed for experimental use and AC-type for module assembly. An LD chip is mounted on a submount on a heat sink and the mirror facets are exposed to the air. Special care is required as follows:

(1) Never touch the bonding wire on the upper part of a device.
(2) Prevent mechanical contact to an LD chip, because the stress peels off the chip from the heat sink or deteriorates the device properties such as beam divergence, far field pattern and reliability.
(3) Cleanest atmosphere is strongly desired to handle a device, to keep mirror facets free from dust and scratch, because a light emitting source is extremely small. As a result, this precaution prevents degradation of optical output power and far field pattern.
(4) Hold the copper heat sink in handling a device. Do not drop the device or give any other mechanical shock.
(5) Do not process or deform a heat sink.
(6) Use a good thermal radiator to mount a device on. The temperature of an LD chip rises highly owing to the high current density unless a good heat sinking is provided. As a result, this precaution prevents lower optical output power and device deterioration. Notice the following cautions in using a thermal radiator.
   (i) Never use silicone grease because it creeps up and adheres to the mirror facets, resulting in a degradation of optical output performance.
   (ii) Use a copper or an aluminum plate as a thermal radiator. The radiator should be larger than $30 \times 40 \times 2$ mm^3.
   (iii) Polish up the thermal radiator surface to have a good thermal conductivity with the device heat sink. Finish the radiator surface to keep bump, twist or bend below 0.05 mm.
   (iv) Chamfer all screw holes. The diameters of the chamfered holes should be smaller than that of a screw cap.
   (v) When mounting a device to a radiator, do not allow the device to be turned by screwing down or the chip to contact the thermal radiator.
(7) Soldering:
Notice the following precautions when soldering the electrode ribbon of a device to the circuit.
   (i) Do not exceed the heat sink temperature of 80°C and finish process within 30 seconds, because a low melting point solder is used for chip mounting.
   (ii) Use the fine tipped soldering iron commercially available or a common soldering iron with the copper coil around the tip. At the time, earth the tip of the iron. A battery operation type is best to use.
   (iii) Do not allow the solder to flow into the pad of bonding wire.
   (iv) Do not allow the scattered flux to adhere to the mirror facets.
   (v) Do not wash out flux after soldering, because it contaminates the mirror facets.
(8) Hermetic seal:
Hermetically seal a device to extend its life time.

These packages should be hermetically sealed on mounting on systems.

6.2 B-, P- and SP-types

These packages are designed for fiberoptic communications. B-type is provided with an optical output fiber and a monitor output guide (a glass rod), P-type with multimode fiber and built-in photodiode and SP-type with single-mode fiber and built-in photodiode.

An LD chip is mounted on a heat sink and the fiber and the chip are aligned then it is hermetically sealed. Pay attention to the following precautions in handling these devices.

(1) Excessive force to optical fiber disconnects the fiber at a moment or deforms it partially. Do not pull, crook or twist the fiber because it deteriorates fiber characteristics. Do not bend the optical fiber within 30 mm radius.
(2) Do not apply excessive stress between the package and the optical fiber, to prevent a fiber from breaking, falling out and reducing optical output power. Lift both of the package and the optical fiber at the same time not to bend the fiber bottom.
(3) Do not contaminate or damage a monitor output guide.

(4) Do not apply excessive stress in tightening the screw of the monitor guide when attaching an external monitor photodetector, because it breaks the monitor glass. The torque should be 1 to 2 kg·cm.

(5) Do not apply excessive stress by bending or pulling the pins, because it deteriorates hermeticity.

(6) Do not process or deform a package.

(7) Processing the optical fiber:
Do not contaminate or damage the tip of an optical fiber to prevent the loss of optical output power or of coupling efficiency. Follow the instructions below in processing the fiber tip.
  (i) Remove the appropriate length of the nylon jacket from the fiber tip with a proper stripper.
  (ii) Remove the fiber coating remedy from the peeled fiber with aceton.
  (iii) Scratch the cutting point of the fiber with a diamond cutter.
  (iv) Hold the fiber tip with a pair of tweezers and bend to snap, then expose the clean surface. When the surface of the fiber cannot be snapped flatly, try again (Fig. III-3).
  Take enough care when processing a fiber, because the extremely thin core of fiber may easily pierce human skin.

(8) Mounting a device on a thermal radiator:
Use an LD with a thermal radiator.
  (i) When screw mounting a device on a radiator, torque should be 1 to 2 kg·cm. Too small torque may result in excessive thermal resistance and excessive torque may damage the diode on the other hand.
  (ii) Use a screw of 2 mm dia.
  Use a spring washer and apply lock paint to tapping holes or nuts to prevent turning or relaxation of the screw.
  (iii) Avoid to give deformation stress to a laser package when attaching a peltier cooler to the package.

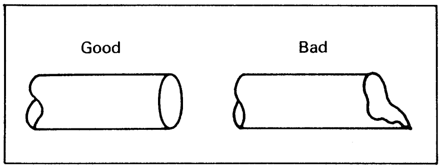


Figure III-3. Processed Fiber-tip Examples

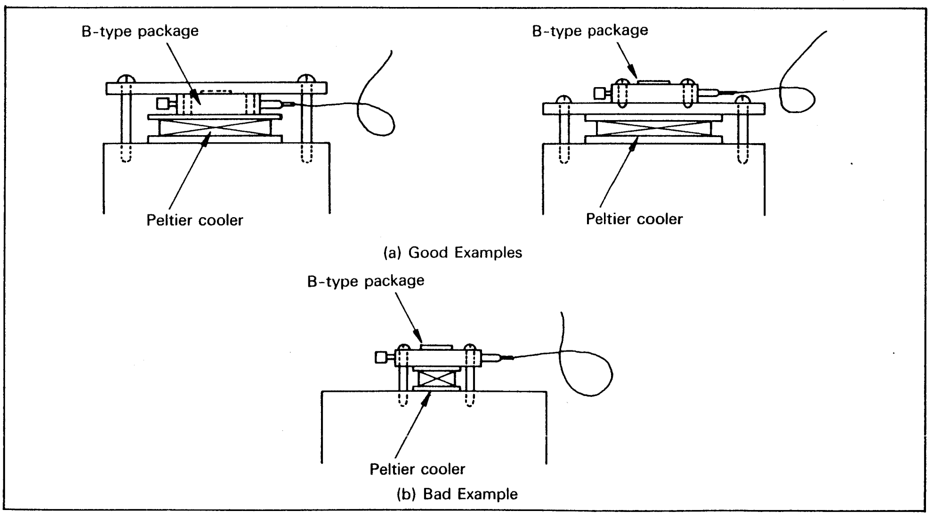


Figure III-4. Examples of Mounting B-type Package on Thermal Radiator

Especially when mounting the peltier cooler between a laser package and a thermal radiator, deformation stress tends to be applied to the package and loses device reliability.

(iv) For other considerations, follow the instructions described in the previous section 6.1 (6).

(9) Soldering:
Follow the instructions described in the previous section 6.1 (7).

6.3 E-, G- and FG-types

(1) Take care not to touch the window glass directly. Contamination and scratches on the window surface will result in decreased optical power output and distorted far field patterns. Contamination can usually be wiped off using a cotton swab with ethanol.

(2) Do not squeeze the cap tightly, as it will cause the window glass to crack and package hermeticity to deteriorate.

(3) Do not bend the bottom of the lead wire, as it will cause the glass area to crack and the hermeticity to deteriorate.

(4) Do not cut or process packages.

(5) Mounting a diode on a thermal radiator:
Laser diodes must be mounted on thermal radiators. For higher reliability, it is necessary to minimize mechanical stress to the packages and achieve sufficient heat sinking. Attention should be paid to the followings when mounting diodes on thermal radiators.

(i) Use a copper or aluminum plate for the thermal radiator. The plate should be larger than 30 × 40 × 2 mm^3.

(ii) To give it good thermal conductivity, polish the thermal radiator surface so it will lie flat with the diode heat sink. Finish the radiator surface to keep bumps, twists or bends below 0.05 mm.

(iii) Chamfer all screws. The diameter of chamfered holes should not be larger than that of the screw heads.

(iv) When screw mounting diodes on radiators, torque should be applied at 2.0 ± 0.5 kg·cm. Insufficient torque may result in excessive thermal resistance, where excessive torque may damage the diodes.

(v) Use screws with diameters of 2 or 2.5 mm for the E-type package. Use spring washers and apply lock paint.

(vi) Do not solder packages to thermal radiators, as this may result in excessive temperature to the assemblies inside the packages or loss of package hermeticity.

(vii) When mounting the diodes, do not touch or hit them against the caps, in order to prevent the window glass from becoming contaminated or cracked.

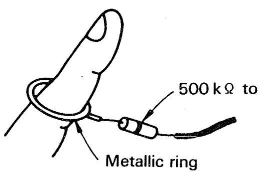
(viii) Do not use heat sink grease, as it may contaminate the window glass.

7. Advice for beginners

(1) Avoiding surge energy:
Laser diodes are easily destroyed by static electricity. To prevent electrostatic discharge, pay attention to the following precautions as well as Table III-1 when handling diodes and designing application circuits.

(i) Set the electric potential of the work bench to be the same as that of the power supply ground line.

(ii) Ground the operator's body by placing a metallic ring on his/her finger with a resistance of 500 kΩ to 1 MΩ, and connect it to the same potential as the power supply ground line.



(iii) Do not operate equipment which may generate high frequency surge energy near diodes. The lead wires of drive circuits pick up surge electricity which may destroy diodes in the induced electric field.

(2) Operating laser diodes:

(i) Mount a diode on a thermal radiator. The radiator size depends on operating time and output power. When there is no condition set, use a relatively large radiator (50 × 50 × 2 mm^3) of copper or aluminum.

(ii) The drive circuits preferred are ones with APC (automatic power control) function. However, a simple constant current source is recommended when merely testing performance, because adjustment miscalculation can result when circuits are too complex, leading to destruction of the diodes.

(iii) Before connecting a laser diode to the power supply in the ON-state as shown in Fig. III-5, set the output level at minimum. Also, before disconnecting a laser diode from the power supply, set the output voltage at minimum. After disconnecting, turn off the main switch.

(3) Experimental LD drive circuit:
The optical output power from an LD is affected easily by the fluctuation of ambient temperature. APC (automatic power control) function is generally recommended for a drive circuit to achieve stable operation. The function to monitor beam and feed it back to drive current is useful to achieve constant optical output power against temperature change. Figure III-6

Table III-1. Ways to Prevent Surge Destruction of LDs (Examples)

Items	Check points	Specification examples
Human body	Ground operator's body.	Place a non-metallic, carbon band with a resistance of 500 Ω to 1M Ω on his wrist.
	Commonly ground the measuring and inspecting equipment and the work bench.	Should be carried out in shielded rooms as well.
	Control the ground level.	Under 10 Ω
Power supply	Distribute power from main power supply through noise filter to each measuring and testing unit.	
	Insert noise filter in each power supply unit.	Organize with capacitors and resistors.
	Keep the main power supply in the on-state, and switch the power on and off using an external switch.	
	Set up sequence control for turning the power supply off during electric outages.	
	Eliminate relay chattering.	
	To prevent chattering, avoid turning on and off of switch in APC circuit or relay.	
Working conditions	Temporarily stop work when the power supply for lights or other equipment connected to the same power line is turned on or off.	
	Conduct diode packing and measuring while performing ion blowing or in a weak minus ion atmosphere.	
	Select the right soldering iron.	Battery operated soldering iron.
Jigs and other considerations	Make carrier jigs and packing cases conductive.	Particularly the cases.
	Place conductive mats on the working floor.	Under 300 Ω
	Control room temperature and humidity.	Humidity should be 50±10%.
	Make short circuits between diode leads.	
	Do not use sticky volume knobs.	Periodically replace with new ones.
	Eliminate ripples from power supply.	Battery operated power supply.

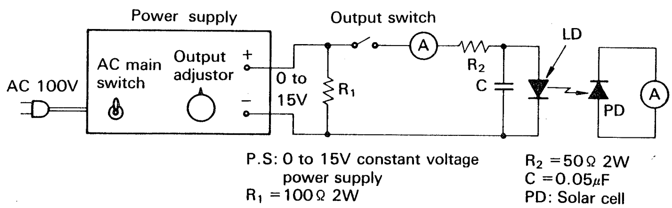


Figure III-5. Simple Drive Circuit

shows an experimental APC circuit example. A_1 provides constant voltage. A_2 converts photovoltaic current of a photodetector to voltage. By adjusting R_1, optical output power from an LD is controlled to obtain the desired value through a differential amplifier, A_3. The integral circuit of C_1 and R_2 is a slow starter to prevent surge input from the power supply into the diode. The terminal, T, applied about 1 V has the standby function to minimize the idling current while an LD is not operated, by switching off the drive circuit. Figure III-7 shows that optical power output stability is achieved even when diode case temperature varies significantly.

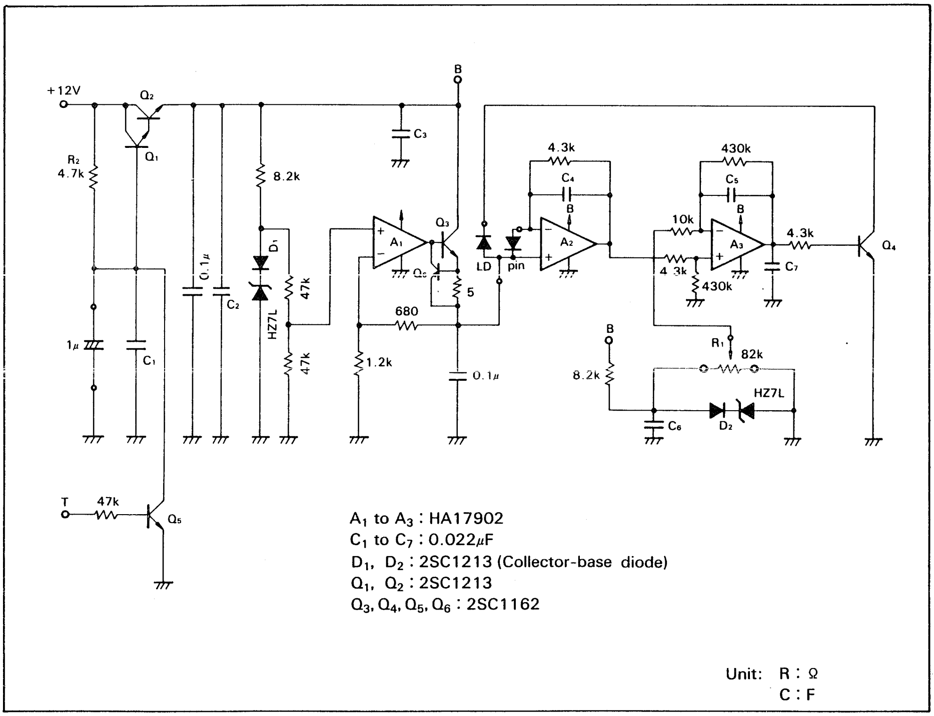


Figure III-6. LD Experimental APC Circuit

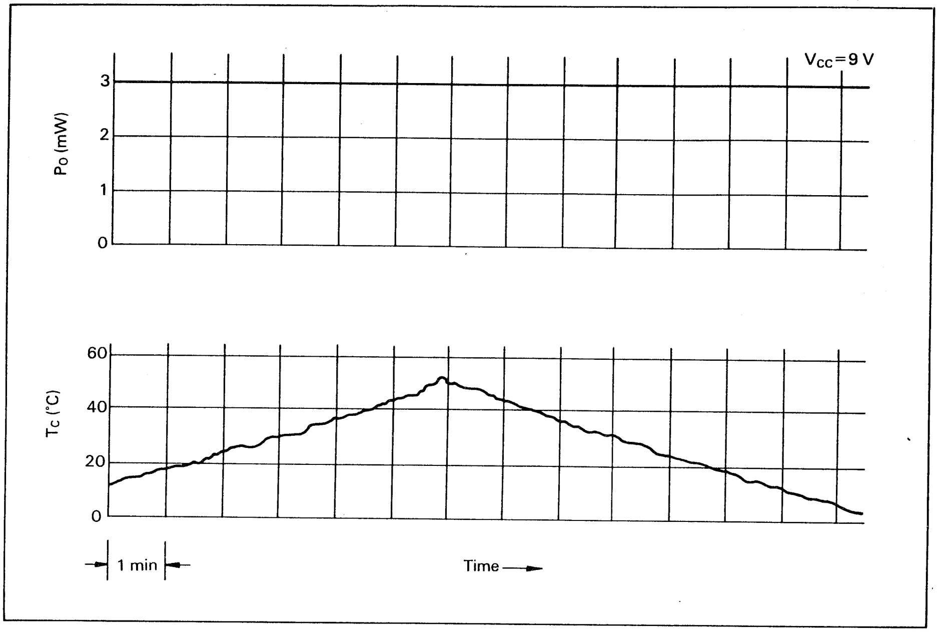


Figure III-7. Temperature Characteristics of LD with APC Circuit (HL7801E)

8. IRED-package handling

8.1 R-type (Open-air type)

An IRED chip on R-type package is exposed to the air for the convenience of coupling to the fiber or external optics. The following particular care must be taken for the open-air type package.

(1) Never touch the extremely thin gold bonding wire which is bare.
(2) Never apply mechanical stress to an IRED chip, or it peels off the chip from a diode base and deteriorates the properties and reliability. Also do not contaminate the chip surface, because it deteriorates optical properties and output power.
(3) Do not process or deform a diode base.
(4) Mounting a device on a thermal radiator:
An IRED must be mounted on a thermal radiator to reduce the temperature rise because it is usually driven at high current density. Without a radiator, specified optical output power cannot be obtained and the device may be degraded due to the chip temperature rise. When mounting a device on a radiator, follow the instructions below.
 (i) The appropriate size of a thermal radiator differs with operating conditions, but a large plate than 20 × 30 × 2 mm^3 of copper or aluminum is usually recommended.
 (ii) Polish up the thermal radiator surface to have a good thermal conductivity with the device heat sink. Finish the radiator surface to keep bump, twist or bend below 0.05 mm.
 (iii) Use of silicone grease is absolutely prohibited as described in the previous section 6.1(6) for A-type LD heat sink.
(5) Soldering:
 (i) Use a low melting point (below 200°C) solder.
 (ii) Soldering should be done in 10 seconds and at below 260°C.
 (iii) Do not allow the scattered flux to adhere to the chip surface.
(6) Hermetic seal:
Hermetically seal a device to extend its life time.

8.2 RG-, SG-, ML- and SL-types (Hermetically sealed)

These packages are well moisture-proof and easy to handle because of the hermetic seal. Pay attention to the following precautions in handling a device.

(1) Keep the glass surface of a device clean to have uniform optical output available.
(2) Do not process or deform a package. Especially do not nip the cap hard or bend the bottom of a lead wire forcibly, or it cracks the glass area and deteriorates the hermeticity.
(3) Mounting a device on a thermal radiator:
Use of a thermal radiator is recommended for higher reliability. Do not apply silicone grease to the contact area of the thermal radiator even for effective heat sinking, because it creeps up and adheres to the window glass as temperature increase, resulting in a degradation of optical properties and output power. For further details, see the previous section 8.1 (4).
(4) Soldering:
 (i) Soldering point must be away by 1.5 mm or more from the bottom of lead wires.
 (ii) Use a low melting point (below 200°C) solder.
 (iii) Soldering should be done in 10 seconds and at below 260°C.

8.3 F-type (Hermetic seal type)

The F-type package is designed for fiberoptic communications. The GI type fiber rod of 50/125 μm dia. in a precision ceramic sleeve is provided with this type, which couples effectively with the output fiber through a receptacle.

The fiber rod and the sleeve are designed to fit the standard FA connector. This package is completely hermetically sealed with a cap ring-welded to a stem and a fiber rod soldered to a cap inside. Pay attention to the following precautions in handling a device.

(1) Never touch the tip of the fiber rod not to contaminate the tip, or it reduces the optical output power. It is hard to clean it once adhered.
(2) Do not apply the mechanical stress to the bottom of a ceramic ferrule and a lead wire, because it deteriorates the hermeticity and the optical coupling efficiency.
(3) Mounting a device on a thermal radiator:
Use of a thermal radiator is recommended for longer device life. For further details, see the previous section 8.1 (4).
(4) Soldering:
Follow the instructions described in previous section 8.1 (5).

9. Photodiode package handling

9.1 QG and TG hermetically sealed packages

These hermetically sealed packages are moisture-proof and easy to handle. Nevertheless, be careful to observe the following when handling them.

(1) Keep the glass surface of QG or TG type devices clean to assure uniform optical input.
(2) Do not process the packages or change their shape. Be especially careful not to apply heavy stress to the glass surface, pinch the cap hard, bend the bottom of the lead wires forcibly, or apply stress to the bottom of the stem since this may degrade the hermetic integrity of the package.
(3) Soldering:
See item 8.2 (4).

9.2 CX chip-carrier package

This package has been designed for use in optical module assemblies. A photodiode chip is attached to a ceramic carrier stem, where it is left exposed to the air. With this package type, particular care must be taken in the following areas.

(1) Storage:
(i) Store the photodiode in a dry, particle-free box, or in a nitrogen atmosphere between +20 and +30°C, where the dew point is below −30°C. Maintain these same conditions when storing the package unsealed during processing. The storage period recommendations in Table III-2 are meant to assure maximum product quality.
(ii) Use storage containers which are not subject to buildups of static electricity.
(2) Handling and assembly conditions:
(i) Never touch the chip bonding wire.
(ii) Keep the chip photodetector area clean.
(iii) Be careful not to scratch the chip surface, or crack or break the device when implementing the CX type in your system. The soldering conditions given in Table III-3 should be maintained if optical and electrical characteristics and reliability are not to degrade.
(iv) This device should be hermetically sealed when it is finally mounted. The sealing process should be carried out within an atmosphere composed of an inactive gas such as nitrogen.
Results of hermetic-seal helium leak tests should be below 10^{-8} atm.cc/sec.
(v) Be sure to ground the worker's body and equipment when he or she handles the device.

Table III-2. Recommended Storage Period

Conditions	Storage period
Unopened, in Hitachi's packing case	Less than three months
Stored under the above conditions after opening the packing case	Less than one month

Table III-3. Recommended Soldering Conditions

Temperature	Time	Atmosphere
230 °C	Within 30 sec.	Inactive gas such as nitrogen

IV. Operation principles and characteristics

1. Operation principles of LDs, IREDs and photodiodes

1.1 Emitting principles

Each electron in atoms and molecules has a specific discrete energy level, as shown in Fig. IV-1. The transition of electrons between different energy levels is sometimes accompanied by light absorption or emission of the wavelength, λ, expressed as:

$$\lambda = \frac{C}{f_0} = \frac{C}{|E_2 - E_1|/h} = \frac{1.2398}{|E_2 - E_1|}$$

C: Light velocity
E_1: Energy level before transition
E_2: Energy level after transition
h: Planck constant (6.625×10^{-34} joul. sec.)
f_0: Emission frequency

There are three types of electron transitions, as shown in Fig. IV-2.

Firstly, Fig. IV-2 (a) shows what is known as resonant absorption. An electron transits from the stable low energy level, E_0, to the higher energy level, E_1, through absorbing light.

Secondly, Fig. IV-2 (b) shows spontaneous emission. An electron transits from the high energy level, E_1, to the stabler low energy level, E_0. At the time, the energy balance of $|E_1 - E_0|$ is released in the form of light. Since each electron in the level, E_1, transits independently, light is emitted at random and out of phase. Such light is referred to as incoherent light and one of the typical characteristics of spontaneous emission. The light from IRED is of such spontaneous emission light.

Under thermal equilibrium, probability of electrons to exist in the lower level, E_0, is higher than that in the higher energy level, E_1. Therefore, electron transition to higher energy level ($E_0 \rightarrow E_1$) by absorbing light is more likely to occur than light emission as shown in Fig. IV-2 (a). In order to emit light, electrons must exist in E_1 with high probability, which is referred to as inversed population.

Thirdly, Fig. IV-2 (c) shows stimulated emission. The electrons in the higher energy level, E_1, are forcibly transferred to the lower energy level, E_0, by incident light. The light generated this time is referred to as stimulated emission light. Its phase is the same as that of incident light, because the stimulated emission light is emitted with resonating to the incident light. Such stimulated emission light is referred to as the coherent light.

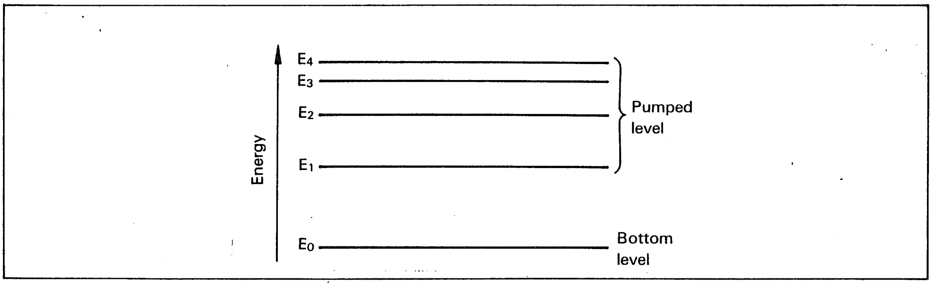


Figure IV-1. Energy Level

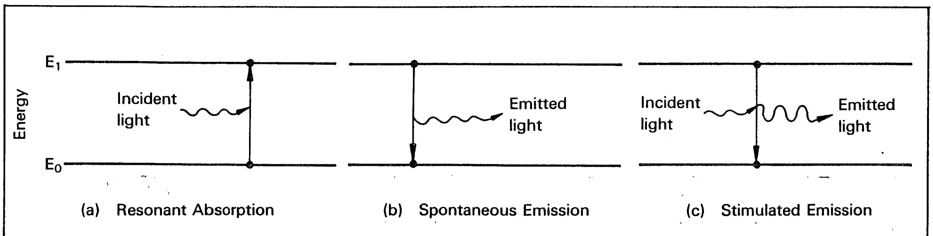


Figure IV-2. Transition Process

Similarly to the electric circuit, laser oscillation requires the feedback function in addition to the gain which exceeds the loss. Laser beam is oscillated by amplification of stimulated emission and positive feedback with mirrors.

Figure IV-3 shows a Fabry-Pérot resonator which is the most fundamental optical resonator.

The structure of an LD, in principle, is the same as shown in Fig. IV-3, which has the both surfaces of the chip with reflection mirrors by cleaving.

The light heading to the reflection mirror among incident spontaneous emission light, is amplified by stimulated emission and comes back to the initial position after reflection. This process accompanies the loss by passing through or diffraction of light at the reflection mirrors and scattering or absorption in the cavity. When the loss is higher than the amplification gain, the light attenuates. Injected current strengthens amplification gain in an LD and at the condition that the gain and the loss are balanced, initial light intensity becomes equal to that of returned. This condition is referred as threshold. A laser oscillates above the threshold when the gain increases enough.

Injection pumping is mainly taking place at the p-n junction in a semiconductor laser diode. A semiconductor crystal can obtain higher gain than a gas laser (HeNe for example) due to the higher density of atoms available with a cavity. Therefore, a laser can oscillate with such a short resonant cavity of 300 μm and low reflectivity of 30%.

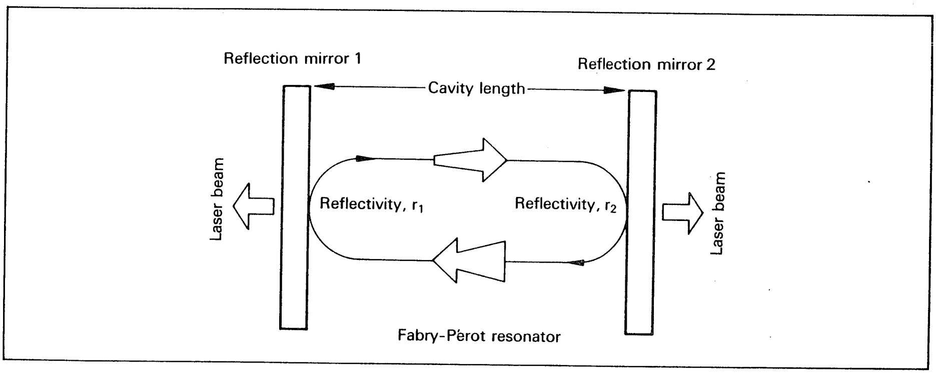


Figure IV-3. Fundamental Structure of Fabry-Pérot Resonator

1.2 Photo-detection principles

Photodiodes make use of a photovoltaic effect resulting from application of voltage to both ends of a p n junction at the time light exposes the junction. Under reverse-voltage conditions at the p-n junction, a depletion region is generated to which an electric field has been applied (see Fig. IV-4). Incident light with the same energy as the bandgap energy is absorbed in the depletion region. This absorption of light produces electron-hole pairs. The electrons and holes then drift, under electric field action, in opposite directions across the depletion region. Electrons move forward to the cathode electrode, and holes move to the anode. As a result, a current flows through the load resister, and light signals are converted to electric signals. Carriers produced in the depletion region move at high speeds due to acceleration by the electric field. Carriers generated in the diffusion region, however, move slowly due to diffusion in accordance with the concentration gradient.

In optical fiber or information terminal equipment systems, a high-speed response and high quantum efficiency are essential photodiode capabilities. Accordingly, Hitachi has been employing PIN structures for photodiodes to achieve higher quantum efficiency and reduce junction capacitance for a faster response. "PIN" signifies a structural configuration whereby an intrinsic layer with high resistance is sandwiched between p-type and n-type semiconductors. The electric field is applied to the intrinsic region, and most incident light is absorbed in this region, producing a great many electron-hole pairs.

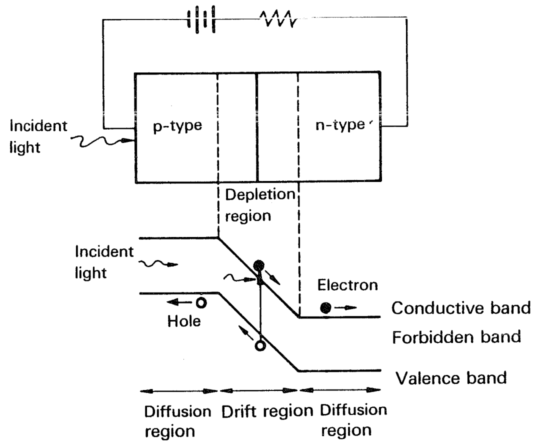


Figure IV-4. Photo-detection Principles

2. IRED structures and characteristics

2.1 Heterostructure

The p-n junction barrier of the diode confines the injected current to the active layer. The heterojunction (Fig. IV-5 (a)) consists of p-type and n-type whose band gap energy are different from each other. This heterojunction structure increases the confinement effect and realizes high power output with high speed. Practically, $Ga_{1-x}Al_xAs$ is used, controlled band gap energy by changing the mixture ratio, x.

Hitachi IREDs are devided into two structures: SH (Single Hetero) structure which has only one heterojunction and DH (Double Hetero) structure which has two heterojunctions (Fig. IV-5 (b)) and realizes high power output with high speed. Table IV-1 shows the structure of each type number.

High efficiency of current-light conversion is achieved, using GaAs crystal which is a direct transition type material. Hitachi shapes the chip surface hemispherically to best utilize the emitted light out of a chip (Fig. IV-6).

Table IV-1. Hitachi IRED Structures

Part no.	Structure
HLP series	SH
HE8801	SH
HE8805VG	SH
HE8806VG	SH
HE8807 series	SH
HE8811	DH
HE8403 series	DH
HE8402F	DH
HE1301 series	DH

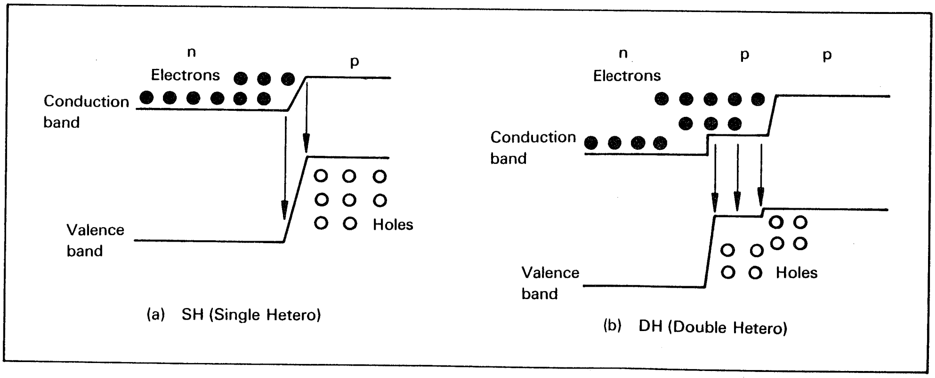


Figure IV-5. Junction Structure

Table IV-2. Dome Diameter and Junction Diameter of Each Part Number

Part no.	Dome Dia. (μm)	Junction Dia. (μm)
HLP series	600	160
HE8801	400	100
HE8805VG	400	100
HE8806VG	400	100
HE8807 series	400	100
HE8811	400	100
HE8403 series	400	30
HE8402F	400	30
HE1301 series	400	30

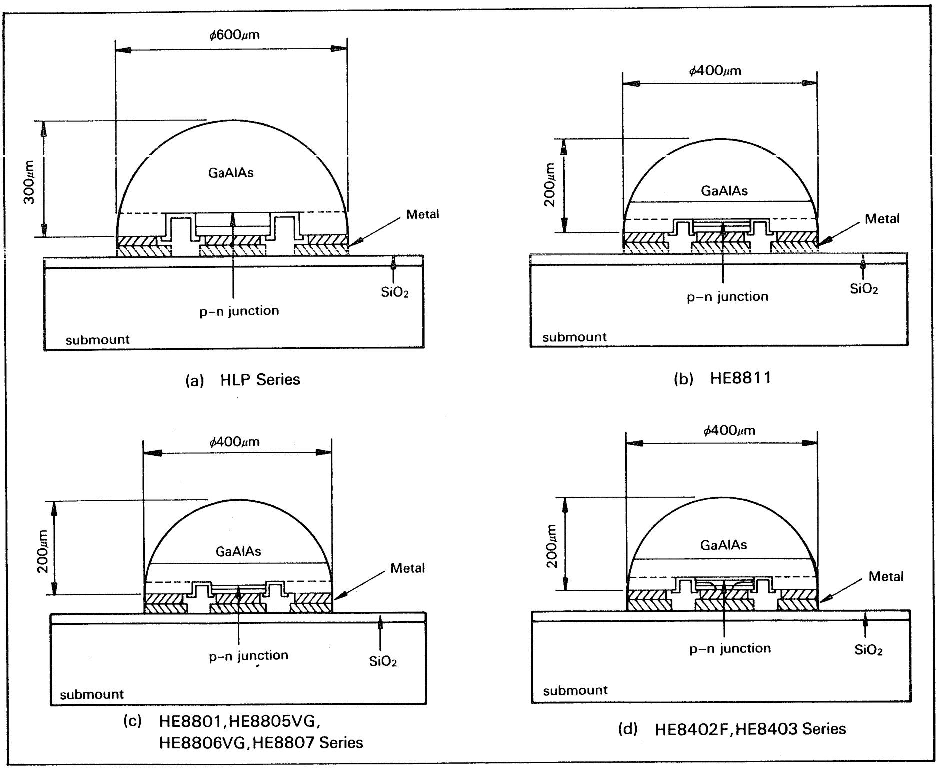


Figure IV-6. IRED Structures

2.2 Dome shaped chip

Refraction at the outer surface of the dome must be taken into account when considering light emission. Since the refractive index of GaAlAs is about 3.4, light projected to the surface of a flat-shaped chip is unable to pass out at angles above 17 degrees and is reflected inside the chip, as shown in Fig. IV-7. Therefore, by making the chip dome-shaped, light from the center of the chip will hit the surface perpendicularly no matter what the angle and will almost all emit from the chip, as shown in Fig. IV-8. Also, the chip is designed so that the light emitting area is sizable in relation to overall chip diameter: about 25% for high output IREDs and 7.5% for high speed ones. As a result, light hitting around the dome periphery is refracted forward which increases the amount of utilizable light.

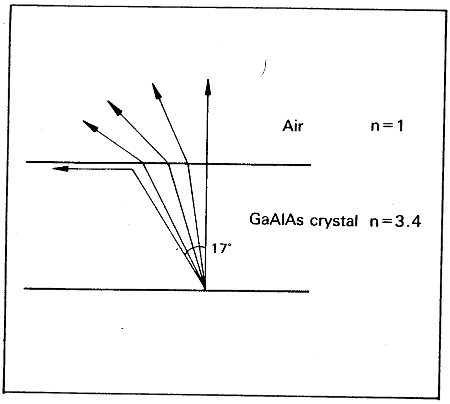


Figure IV-7. Light Refraction at Boundary Layer

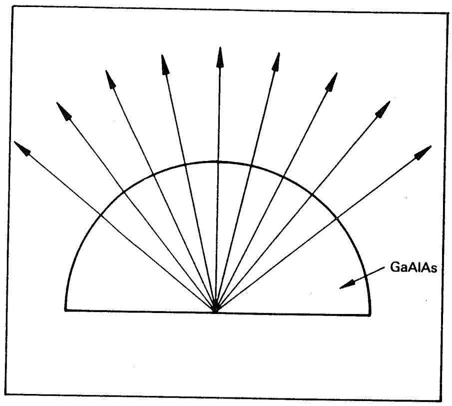


Figure IV-8. Hemispherical Shaped Light Radiation

3. LD structures and characteristics

3.1 GaAlAs LD structure

The p-type active layer is processed first in which stimulated emission enforces optical amplification (Fig. IV-9 (a)). The p-n junction is made here to inject minority carriers (the p-n heterojunction). With forward current applied to the junction, electrons in n-type region are injected into p-type region. With a p-type semiconductor of wide band gap on the other side of p-n junction (heteroisolation junction), the injected carriers are much confined within the p-type active layer. This carrier confinement makes population inversion easily and the light emission intensity is then increased.

The active layer of the GaAlAs LD is made of GaAs or $Ga_{1-y}Al_yAs$ (Fig. IV-10). The thickness of the layer is 0.05 to 0.2 μm. p-type $Ga_{1-x}Al_xAs$ and n-type $Ga_{1-x}Al_xAs$ ($x > y$) sandwich the active layer (x and y here are the mixture ratio of aluminum). When x is 0.3, the band gap of the sandwich layers is 1.8 eV and there is balance of 0.4 eV against 1.4 eV of GaAs. When forward bias is applied here, the heterobarrier confines carriers within the 0.05 to 0.2 μm active layer, carrier population is inverted and the gain increases. The refractive index of GaAs is higher by some percents than that of $Ga_{1-x}Al_xAs$, which confines the generated light within the GaAs active layer. The light penetrating into Al_xAs layer is not absorbed because of its wide band gap. So laser oscillates effectively there (Fig. IV-9). The thinner GaAs layer can do with less threshold current density for laser oscillation. At present, the threshold current density of as low as 1 to 2 kA/cm² is achieved, which realizes the continuous oscillation (CW) stably at room temperature.

3.2 Lasing modes of GaAlAs LD

Under the laser oscillation, the light standing wave forms with wavefront parallel to mirror facets while light is traveling back and forth within the laser cavity. This standing wave consists of longitudinal mode and transverse mode (Fig. IV-11). Longitudinal mode expresses the condition in the direction of cavity length (z direction).

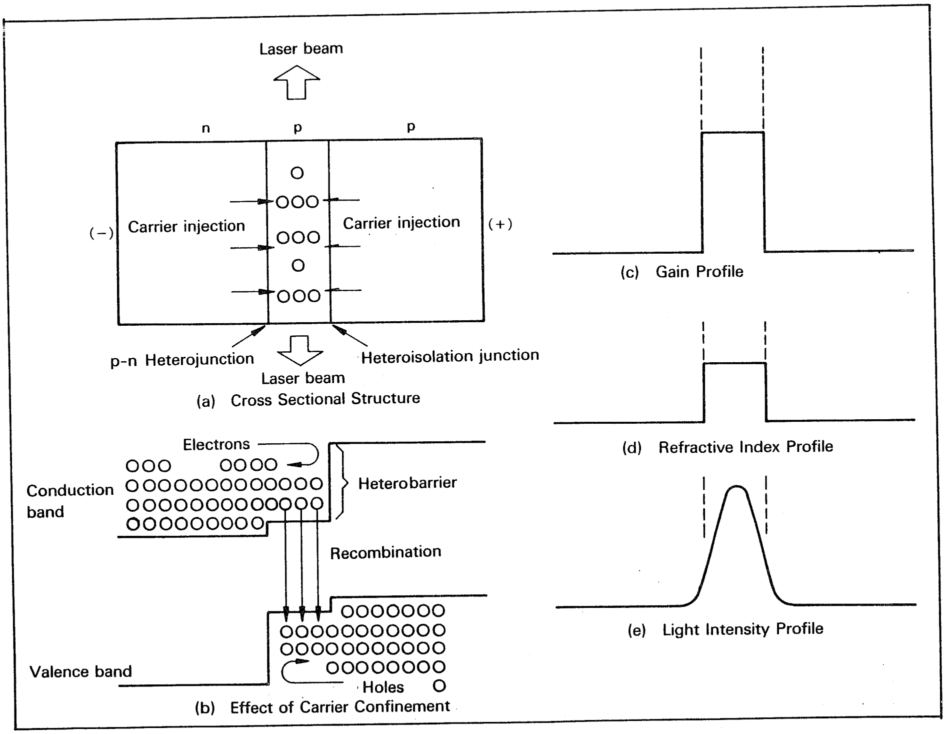


Figure IV-9. Operation Principles of Double-heterojunction LD

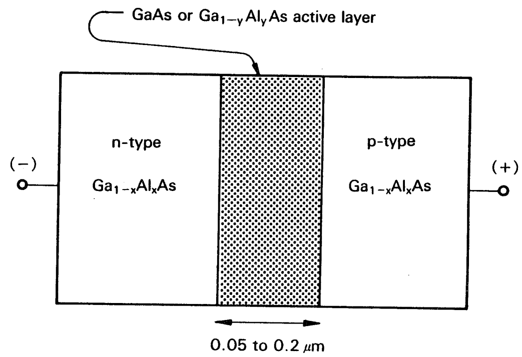


Figure IV-10. GaAlAs DH Structure LD

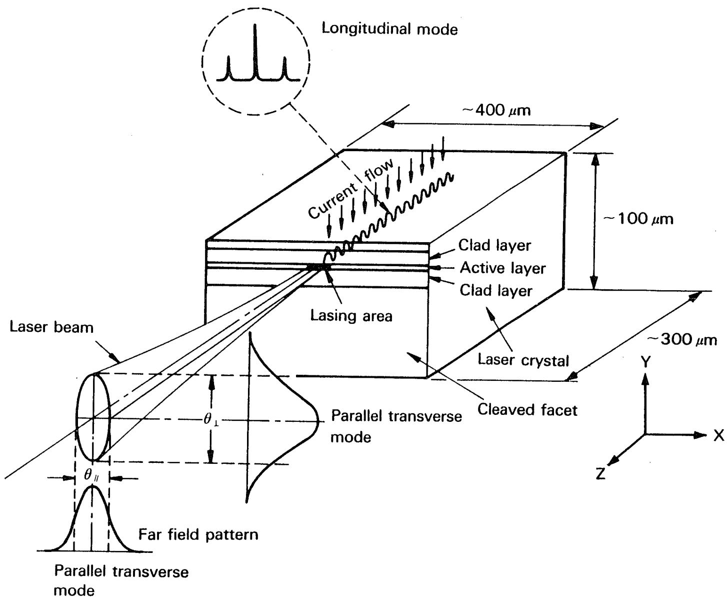


Figure IV-11. Lasing Mode of LD

Transverse mode expresses the condition of the perpendicular axis to the cavity length direction. And the transverse mode is devided into perpendicular transverse mode which is perpendicular to the active layer and parallel transverse mode which is parallel to the layer.

Longitudinal mode

Figure IV-12 shows that a standing wave of the half wavelength multiplied by an integer, q, forms in the direction of laser cavity length (z direction). When the refractive index of the medium is n and the wavelength in the vacuum is λ, the wavelength of light λ' is expressed as:

$$\lambda' = \lambda / n$$

So the half wavelength is expressed as:

$$\frac{1}{2}\lambda' = \frac{\lambda}{2n}$$

As described at the beginning, since the half wavelength multiplied by an integer, q, equals to the cavity length, L:

$$q \cdot \frac{\lambda}{2n} = L$$

For a semiconductor laser diode, when λ is 850 nm, n is 3.5 and L is 300 μm, q is about 2500. This q is referred as a mode number.

When a mode number, q, changes by 1, the wavelength change, Δλ, is expressed as:

$$|\Delta\lambda| = 0.34 \text{ nm}$$

Since a cavity length is incomparably longer than a wavelength, cavity resonance can take place at multiple wavelengths. The particular wavelength area where the cavity gain becomes maximum will then be chosen to have a stable standing wave.

In a semiconductor laser diode, when the temperature changes, the band gap energy changes then the wavelength where the maximum gain is achieved changes. As for the GaAlAs DH structure laser, this temperature coefficient is about 0.25 nm/deg. So the temperature rise makes the oscillation wavelength jump upward at intervals of Δλ (≈ 0.34 nm). The same phenomenon takes place because of temperature rise in the active layer when the injection current increases for the higher optical output power under the continuous operation (CW).

Perpendicular transverse mode

In a GaAlAs laser diode, the active layer is sandwiched by heterojunction (Fig. IV-13). Light is confined within the active layer because of the higher refractive index here than that of sandwiching layer GaAlAs, although it is a matter of some percents. The amount of light confined here depends on the thickness of the active layer. A thicker layer confines more light. On the other hand, light penetrates into the sandwiching layers in case of a too thin layer. The width of laser beam divergence depends on the thickness of an active layer and when it is 0.3 to 0.4 μm, the width becomes narrowest. At this width, the radiation angle of laser beam emitted from the cleaved facet becomes widest (Fig. IV-14). In general, in a semiconductor laser, the radiation angle of laser beam out of the device becomes very wide because the laser beam profile width in the device is the same as or less than the lasing wavelength. This is very the different characteristic from that of a conventional gas laser or solid state laser.

Parallel transverse mode

Waveguide must be formed by some means because there is nothing to guide light in the active layer in parallel to the junction. When the current injection is limited to a narrow enough region with a full cavity length, laser oscillation can then take place in the region (Fig. IV-11). Figure IV-15 shows the basic stripe structure which can limit current pass only.

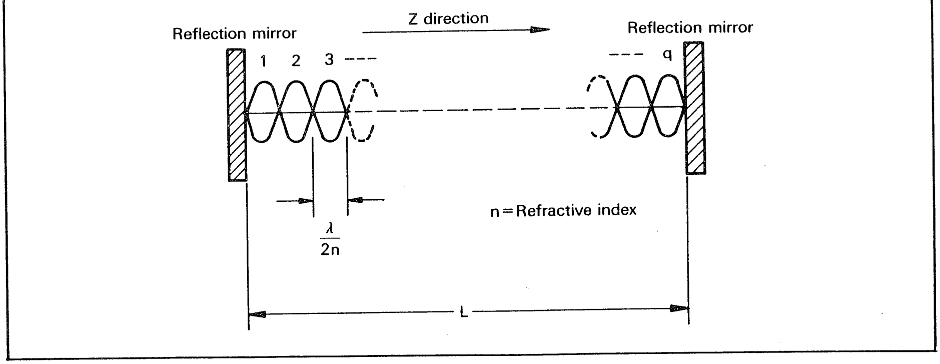


Figure IV-12. Longitudinal Mode of LD

In order to control the transverse mode more effectively, the refractive index profile or the optical loss profile should be built in structurally to the stripe structure additionally. Figure IV-16 shows examples of this structure.

Figure IV-16 (a) describes a CSP (channeled substrate planar) laser. Outside of the channel fabricated in the base, the light penetrated from the active layer reaches the base and suppresses the lasing due to absorption loss. Figure IV-16 (b) describes a BH (buried heterostructure) laser. In the both directions of perpendicular and parallel, the double-heterostructure is made.

These structural waveguides stabilize the single fundamental transverse mode. All of Hitachi LDs have the stable single transverse mode. A GaAlAs laser diode is described above.

HLP1000, HL7801, HL8311, HL8312 and HL8314 series employ basically the same material; GaAlAs. HLP5000 and HL1321 series employ InGaAsP in an active layer and InP in sandwiching layers, and the fundamental lasing principle and the lasing mode are the same as the former.

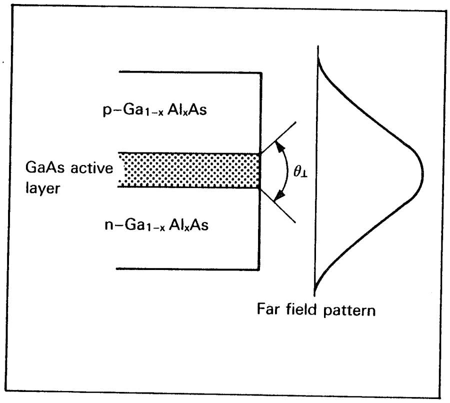


Figure IV-13. Perpendicular Transverse Mode

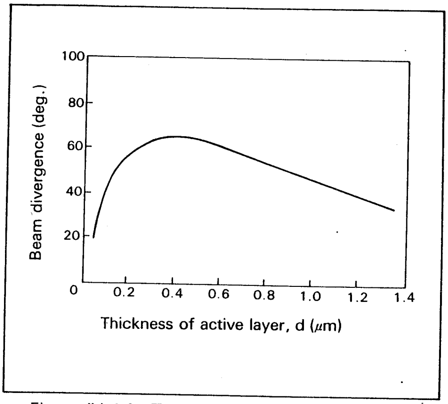


Figure IV-14. Thickness of Active Layer vs. Beam Divergence

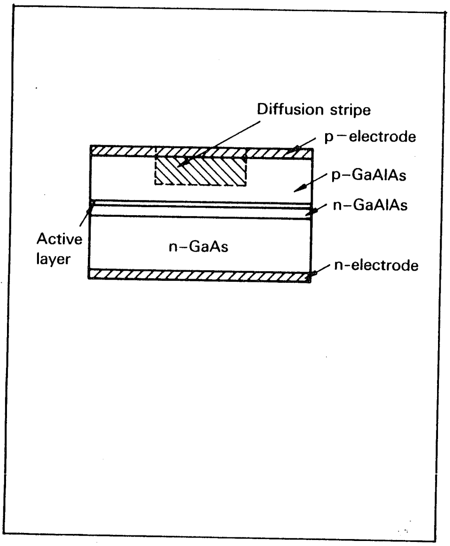


Figure IV-15. Basic Stripe LD

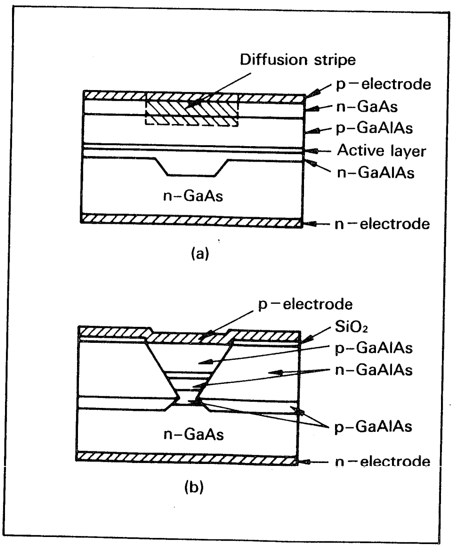


Figure IV-16. Stripe Lasers with Built-in Waveguide

4. Photodiode structures and characteristics

4.1 Si PIN photodiodes

PIN photodiodes are characterized by high quantum efficiency and a high-speed response under low voltage operations. To operate photodiodes at low voltages, it is necessary that impurities in the intrinsic layer be limited to the greatest extent possible, thus leading to a wide depletion region and a high light-absorption coefficient.

Hitachi Si PIN photodiodes achieve their depletion regions with less than a 5 V bias voltage. This is brought about Hitachi's high-purity epitaxy processes. A cross-section of Hitachi Si PIN photodiodes is illustrated in Fig. IV-17.

These photodiodes are sensitive over wavelength ranges from 450 nm to 1000 nm, and quantum efficiency at 830 nm is as high as about 70%. Figure IV-18 shows frequency response under conditions of 830 nm incident light, 50Ω load resistance and use of a network analyzer. As can be seen in this figure, a cut-off frequency of more than 300 MHz can be obtained at a 5 V bias voltage.

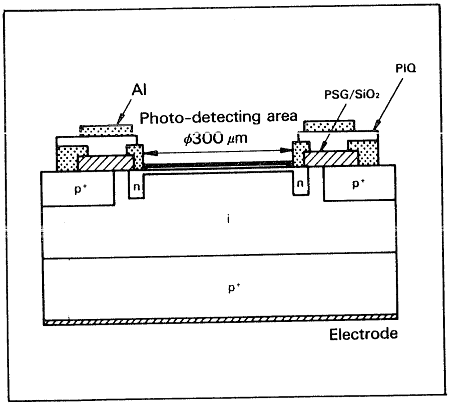


Figure IV-17. Si PIN Photodiode Structure

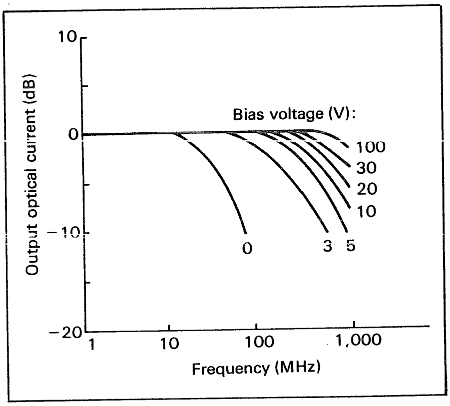


Figure IV-18. Frequency Response for Si PIN Photodiode

4.2 InGaAsP/ InP PIN photodiodes

To optimize InP compound semiconductors for photodiode use, a unique light absorption structure is employed to gain high quantum efficiency. This is necessary because the absorption coefficient of InP compounds is so large for light of greater than band gap energy.

Electron hole pairs also recombine and are annihilated easily when there are defects at the chip surface.

Hitachi InGaAsP/ InP photodiodes make use of a planar structure (Fig. IV-19). In them, incident light is absorbed into the InGaAsP layer through the InP diffusion layer.

The absorption edge of the InP has a wavelength of about 900 nm. Light with longer wavelengths can pass through the InP layer to the InGaAsP layer. One attractive characteristic of this structure is that the spectrally sensitive region can be set easily by changing the mixture ratio of the $In_{1-x}Ga_xAs_yP_{1-y}$ light absorbing layer.

Quantum efficiency is about 65% at 1300 nm when the spectrally sensitive region is set at 1000 nm to 1500 nm.

Frequency response is flat up to around 1 GHz. Thus, this area is suitable for signal detection use in high-speed fiberoptic transmission systems.

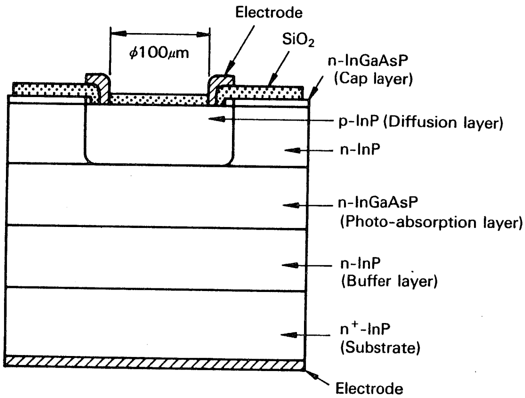


Figure IV-19. InGaAsP/InP PIN Photodiode Structure

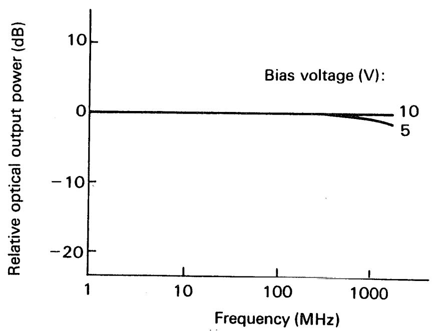


Figure IV-20. Frequency Response for InGaAsP/InP PIN Photodiode

V. Application hints

1. Applications of LDs

Laser beam is characterized by its excellent monochromacy, directionality, good collimation capability and coherency which gives much interference characteristics. In addition to these properties, semiconductor LDs have various advantages such as compact size, light weight, and capability of low voltage drive and direct high speed modulation. Laser technology is to control these properties in respect of time and space for LD applications.

Table V-1 shows application examples and applicable LD products.

Table V-1. LD Applications

Application fields		Applications	Features	Applicable products
Fiberoptic communications	Long distance	Telephone trunklines Undersea cables Terrestrial communications network	Low dissipation Wide bandwidth No cross talk Light weight	HLP5400 HLP5500 HL1221A HL1221B HL1321P HL1321SP HL1321AC HL1321DL HL1321BF HL1322A HL1341A/AC/FG HL1541A/AC/FG
	Short and intermediate distance	LAN CATV Data highway and freeway Subscriber lines Computer process control		HLP1500 HL1321P
Optical beam communications		Intersatellite communications Video data transmission	No radio wave interference	HL8312E/G HL8314E/G
Information terminal equipment		Laser beam printers	High-speed and high-resolution printing	HLP1400 HLP1600 HL7801E/G HL7802E/G HL7806G HL7838G HL8311E/G HL8312E/G HL8314E/G HL8315E
		POS terminals	Office automation	
		Optical disc memories	Semi-permanent storage High-bit-rate, high-density information	
Consumer equipment		Video discs		HL7831G HL7832G
		PCM audio discs	Wide dynamic range Excellent frequency performance	
Measuring equipment		Laser dust monitors	Compact size Light weight High precision	HLP1600 HL7801E/G HL8311E/G HL8312E/G HL8314E/G HL7806G HL7838G
		Precision surface inspection equipment	Non contact Non destructive inspection	
		Interferometers Spectrometers Distance meters Range finders Laser speedometers Laser current transformers	High precision Non contact	

1.1 Fiberoptic communications

The communication with optical fiber has the following advantages compared with the conventional coaxial cable.

(1) Higher bit rate and longer distance communication for its lower loss and wider bandwidth performance.
(2) Smaller diameter and lighter weight.
(3) Free from electroinductive noise from high voltage transmission line or thunderbolt.
(4) Free from spark, electric shock or heat when fiber is broken.
(5) Potential cost advantage and material saving in future.

Various applications have materialized up to now for these advantages. The transmission loss of fiber mostly depends on the amount of water component (OH radical) included in the silica glass as impurity. Figure V-1 shows the typical transmission loss characteristics of a silica fiber vs. wavelength. The fiber at the early stage of development had its high absorption peaks of OH radical in 0.9 μm to 1.7 μm range and the minimum transmission loss in 0.8 μm band. The wavelength area in which the transmission loss becomes least is referred to as a fiber window. Major efforts in the research and development have been concentrated to minimize the transmission loss and the fiber window has been widened to achieve transmission loss of 2 to 3 dB/km in 0.8 μm band.

Further progress of the purification technology of a silica fiber achieved transmission loss minimization which made it very close to the theoretical curve as shown in Fig. V-1.

Hitachi HL1321 and HLP5000 series are developed to utilize 1.3 μm window, and they are the most suitable for high bit rate and long distance fiber communications.

Fiberoptic transmission falls into two signal patterns: the analog system and the digital system. Analog transmission equipment such as VHF or IF band TV signal and base band picture signal strongly requires wide band width, low noise and low distortion. Therefore, extremely good linearity of light output characteristics is required against a light signal source. On the other hand, the digital transmission system has various modulation methods and can easily achieve the bit error rate of 10^{-9} bit/sec. This transmission system can realize far higher transmission quality than the conventional coaxial cable system by four or five digits.

Long distance transmission may need a repeater. Figure V-2 shows the block diagram of the repeater for digital system. The feedback loop controls the laser driver, which compensates fluctuation of LD output power. A circuit to compensate non-linearity of LD may be added for analog modulation.

The wavelength division multiplexing (WDM) system which adopts the multiple wavelengths for one fiber is commonly used to increase transmission capacity at low cost. The WDM system is widely spreading not only for public subscriber line but for long distance terrestrial trunk line and intercontinental communications. As advancement of network systemization, frequency division multiplexing against a specific wavelength which is referred to as super division multiplexing will be required further.

The problems with the analog modulation systems are distortion and noise due to the non-linearity of a light signal source as described before.

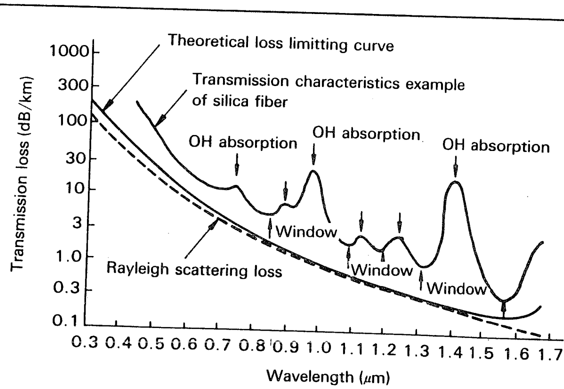


Figure V-1. Transmission Loss of Typical Fiber

These problems, however, do not arise unless direct amplitude modulation is applied to a light source. An applicable method is to pre-modulate carrier frequency with pulse signals in a preceding electric circuit and to carry out only pulse transmission in an optical signal processor. PPM, PIM, PFM, PWM and others are available for pre-modulation and contribute to extend the bandwidth of communications systems.

1.2 Optical printers

Laser beam printers were commercialized for the computer off-line printer. Printing speed of 10,000 to 18,000 lines per a minute is achieved, using a HeCd or HeNe gas laser as a light source and electrophotography technique. Office automation equipment developing rapidly these days need such a printer as can print out with high quality and high speed. Responding to this requirement, use of LD is becoming more popular, which realizes printers of compact size, light weight, high speed operation and low energy consumption.

Figure V-3 shows the principle structure of laser printer system. After LD drive current is modulated with recording signals, a Polygonal mirror or

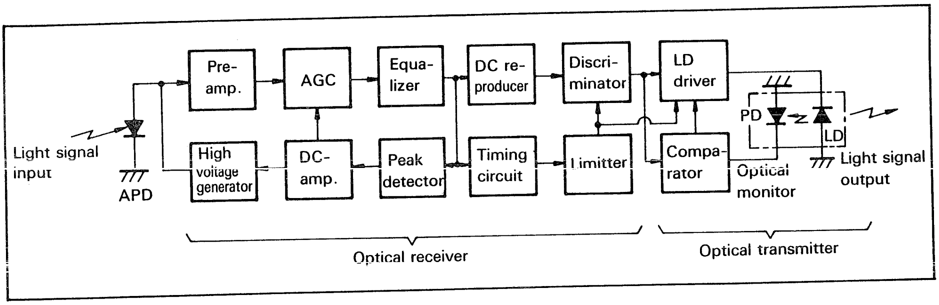


Figure V-2. Block Diagram of Repeater for Digital System

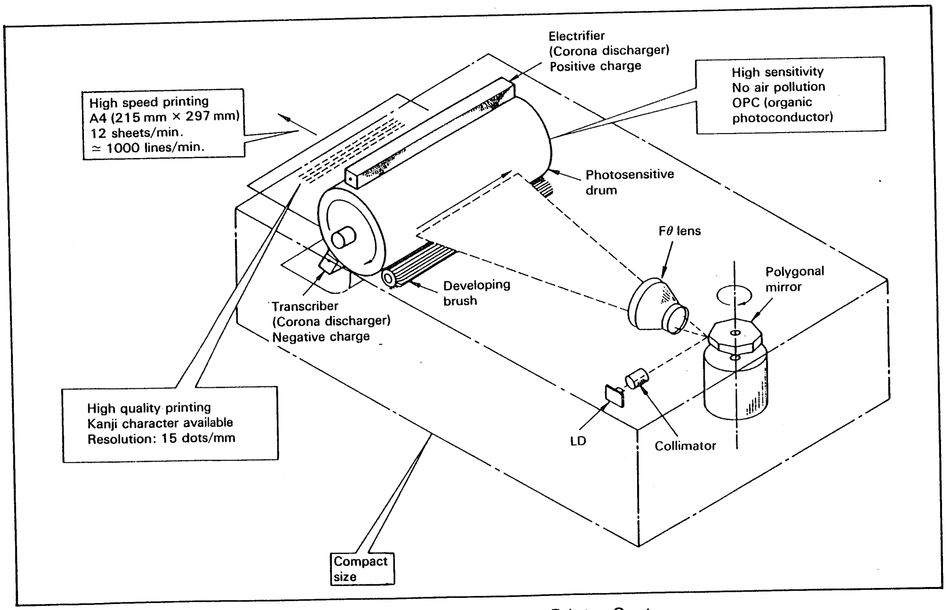


Figure V-3. Structure of Laser Printer System

Galvano mirror scans laser beam horizontally to the photosensitive drum which spins with constant speed and forms a kind of electrostatic latent image on the drum. The surface of the photosensitive drum (an insulator) is charged with positive electricity initially by the corona discharge method. Then negative electricity is charged between a conductive substrate and an insulator. After the surface electricity is discharged by alternative electric field applied, the resistance of the area where laser beam is applied lowers and electricity discharges. This is electrostatic latent image, developed by adhering toner (colored particles charged with opposite electricity) to the area of charged surface. Then the image is printed secondarily to a paper by corona discharge and settled by pressure and heat. This is the procedure of printing.

An organic photoconductor is usually used as a photosensitive medium whose spectro-sensitivity is higher at shorter wavelength. Therefore, development of LD with short wavelength and improvement of a photosensitive medium with good spectro-sensitivity at longer wavelength are two areas of key technology.

High power LDs, HL8311 (15 mW), HL8312 (20 mW) and HL8314 series (30 mW) at 830 nm, and short wavelength LDs, HL7801 and HL7806 (5 mW) and HL7802 series (10 mW) at 780 nm are available for this application.

1.3 Optical disc memory systems

The optical disc memory systems write and read data with a laser beam focused to a spot of 1 to 2 μm dia. through optics. This minute spot corresponds to one bit. The one side of a 30 cm LP size disc can record 10^{10} to 10^{12} bits (10 Gb to 1000 Gb). An optical disc system includes DRAW (direct read after write) system developed mainly for computer terminal equipment and audio disc and video disc systems for commercial use. The optical discs are formed with the acrylic resin coated with Al and Te, etc., and are written with heat of focused laser beam. The system does not have rewriting capability. Optothermal magnetic recording system is under intensive research and development for the rewritable optical disc memories.

PCM digital audio discs and video discs

A digital audio disc is standardized to a compact disc (CD) type and equipment is widely commercialized. Figure V-4 shows optics of CD system with tracking function. At the information signal pickup, tracking deviation and defocusing are also detected, then each signal is led into a servo control circuit. A coupling lens collimates laser beam to parallel beam. The $\lambda/4$ wave plate turns the poralization direction by 90 degrees. When the laser beam hits a pit, the reflected light interfers each other and is diffracted to the outside of the aperture of an objective lens, resulting in decrease of the light amount which returns to a lens. When the laser beam hits a mirror facet (concave portion), all the light reflect to return to the inside of the aperture and enter the detecting system. A polarized beam splitter leads the beam reflected from a mirror facet to a photodetector through a lens. In CD system a program source is sampled at 44.1 kHz and encoded with 16 bit linear quantization then recorded on a disc as a chain of pits. The source information is reproduced by reversing this order, using a 16 bit D-A converter, a sample-holder and a bit error correction LSIs. An LD couples strongly with reflection objects located within a matter of some cm such as a disc surface forming an external cavity, which brings reflection light back into the laser cavity and causes fluctuation of lasing mode and optical output power. The phenomenon is referred to as SCOOP (self-coupled optical pickup) noise and enough care as well as for mode hopping noise is required on designing player equipment. Hitachi HL7831G realizing low noise level is suitable for this application.

A video disc system handles analog signals, on the other hand, length of a pit on a disc corresponds to analog signal amplitude, unlike the pit of CD which expresses "1" or "0" as a chain of pits. A video disc needs much tighter noise level by 20 to 30 dB compared with CD, because of its wide signal bandwidth of 1.7 to 9 MHz. Hitachi

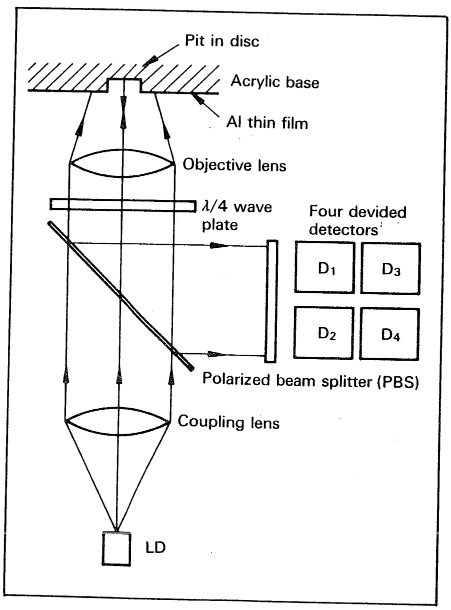


Figure V-4. Optics of CD System

HL7832G with extremely low noise level is suitable for use in optical video disc system use.

The family tree chart of optical memory system is shown in Fig. V-5 as an example.

An office video disc has basically the same functions as for home use. It has been enforced usually with microcomputer softwares to have more versatile features such as random access still pictures or their programmed display. It is going to be widely accepted by information service markets of education, fashion product marketing and others.

Image file and computer memory disc systems

Expected relative positioning of various memory systems is shown in Fig. V-6 on cost per bit vs. access time. The optical disc memory system is located in lower cost region by about 3 digits than the magnetic system. This is because the memory density which is now about 10^{10} bits achieved is higher by this figure. It means that a single side of a 30 cm LP size disc can record or memorize enormous information of about 50,000 tracks or 10,000 sheets of A4 size (215 × 297 mm²) still pictures. On writing signals, beam of 15 to 25 mW focuses to a spot of 1 to 2 μm dia. through a lens and a disc surface can obtain optical power of 8 to 10 mW. On reading signals, the pickup system similar to that for other optical disc system is employed with about 1 mW of focused beam power.

Figure V-7 shows the document filing system using an optical memory disc system and a laser beam printer. Since the present general trend is to minimize the bulky papers especially in offices where huge volume of information is handled, the document filing system is getting much footlights.

Hitachi LDs, HL8311, HL8312, HL8314 and HL7802 series are recommended for read and write and HL7831 series for read only.

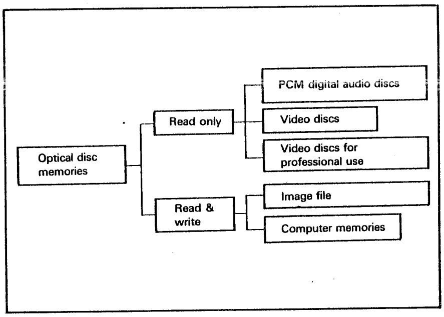


Figure V-5. Family of Optical Memory Disc System

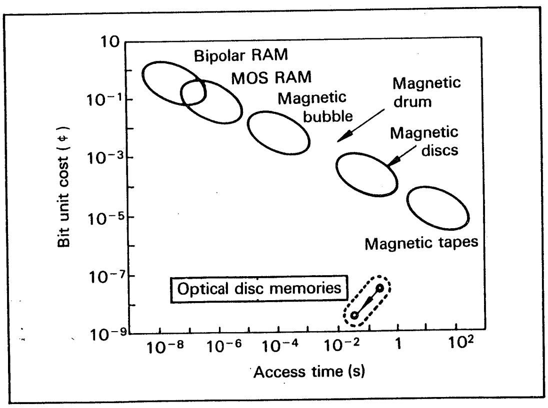


Figure V-6. Access Time vs. Bit Unit Cost of Various Memories

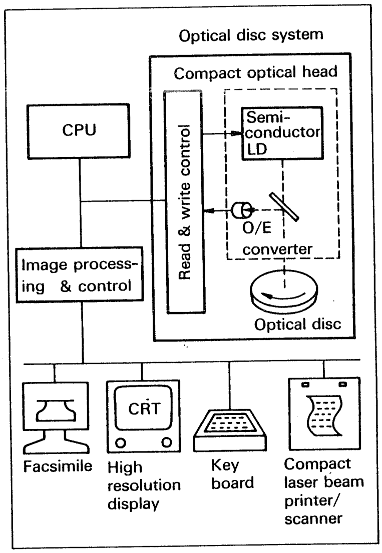


Figure V-7. Document Filing System

HITACHI

1.4 Measuring and control equipment

Various measuring equipment using laser beams are commercialized. Most of them require rather high output power and the use of LD is limited due to its relatively low power output. So LD application started from the field where the LD's advantageous characteristics of compact size, high efficiency and coherency are best utilized.

Distance meters

Figure V-8 shows the principle of a light-wave distance meter using modulated light. Distance is computed with detected phase difference between the radiated light and the reflected light. Measurement error depends on the wavelength of signal light, modulation frequency and temperature change.

A range finder, which measures a distance to a target such as a moving object, geographical features and a building, penetrates into markets because of the LD's advantages of compact size, light weight and high efficiency.

A high sensitivity photodetector is required to detect scattered weak light from objects because the corner mirror cannot be sometimes used for this kind of measurement.

High power LDs, HL8311, HL8312 and HL8314 series are recommended for this application.

2. Applications of IREDs

Hitachi IREDs have the advantages of high efficiency, high-power output, high-speed response and choice of variable emission wavelength from 760 nm to 1300 nm. And the availability of the ample package variations realizes applications for various kinds of systems.

Application examples and recommended products are described in Table V-2.

2.1 Fiberoptic communications

Fiberoptic communications have two methods to transmit data signals: the digital transmission method and the analog transmission method. And there are two methods to modulate light intensity with electric signals: the direct modulation method in which a light source device is driven with the modulation signals directly and the external modulation method in which constant optical output power from a light source is modulated through an external modulator.

Optical output power from an IRED changes proportionally with the drive current as shown in Fig. V-9.

The simplest analog transmission system with the direct modulation method is described in Fig. V-10. The electric circuit of a repeater needs amplification function only in this system. However, the linearity of a light signal source becomes an important factor. For the nonlinearity distortion level required for analog communications, the second nonlinearity distortion is over −45 dB and the third is over −55 dB in general. Hitachi IREDs meet these system requirements sufficiently.

A digital transmission system with a typical repeater complex with an equalizer, a discriminator and retiming function is described in Fig. V-11. Despite the fact that the electric circuit is complicated compared with the analog transmission system, transmission bandwidth is wider and more accurate information transmission capability in the digital transmission system is much advantageous. Efficient coupling of IRED optical output to fiber is extremely important in any of fiberoptic communiations systems.

HE8403 and HE1301 series designed to have a small emitting area to achieve highest frequency response and light intensity are highly recommended for fiberoptic communications.

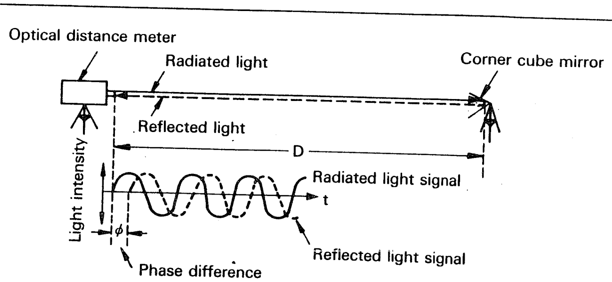


Figure V-8 Light Wave Distance Meter

Table V-2. IRED Applications

Application fields	Applications	Features	Applicable products
Fiberoptic communications (Short distance)	Data buses Links Computer links	Low dissipation Wide bandwidth No cross talk	HE8403R/SG/ML HE8811 HE8402F HE1301R/SG/ML
Optical beam communications	Space transmission optical repeater systems	No need of cable and pole No radio wave interference	HLP20R—60R HLP20RG—60RG HE8811
Information terminals	Facsimiles	Compact size High reliability	HLP20R—60R HLP20RG—60RG HE8811
Measuring equipment	Distance meters	High precision	HLP20R—60R HLP20RG—60RG HE8801 HE8805VG HE8806VG HE8807SG/SL HE8811
	Auto-focusing cameras	High precision	
	Alarm systems	Compact size No radio wave interference	
	Medical appliances	Compact size High reliability	
	Smoke detectors	No error High reliability	

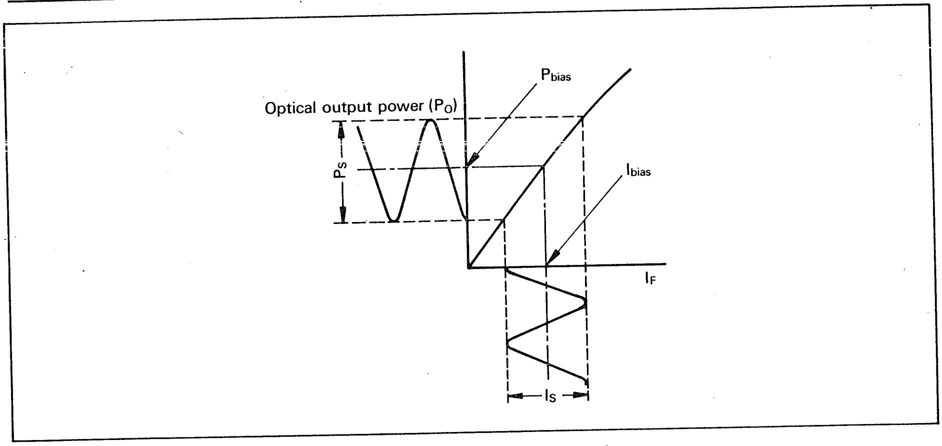


Figure V-9. Fiberoptic Communications

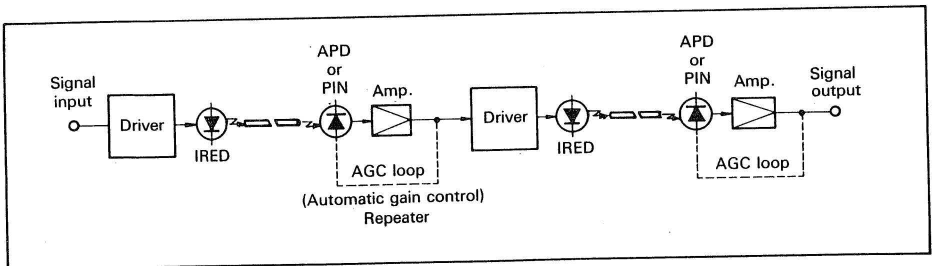


Figure V-10. Direct Modulation Method Analog Transmission System

2.2 Facsimiles

IREDs are also used as a light source to illuminate objects. High power capability with hemispherical chip surface of Hitachi IREDs enables it to be used as a light source of the reading head in information terminals such as facsimile equipment.

Figure V-12 shows the principle of a contact-type facsimile pick-up head. The sensor part (a pick-up head) of a contact-type facsimile consists of an IRED array (a light source), contact fiber, sandwiched fiber and a photodetector array. The emitted light from an IRED reflected at the original picture with some absorption input into a photodetector array sensor through contact fiber and sandwiched fiber then converted to electric signals. Vertical scanning information is picked up along with the direction of the original picture move and horizontal scanning information is picked up along with the direction of IRED and photodetector which are arrayed.

High power IREDs, HLP20 – 60 series and HE8801 are recommended for this type of application.

2.3 Autofocusing cameras

Autofocusing cameras are penetrating the market due to their easy-to-handle features with its autofocusing and shutter control functions. There are two methods of autofocusing: the one way is to use the reflected natural light from an object and the other is to use the reflected light from an object but emitted from the light source built in a camera. The light source built-in type camera causes no focusing error which often rises in the natural light system, because the light from the built-in light source hits the specified object and only the light reflected from the target is used to measure the distance. Figure V-13 describes the operation principle of an autofocusing camera with a built-in light source. The intensely modulated light is emitted from IRED mounted at the center of a camera then collimated by a lens and hits an object. The light scatters in all directions at the surface of the object then a part of it is received by photosensors through rotating lenses set at the both edges of the camera. When the reflected light from the object is focused to the photosensors through L_1 and L_2, the

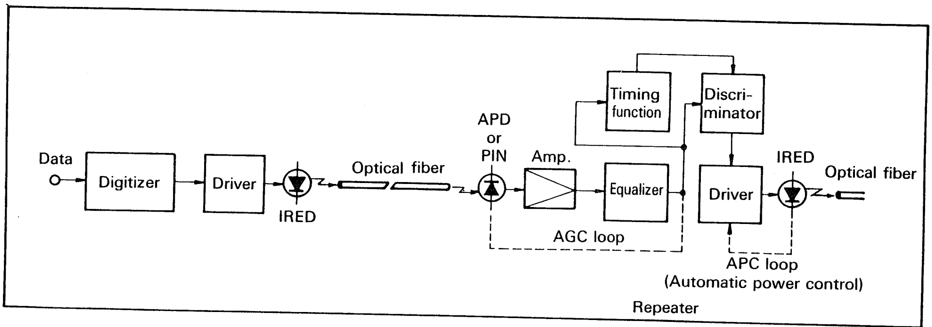


Figure V-11. Digital Transmission System

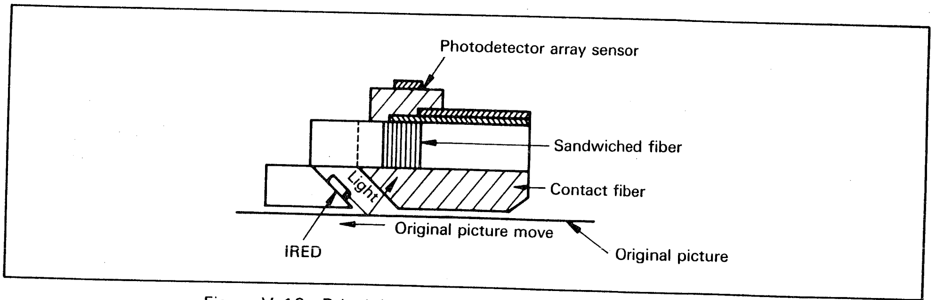


Figure V-12. Principles of Contact-type Facsimile Pick-up Head shutter of a camera is released.

Hitachi IREDs, HE8801, HE8805VG and HE8806VG are recommended for this type of application.

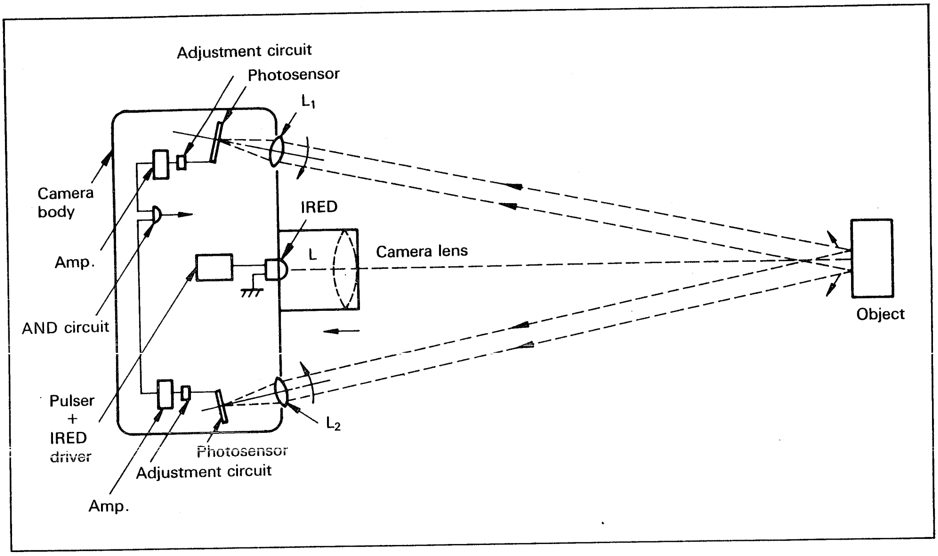


Figure V-13. Operation Principles of Autofocusing Cameras

Data Sheets

Laser Diodes

Product Lineup

Chips	Packages										
	A	AC	C	E	G	FG	B	P	SP	BF	DL
HL7801				HL7801E	HL7801G*						
HL7802				HL7802E	HL7802G						
HL7806					HL7806G						
HL7831					HL7831G						
HL7832					HL7832G						
HL7838					HL7838G						
HL8311/ HLP1000	HLP1400		HLP1600	HL8311E	HL8311G		HLP1500				
HL8312/ HL8315				HL8312E HL8315E	HL8312G						
HL8314				HL8314E	HL8314G						
HL1221	HL1221A	HL1221AC	HL1221C				HL1221B				
HL1321/ HLP5400	HLP5400	HL1321AC	HLP5600			HL1321FG	HLP5500	HL1321P	HL1321SP	HL1321BF	HL1321DL
HL1322	HL1322A	HL1322AC									
HL1341	HL1341A	HL1341AC				HL1341FG				HL1341BF	HL1341DL
HL1521	HL1521A	HL1521AC									
HL1541	HL1541A	HL1541AC				HL1541FG				HL1541BF	HL1541DL

* HL7801G package dimensions are different from those of other G-type products.

HL7801E

GaAlAs LD

Description

HL7801E is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

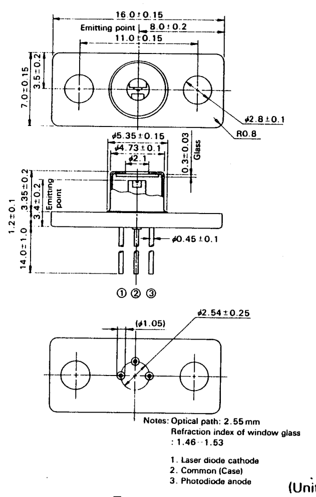
It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: $\lambda_p = 760-800$ nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As $= 2\ \mu$m typ.
- Small beam ellipticity: $\theta_{//} = 15$ deg., $\theta_{\perp} = 30$ deg. typ.
- Single longitudinal mode

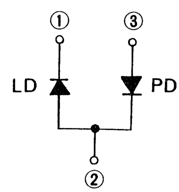
Package Dimensions



(Unit: mm)

E-type

Internal Circuit



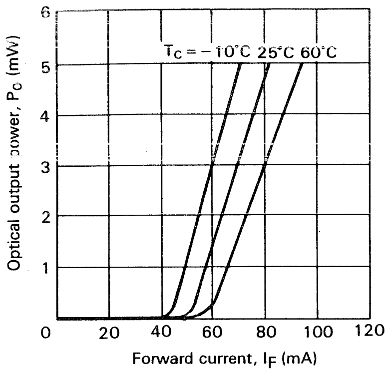
Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

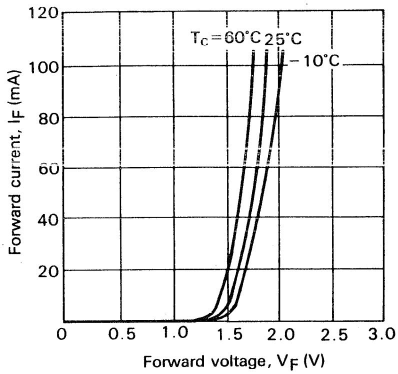
Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{3(\text{mW})}{I(4\text{ mW}) - I(1\text{ mW})}$
Lasing wavelength	λ_p	760	780	800	nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$	10	15	20	deg.	$P_O = 3$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	$P_O = 3$ mW
Monitor current	I_S	0.1	0.3		mA	$P_O = 3$ mW

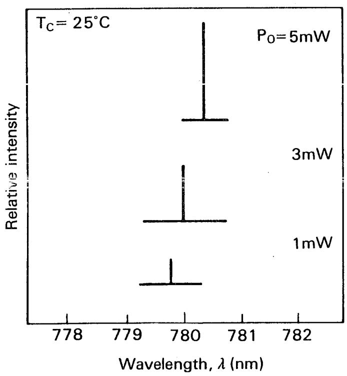
Optical Output Power vs. Forward Current



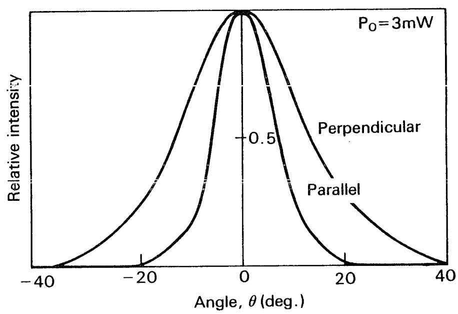
Forward Current vs. Forward Voltage



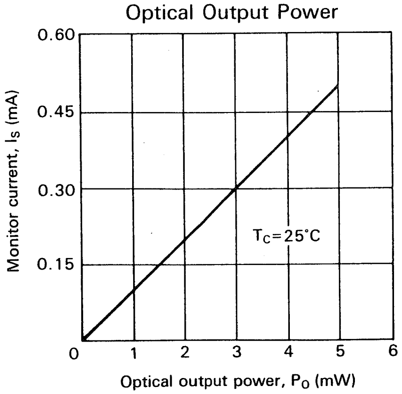
Lasing Spectrum



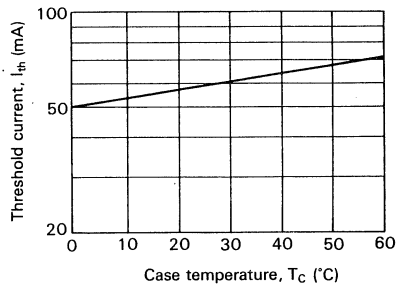
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL7801G
GaAlAs LD

Description

HL7801G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

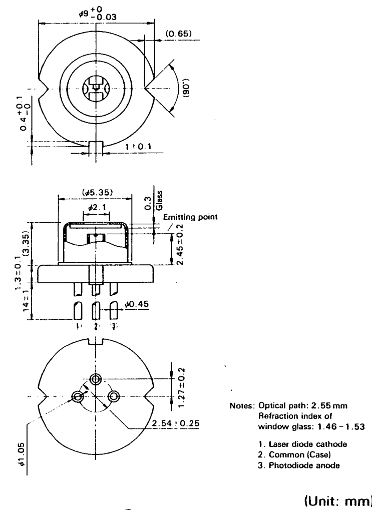
It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

Hermetic sealing of the package achieves high reliability.

Features

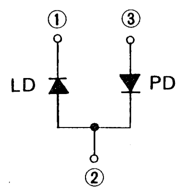
- Visible light output: λ_p = 760−800 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 15 deg., $\theta_{\perp}$ = 30 deg. typ.
- Single longitudinal mode

Package Dimensions



G-type

Internal Circuit



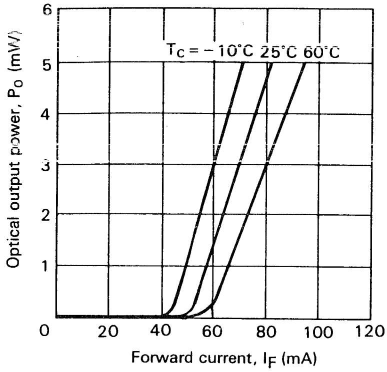
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

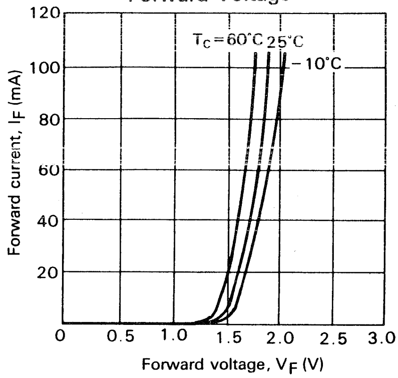
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{3(mW)}{I(4\ mW) - I(1\ mW)}$
Lasing wavelength	λ_p	760	780	800	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	10	15	20	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	P_O = 3 mW
Monitor current	I_S	0.1	0.3		mA	P_O = 3 mW

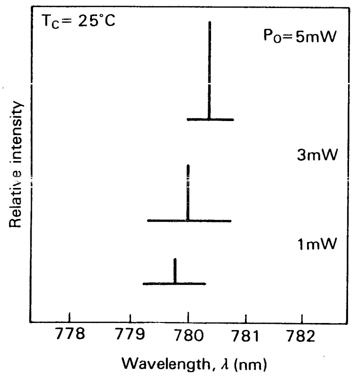
Optical Output Power vs. Forward Current



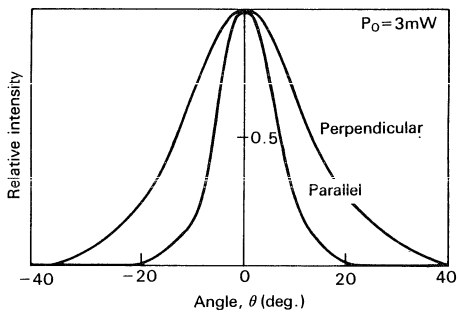
Forward Current vs. Forward Voltage



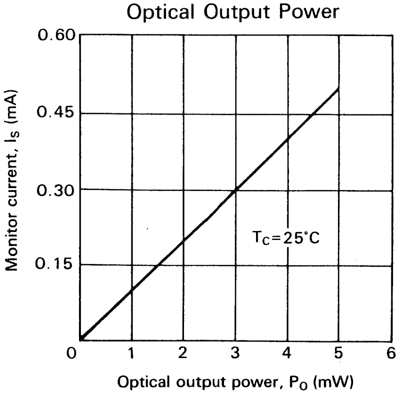
Lasing Spectrum



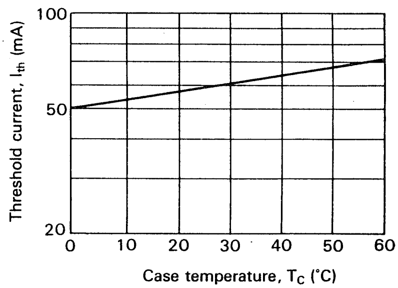
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL7802E

GaAlAs LD

Description

HL7802E is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

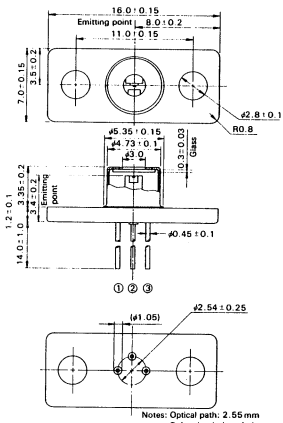
It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770−800 nm
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

Package Dimensions



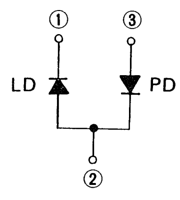
Notes: Optical path: 2.55 mm
Refraction index of glass window: 1.46−1.53

1. Laser diode cathode
2. Common (Case)
3. Photodiode anode

(Unit: mm)

E-type

Internal Circuit



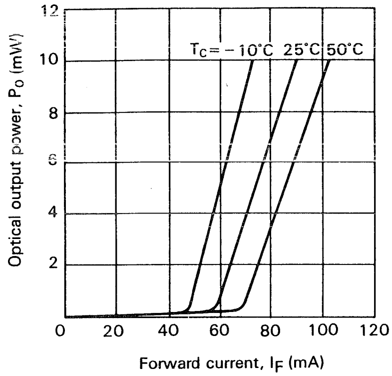
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

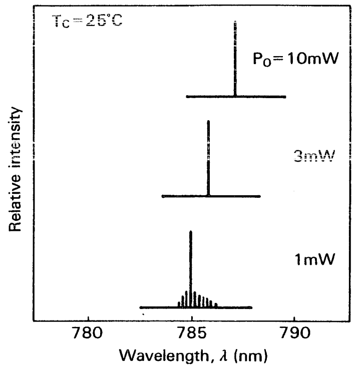
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	10			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{6 (mW)}{I(8 mW) - I(2 mW)}$
Lasing wavelength	λ_p	770	785	800	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	6	11	16	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	P_O = 10 mW
Monitor current	I_S	0.35			mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

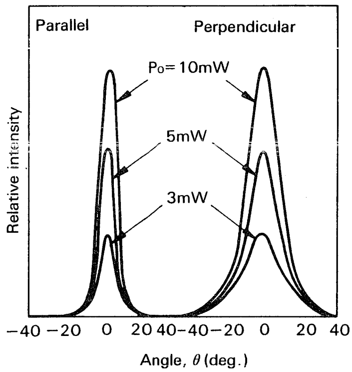
Optical Output Power vs. Forward Current



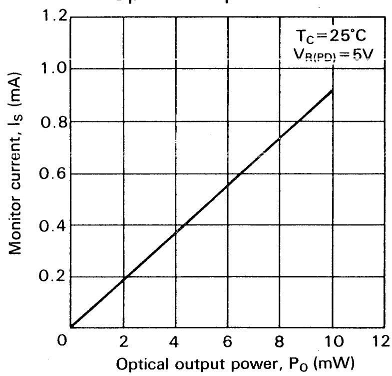
Lasing Spectrum



Far Field Pattern



Monitor Current vs. Optical Output Power



HL7802G

GaAlAs LD

Description

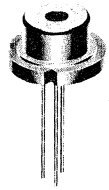
HL7802G is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

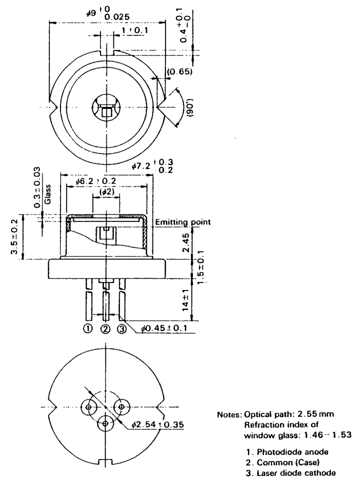
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: $\lambda_p = 770-800$ nm
- Built-in photodiode for monitoring laser output
- Single longitudinal mode



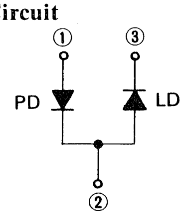
Package Dimensions



(Unit: mm)

G-type

Internal Circuit

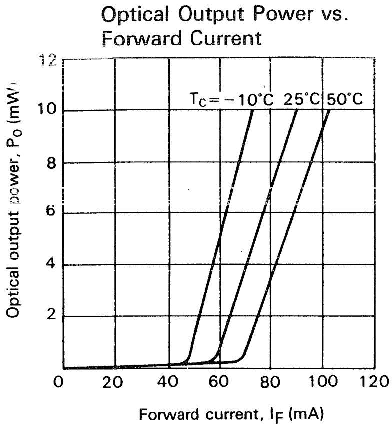


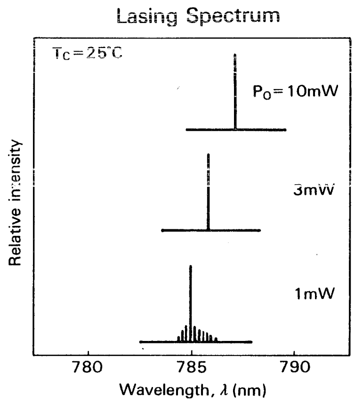
Absolute Maximum Ratings ($T_C = 25°C$)

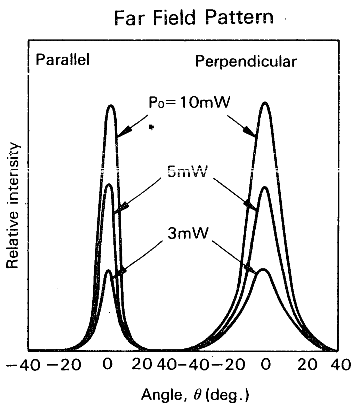
Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

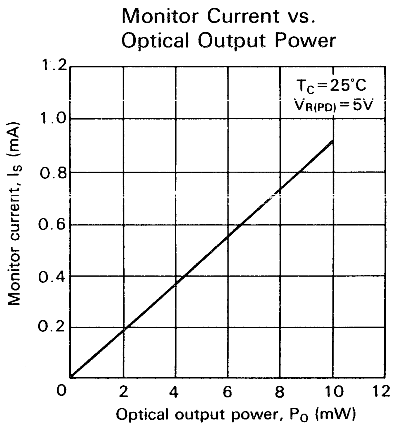
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	10			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{6(mW)}{I(8\ mW) - I(2\ mW)}$
Lasing wavelength	λ_p	770	785	800	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$	6	11	16	deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	$P_O = 10$ mW
Monitor current	I_S	0.35			mA	$V_{R(PD)} = 5$ V, $P_O = 10$ mW


Optical Output Power vs.
Forward Current
Optical output power, P_O (mW)
Tc = −10°C 25°C 50°C
12
10
8
6
4
2
0
20
40
60
80
100
120
Forward current, I_F (mA)


Lasing Spectrum
Tc = 25°C
Po = 10mW
3mW
1mW
Relative intensity
780
785
790
Wavelength, λ (nm)


Far Field Pattern
Parallel
Perpendicular
Po= 10mW
5mW
3mW
Relative intensity
−40 −20 0 20 40−40−20 0 20 40
Angle, θ (deg.)


Monitor Current vs.
Optical Output Power
Tc = 25°C
VR(PD) = 5V
Monitor current, I_S (mA)
1.2
1.0
0.8
0.6
0.4
0.2
0
2
4
6
8
10
12
Optical output power, P_O (mW)

HL7806G

GaAlAs LD

Description

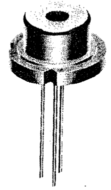
HL7806G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

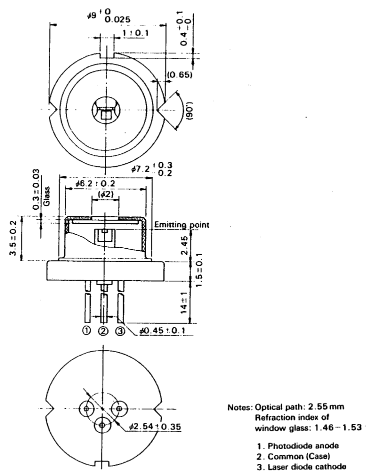
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 775−795 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 14 deg., $\theta_{\perp}$ = 27 deg. typ.
- Single longitudinal mode

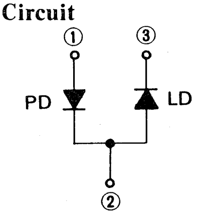


Package Dimensions



G-type

Internal Circuit



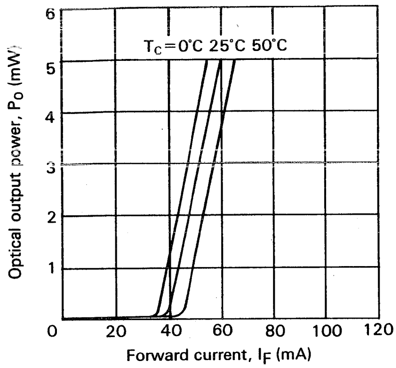
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

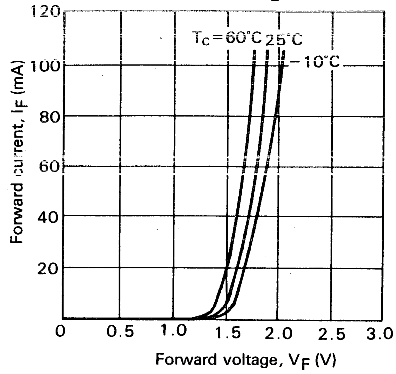
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.15	0.25		mW/mA	$\frac{3(\text{mW})}{I(4\text{ mW}) - I(1\text{ mW})}$
Lasing wavelength	λ_p	775	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	14	20	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	45	deg.	P_O = 5 mW
Monitor current	I_S	0.35	1.0	1.65	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW

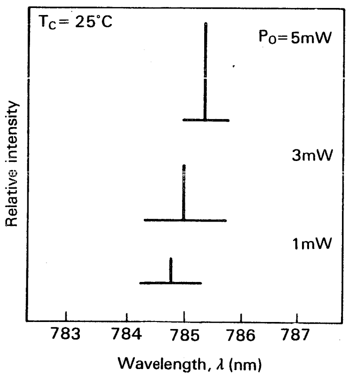
Optical Output Power vs. Forward Current



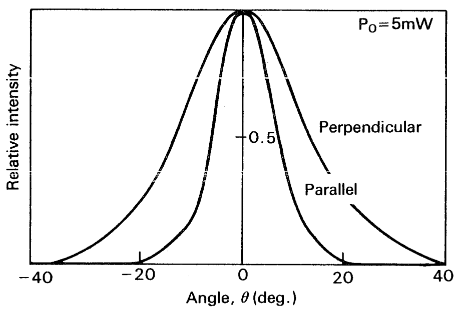
Forward Current vs. Forward Voltage



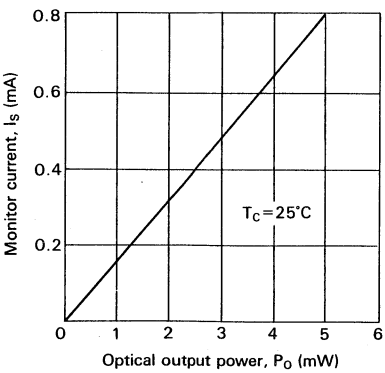
Lasing Spectrum



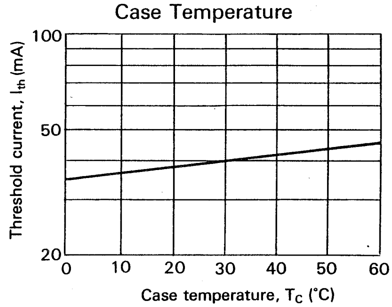
Far Field Pattern

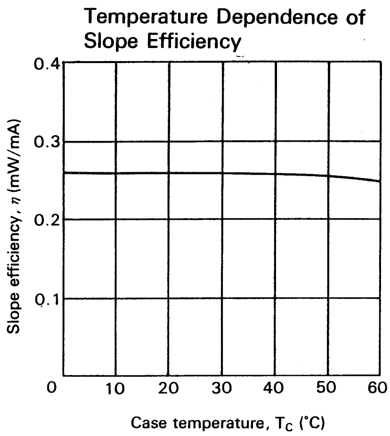


Monitor Current vs. Optical Output Power

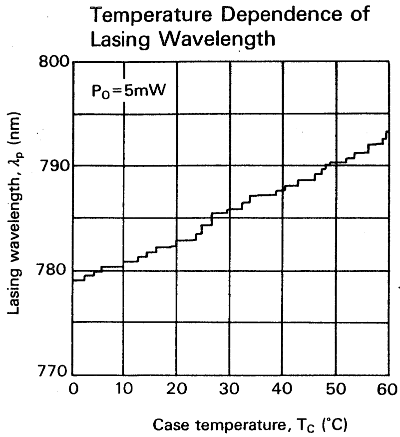


Threshold Current vs. Case Temperature





Temperature Dependence of
Slope Efficiency
Slope efficiency, η (mW/mA)
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
Case temperature, Tc (°C)



Temperature Dependence of
Lasing Wavelength
Po=5mW
Lasing wavelength, λp (nm)
800
790
780
770
0
10
20
30
40
50
60
Case temperature, Tc (°C)

HL7831G

GaAlAs LD

Description

HL7831G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

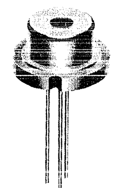
It is suitable as a light source in compact disc and optical video disc players and various other types of optical equipment.

MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

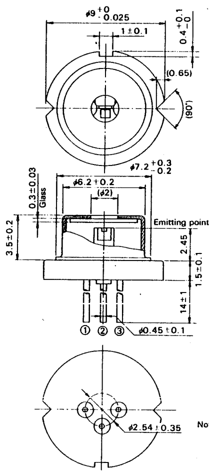
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770−795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 60 dB min.



Package Dimensions

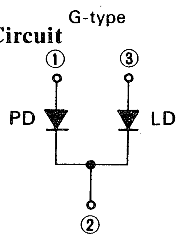


Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46−1.53

1. Photodiode anode
2. Common (Case)
3. Laser diode anode

(Unit: mm)

Internal Circuit



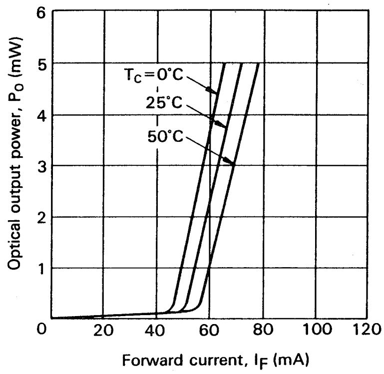
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

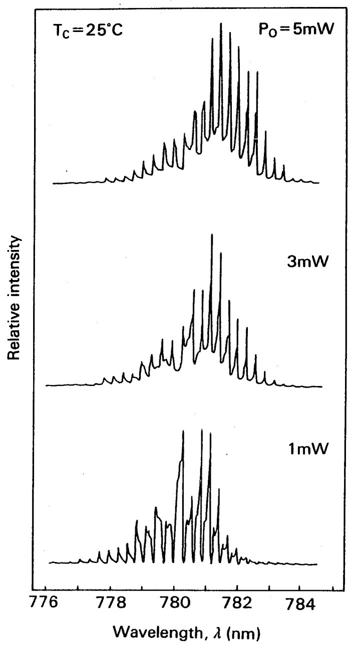
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3 (mW)}{I (4 mW) - I (1 mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	9	13	16	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	35	48	deg.	P_O = 3 mW
Monitor current	I_S	0.3	1.0	1.6	mA	$V_{R(PD)}$ = 5 V, P_O = 3±0.03 mW
Noise	S/N	60			dB	P_O = 3 mW, f = 750 kHz, Δf = 30 kHz

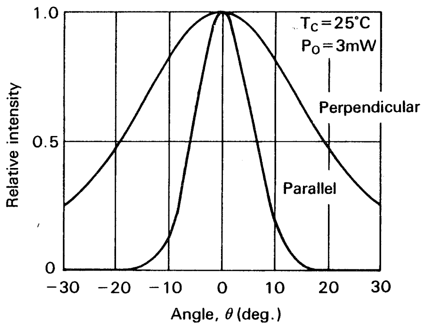
Optical Output Power vs. Forward Current



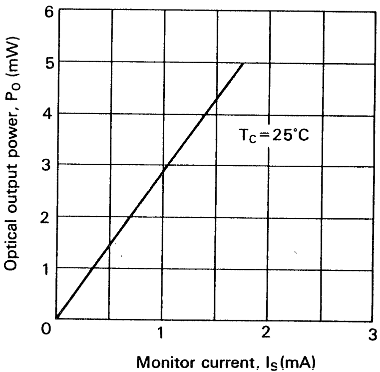
Lasing Spectrum



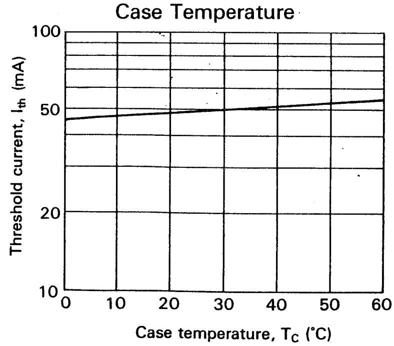
Far Field Pattern



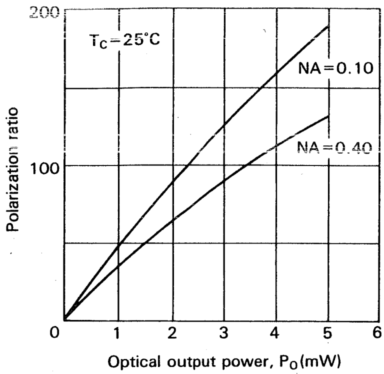
Optical Output Power vs. Monitor Current



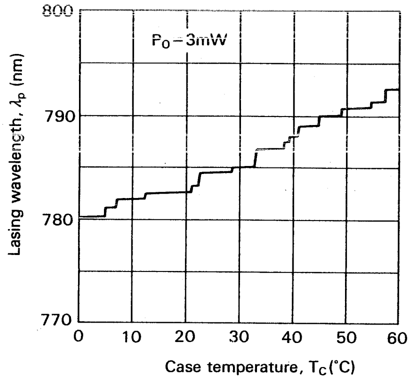
Threshold Current vs. Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



HL7832G

GaAlAs LD

Description

HL7832G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

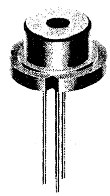
It is suitable as a light source in optical video disc players and various other types of optical equipment.

MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

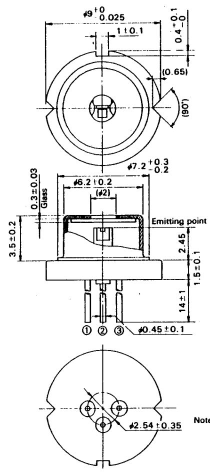
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770 – 795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 80 dB min.



Package Dimensions



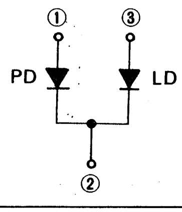
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53

1. Photodiode anode
2. Common (Case)
3. Laser diode anode

(Unit: mm)

G-type

Internal Circuit



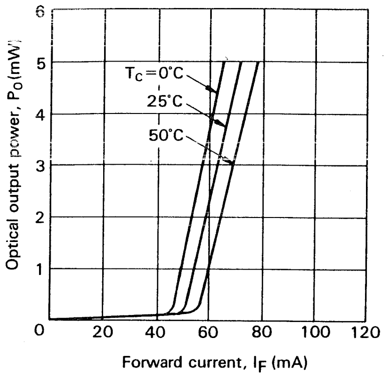
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

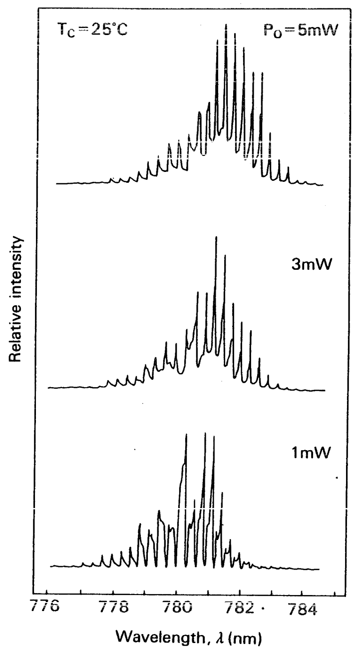
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3(mW)}{I(4\ mW) - I(1\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	13	16	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	35	48	deg.	P_O = 3 mW
Monitor current	I_S	0.3	1.0	1.6	mA	$V_{R(PD)}$ = 5 V, P_O = 3±0.03 mW
Noise	S/N	80			dB	P_O = 3 mW, f = 8 MHz, Δf = 100 kHz

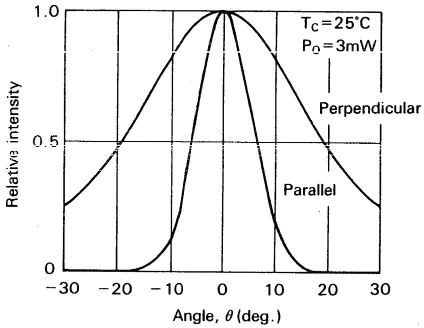
Optical Output Power vs.
Forward Current



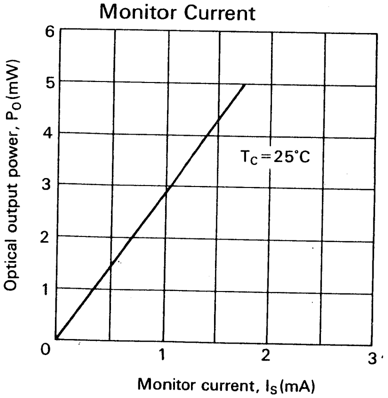
Lasing Spectrum



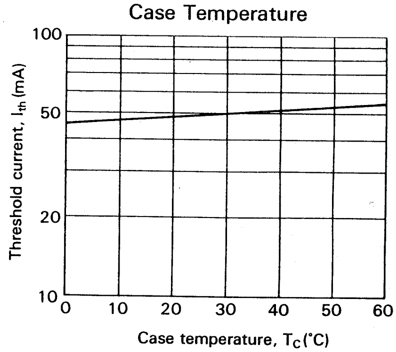
Far Field Pattern



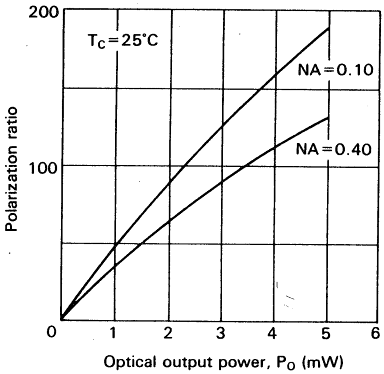
Optical Output Power vs.
Monitor Current



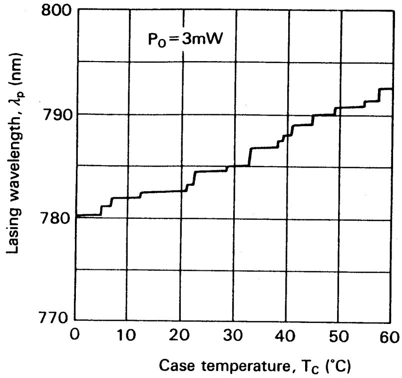
Threshold Current vs.
Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



HL7838G

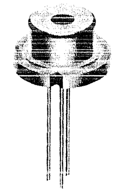
—Preliminary—
GaAlAs LD

Description

HL7838G is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers, optical disc memories and various other types of optical equipment.

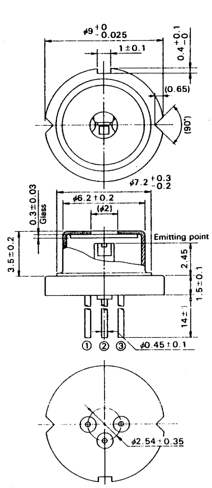
Hermetic sealing of the package achieves high reliability.



Features

- Visible light output: λ_p = 770—795 nm
- 20 mW (CW), 30 mW (pulse) operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

Package Dimensions

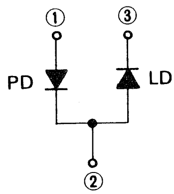


Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 1.53
1. Photodiode anode
2. Common (Case)
3. Laser diode cathode

G-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Pulse optical output power	$P_{O(pulse)}$	30*	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

*PW ≦ 1 μs, duty 50%

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}			80	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.3	0.45		mW/mA	$\frac{12(mW)}{I(16\ mW) - I(4\ mW)}$
Lasing wavelength	λ_p	770	780	795	nm	P_O = 20 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 20 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		26		deg.	P_O = 20 mW
Monitor current	I_S	0.3			mA	$V_{R(PD)}$ = 5 V, P_O = 20 mW

HL8311E

GaAlAs LD

Description

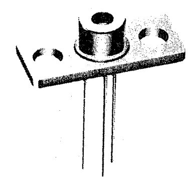
HL8311E is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

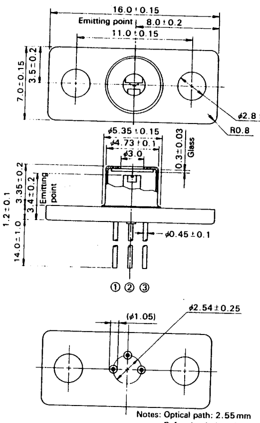
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800–850 nm
- 15 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leq$ 0.5 ns



Package Dimensions

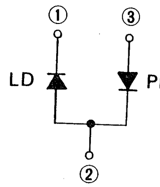


Notes: Optical path: 2.55 mm
Refraction index of glass window: 1.46–1.53

1. Laser diode cathode
2. Common (Case)
3. Photodiode anode

E-type (Unit: mm)

Internal Circuit



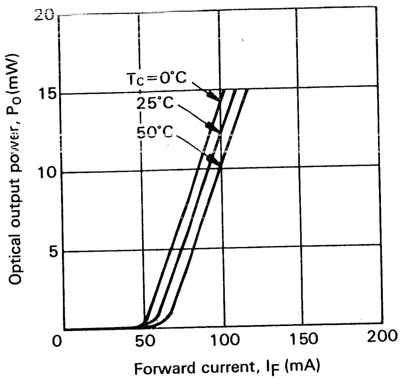
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

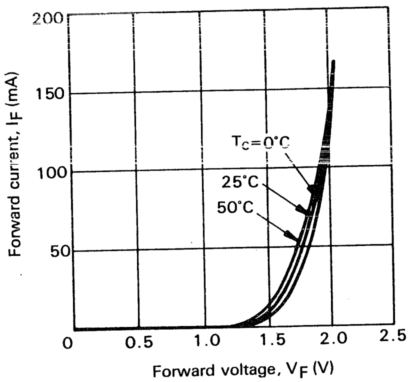
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{8\text{(mW)}}{I\text{(12 mW)} - I\text{(4 mW)}}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	P_O = 10 mW
Monitor current	I_S	0.2			mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

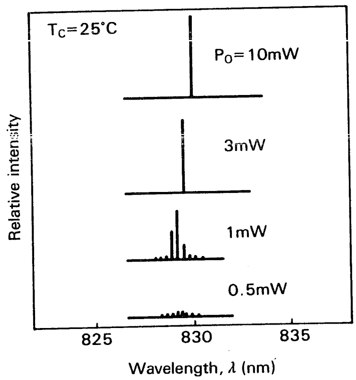
Optical Output Power vs. Forward Current



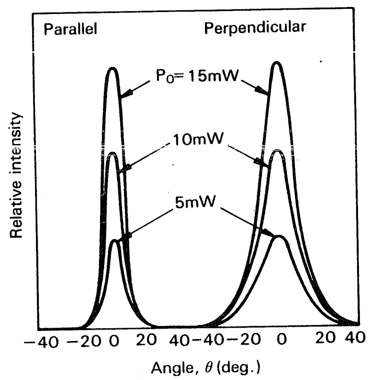
Forward Current vs. Forward Voltage



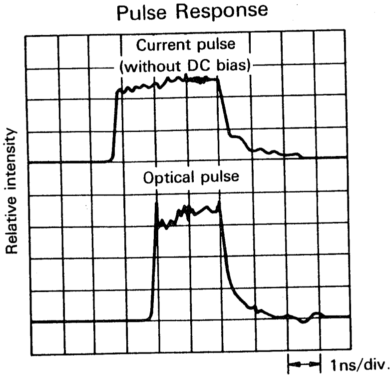
Lasing Spectrum



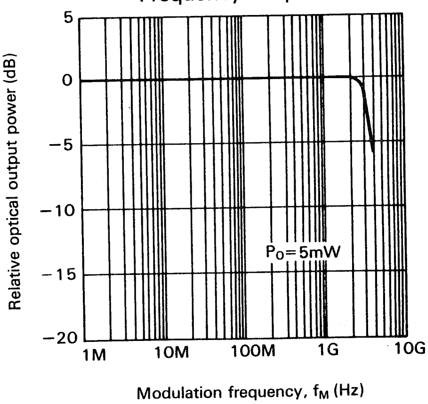
Far Field Pattern



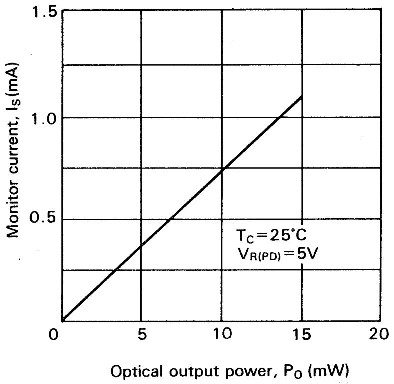
Pulse Response



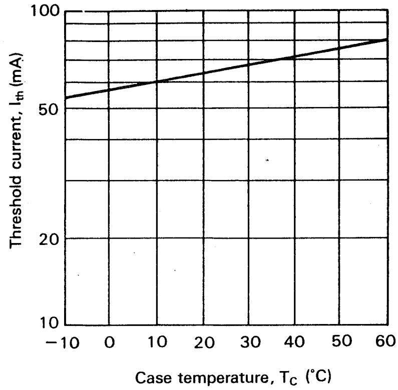
Frequency Response



Monitor Current vs.
Optical Output Power



Threshold Current vs.
Case Temperature



HL8311G

GaAlAs LD

Description

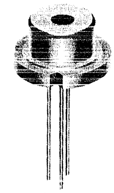
HL8311G is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

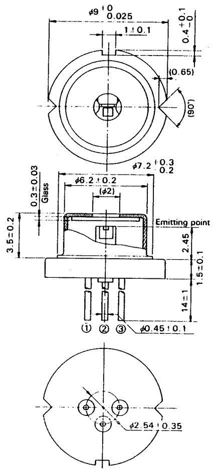
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800 – 850 nm
- 15 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, t_f ≦ 0.5 ns



Package Dimensions

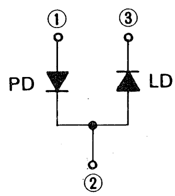


Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53
1. Photodiode anode
2. Common (Case)
3. Laser diode cathode

G-type

(Unit: mm)

Internal Circuit



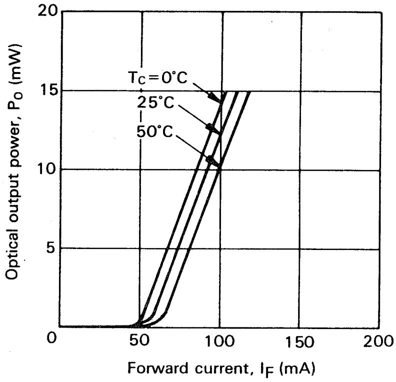
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

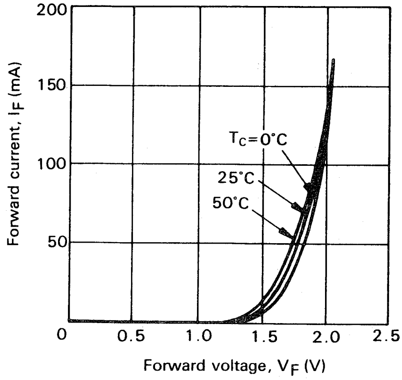
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{8(\text{mW})}{I(12\text{ mW}) - I(4\text{ mW})}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	P_O = 10 mW
Monitor current	I_S	0.2			mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

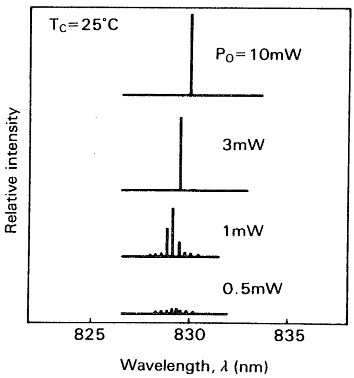
Optical Output Power vs. Forward Current



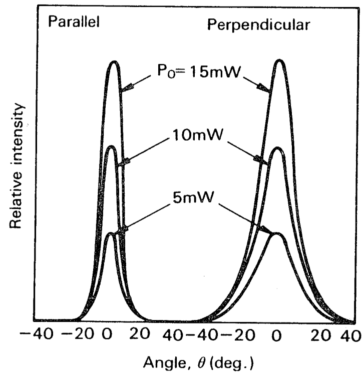
Forward Current vs. Forward Voltage



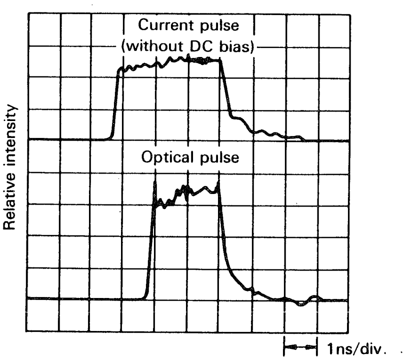
Lasing Spectrum



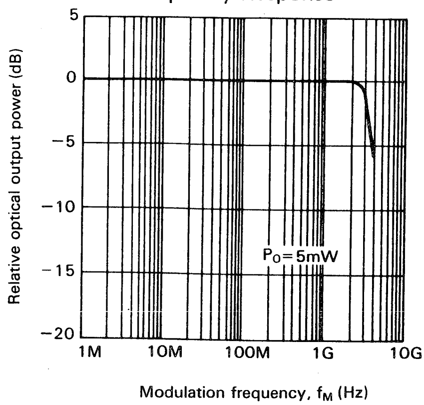
Far Field Pattern



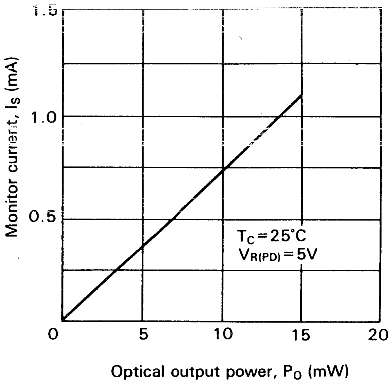
Pulse Response



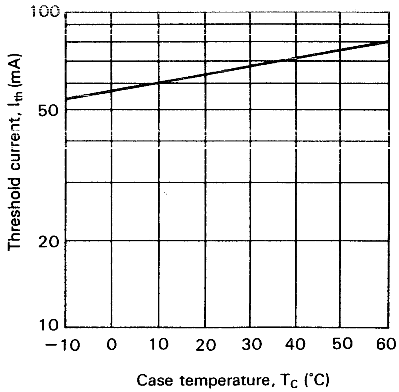
Frequency Response



Monitor Current vs.
Optical Output Power



Threshold Current vs.
Case Temperature



HL8312E

GaAlAs LD

Description

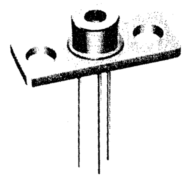
HL8312E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

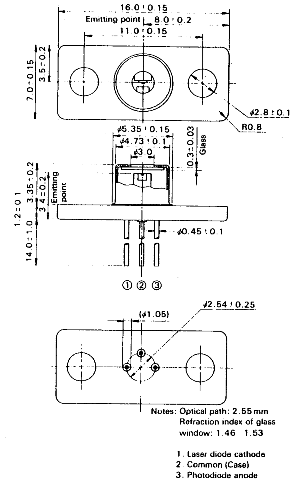
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: $\lambda_p = 810-850$ nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



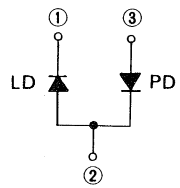
Package Dimensions



E-type

(Unit: mm)

Internal Circuit



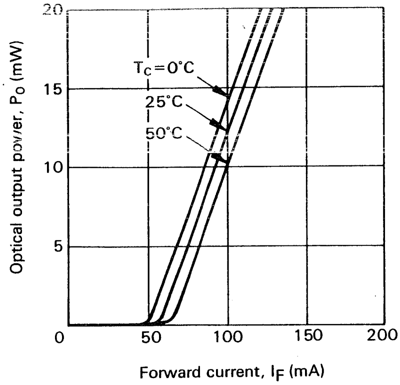
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

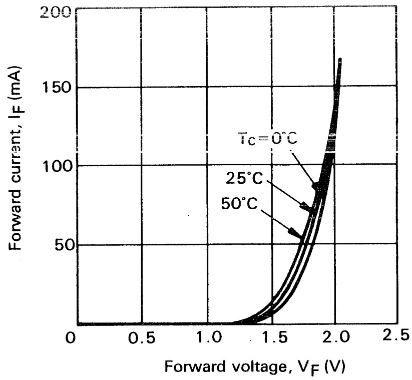
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{12(mW)}{I(16\ mW) - I(4\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	$P_O = 10$ mW
Monitor current	I_S	0.2			mA	$V_{R(PD)} = 5$ V, $P_O = 10$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

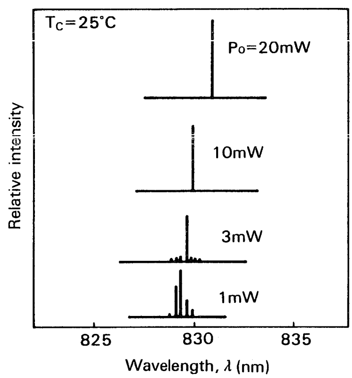
Optical Output Power vs. Forward Current



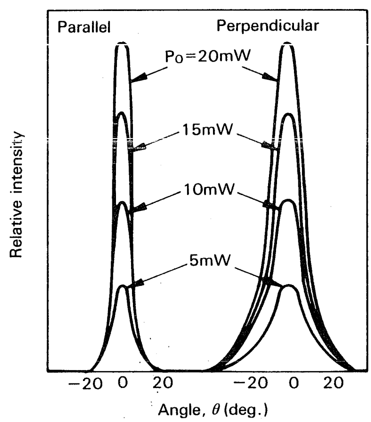
Forward Current vs. Forward Voltage



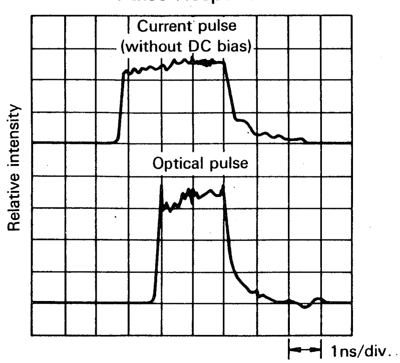
Lasing Spectrum



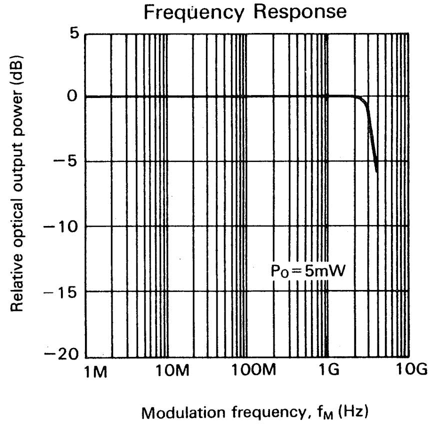
Far Field Pattern



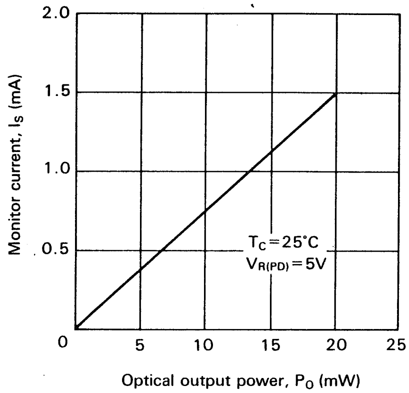
Pulse Response



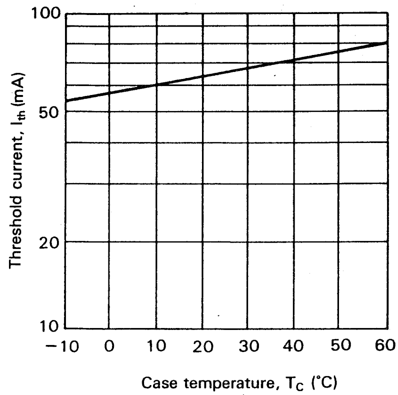
Frequency Response



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8312G

GaAlAs LD

Description

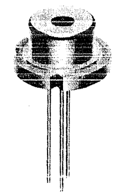
HL8312G is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

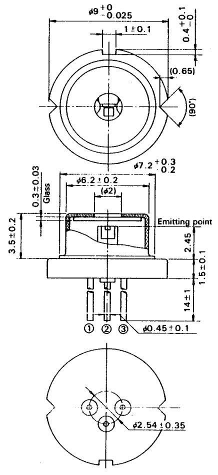
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: $\lambda_p = 810-850$ nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions



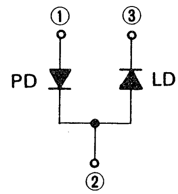
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53

1. Photodiode anode
2. Common (Case)
3. Laser diode cathode

(Unit: mm)

G-type

Internal Circuit



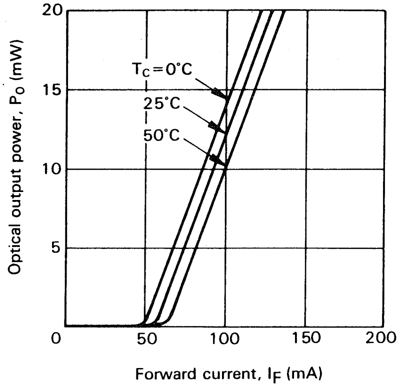
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

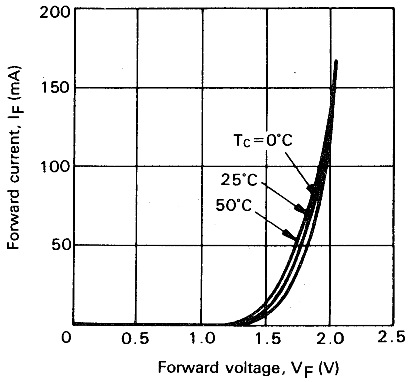
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{12(mW)}{I(16\ mW) - I(4\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	$P_O = 10$ mW
Monitor current	I_S	0.2			mA	$V_{R(PD)} = 5$ V, $P_O = 10$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

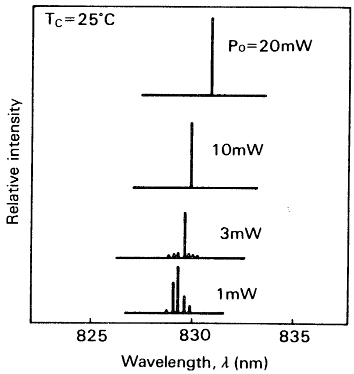
Optical Output Power vs. Forward Current



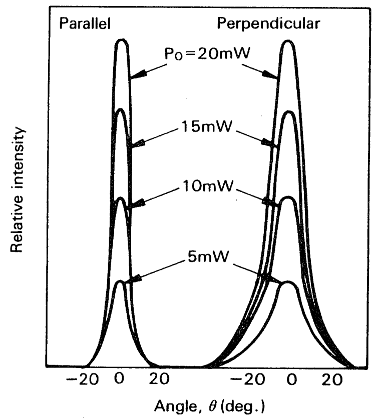
Forward Current vs. Forward Voltage



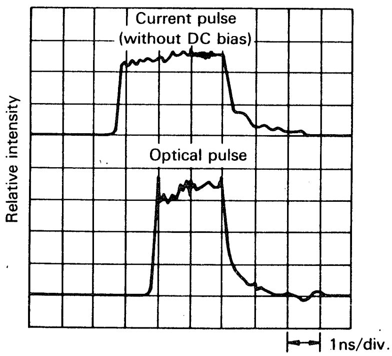
Lasing Spectrum



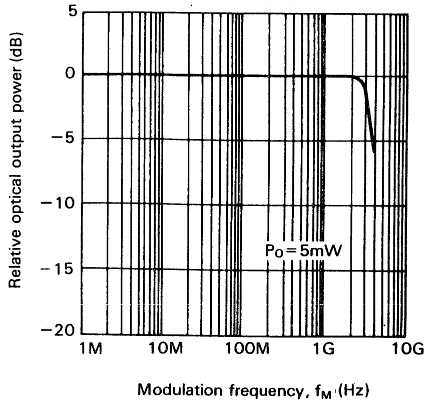
Far Field Pattern



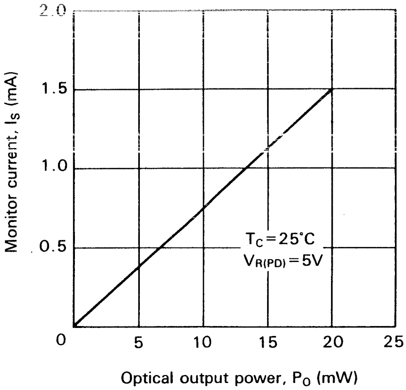
Pulse Response



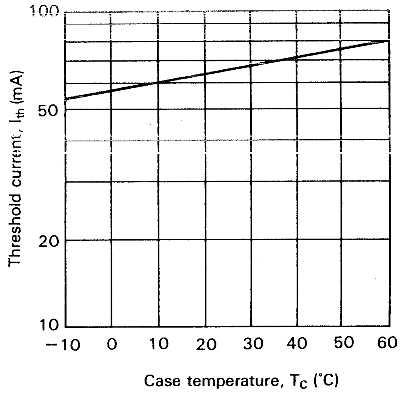
Frequency Response



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8314E

GaAlAs LD

Description

HL8314E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

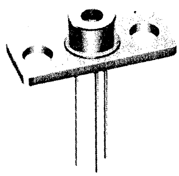
It is suitable as a light source in optical disc memories and various other types of optical equipment.

High power output is obtained through non-symmetrical coating technology for chip mirror facets.

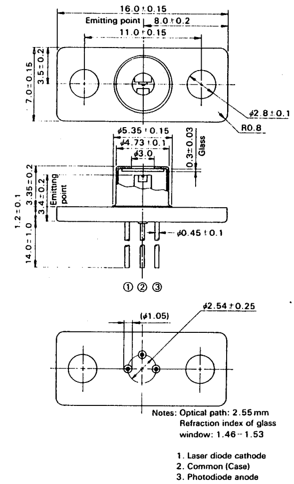
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810−850 nm
- 30 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, t_f ≦ 0.5 ns

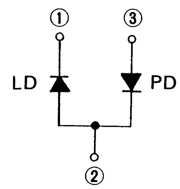


Package Dimensions



E-type (Unit: mm)

Internal Circuit



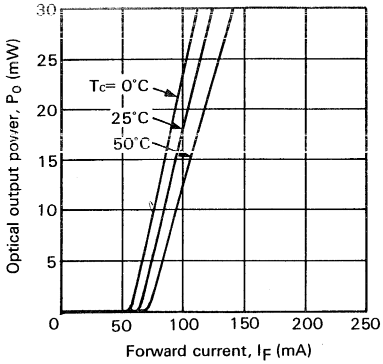
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	30	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

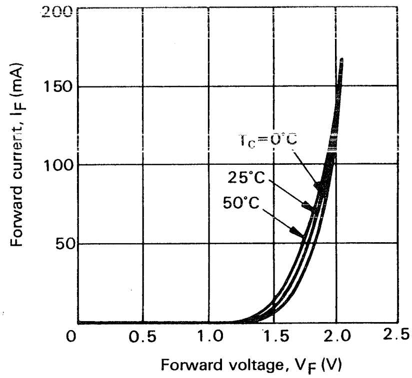
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	30			mW	Kink free
Slope efficiency	η	0.3	0.5		mW/mA	$\frac{18(mW)}{I(24 mW) - I(6 mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 30 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 30 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	P_O = 30 mW
Monitor current	I_S	20			μA	$V_{R(PD)}$ = 5 V, P_O = 3mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

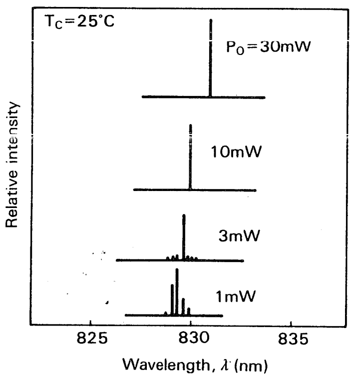
Optical Output Power vs.
Forward Current



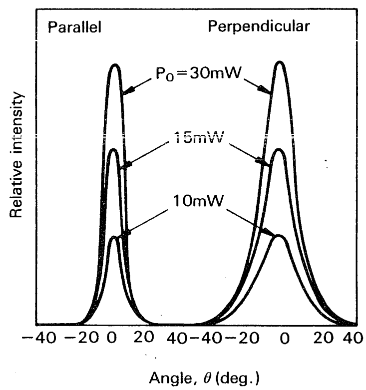
Forward Current vs.
Forward Voltage



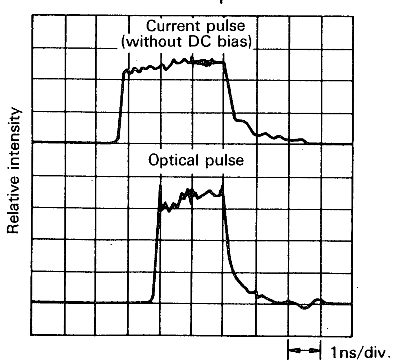
Lasing Spectrum



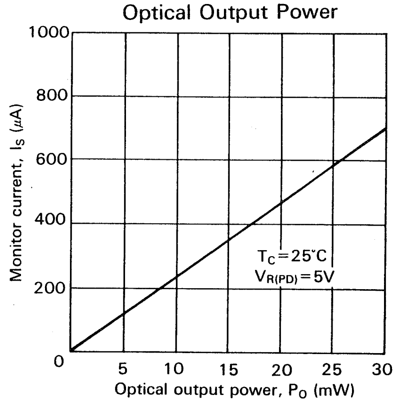
Far Field Pattern



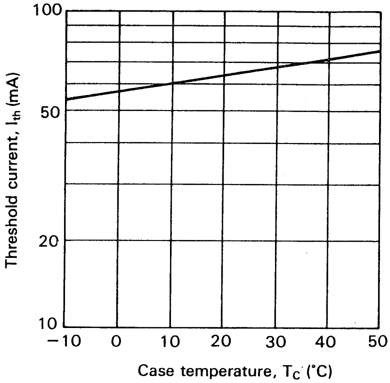
Pulse Response



Monitor Current vs.
Optical Output Power



Threshold Current vs.
Case Temperature



HL8314G

GaAlAs LD

Description

HL8314G is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

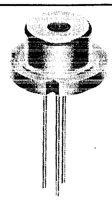
It is suitable as a light source in optical disc memories and various other types of optical equipment.

High power output is obtained through non-symmetrical coating technology for chip mirror facets.

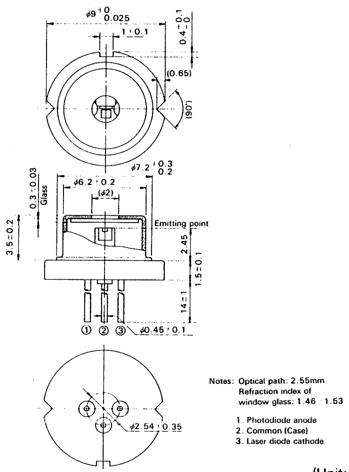
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: $\lambda_p = 810-850$ nm
- 30 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



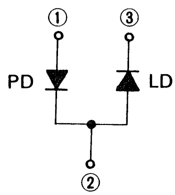
Package Dimensions



G-type

(Unit: mm)

Internal Circuit



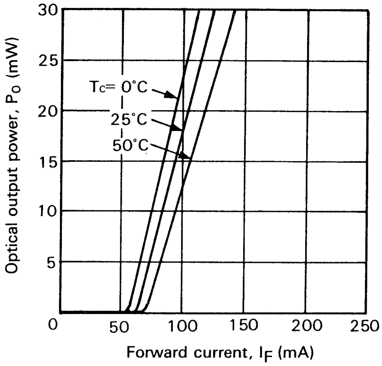
Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Optical output power	P_O	30	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

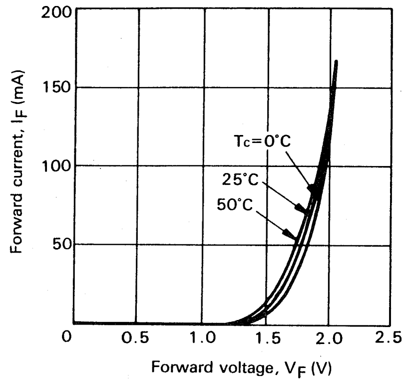
Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	30			mW	Kink free
Slope efficiency	η	0.3	0.5		mW/mA	$\frac{18(mW)}{I(24\ mW) - I(6\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	$P_O = 30$ mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	$P_O = 30$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	$P_O = 30$ mW
Monitor current	I_S	20			μA	$V_{R(PD)} = 5$ V, $P_O = 3$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

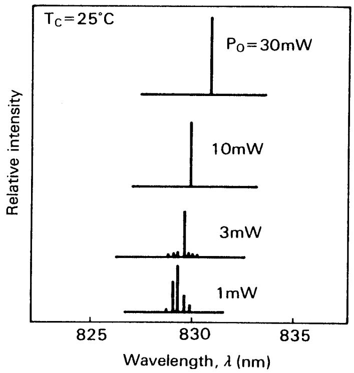
Optical Output Power vs. Forward Current



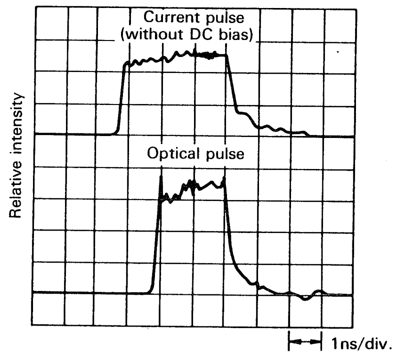
Forward Current vs. Forward Voltage



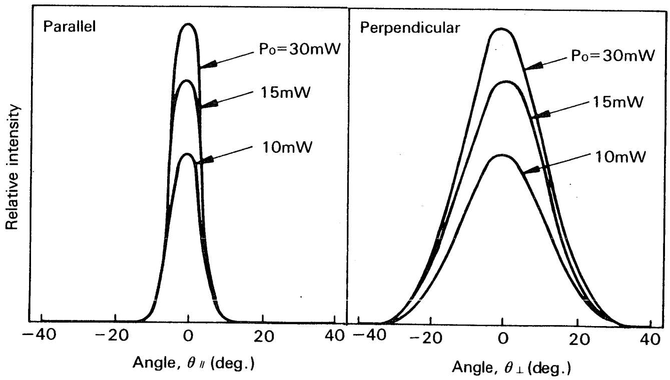
Lasing Spectrum

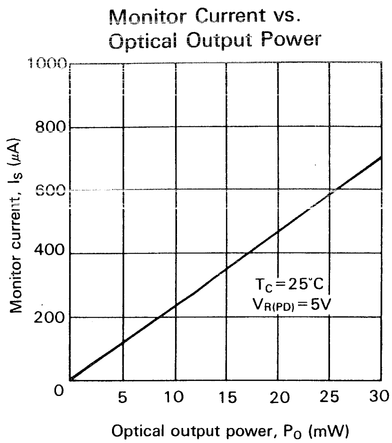


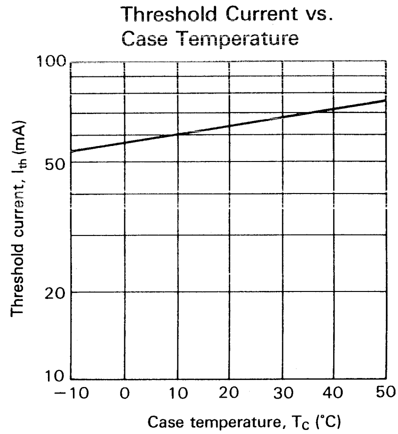
Pulse Response



Far Field Pattern




Monitor Current vs.
Optical Output Power
1000
800
600
400
200
0
5
10
15
20
25
30
Monitor current, Is (μA)
Optical output power, Po (mW)
Tc = 25°C
VR(PD) = 5V


Threshold Current vs.
Case Temperature
100
50
20
10
−10
0
10
20
30
40
50
Threshold current, Ith (mA)
Case temperature, Tc (°C)

HL8315E

GaAlAs LD

Description

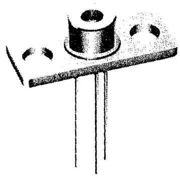
HL8315E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

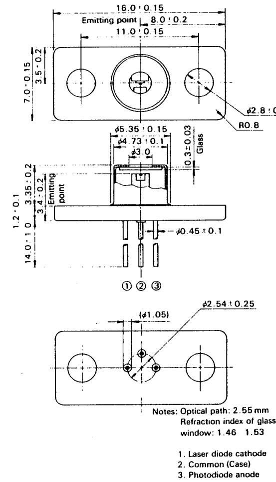
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800−850 nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Fast pulse response of photodiode: t_r, t_f = 50 ns typ.
- Fast pulse response of laser diode: t_r, t_f ≦ 0.5 ns
- Single longitudinal mode



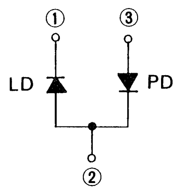
Package Dimensions



(Unit: mm)

E-type

Internal Circuit



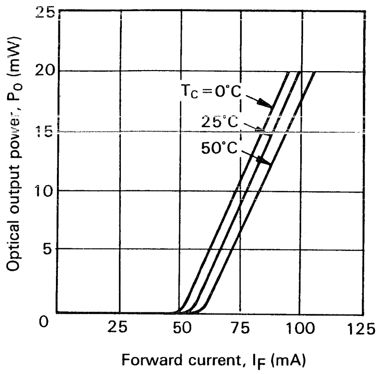
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

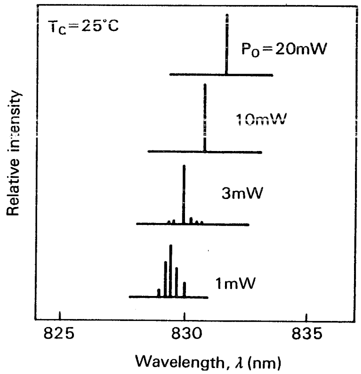
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.3		mW/mA	$\frac{12 (mW)}{I (16 mW) - I (4 mW)}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		27		deg.	P_O = 10 mW
Monitor current	I_S	1.0			mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

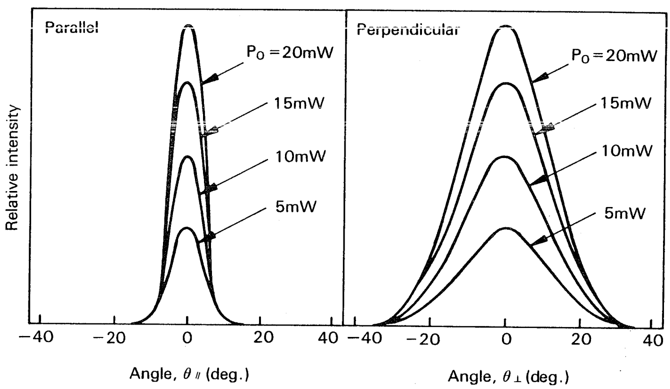
Optical Output Power vs. Forward Current



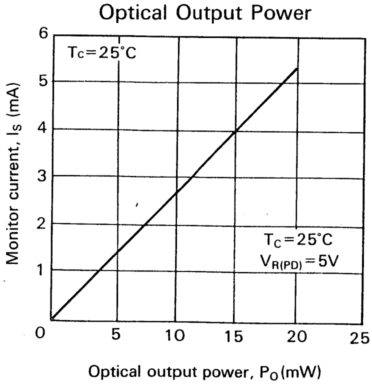
Lasing Spectrum



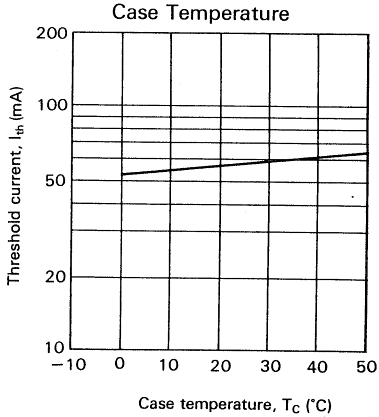
Far Field Pattern



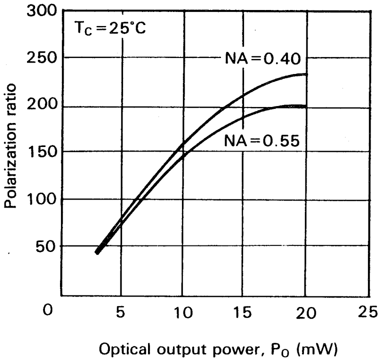
Monitor Current vs. Optical Output Power



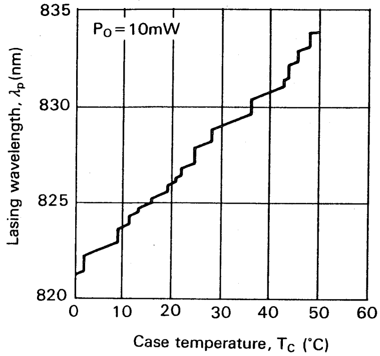
Threshold Current vs. Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



HLP1400

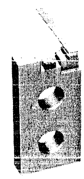
GaAlAs LD

Description

HLP1400 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications, optical disc memories or various other types of optical equipment.

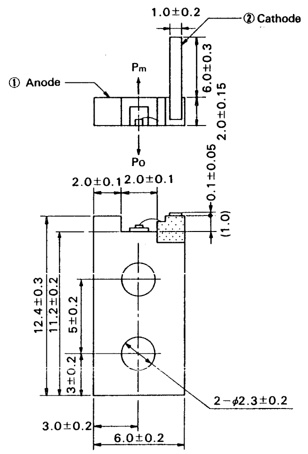
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.



Features

- Infrared light output: λ_p = 800−850 nm
- 15 mW CW operation at room temperature
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

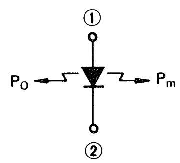
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



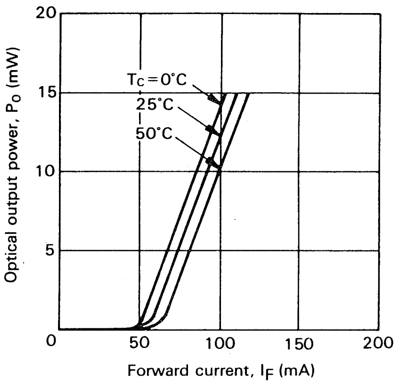
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

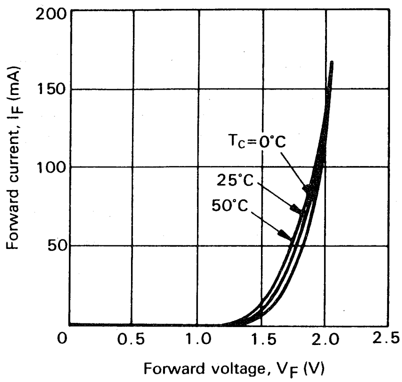
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
		4	5		mW	$I_F = I_{th} + 25$ mA
Monitor power	P_m	2			mW	$I_F = I_{th} + 25$ mA
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		25		deg.	P_O = 10 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

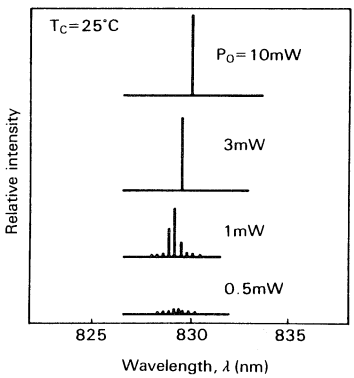
Optical Output Power vs. Forward Current



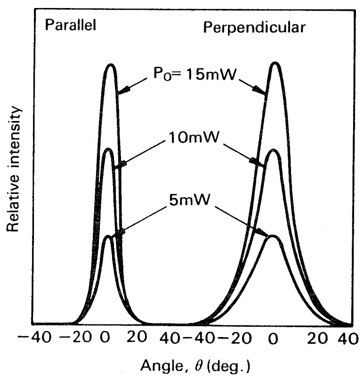
Forward Current vs. Forward Voltage



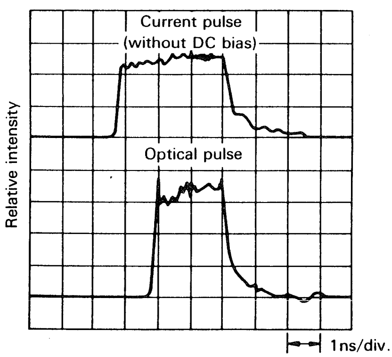
Lasing Spectrum



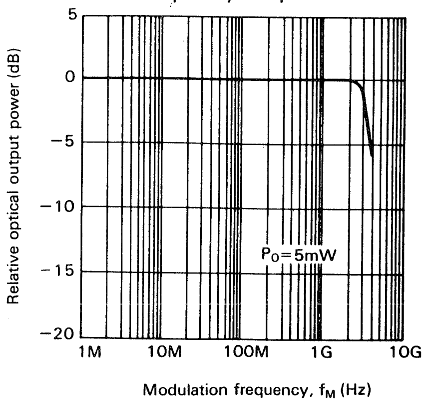
Far Field Pattern



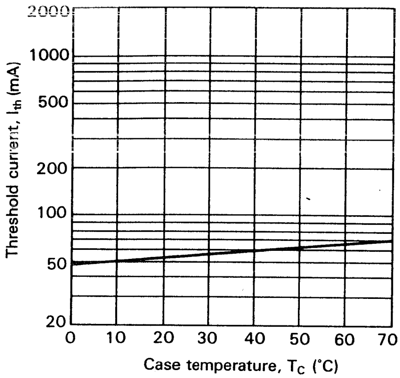
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HLP1500

GaAlAs LD

Description

HLP1500 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications equipment.

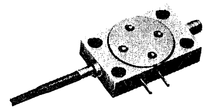
The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

—Fiber specifications—

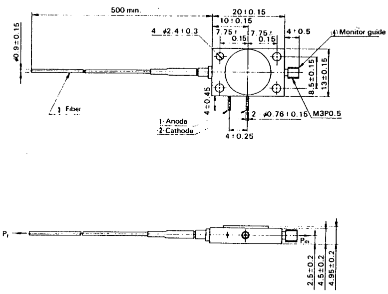
Numerical aperture : 0.2
Core diameter : 50 μm
Outer diameter : 125 μm
Jacket diameter : 900 μm
Refraction index profile : GI type
Fiber length : More than 500 mm

Features

- Infrared light output: λ_p = 800–850 nm
- 6 mW CW operation at room temperature
- Single longitudinal mode
- Fast pulse response: t_r, t_f ≦ 0.5 ns



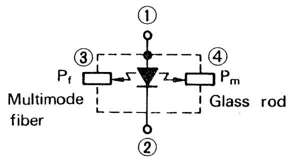
Package Dimensions



B-type

(Unit: mm)

Internal Circuit



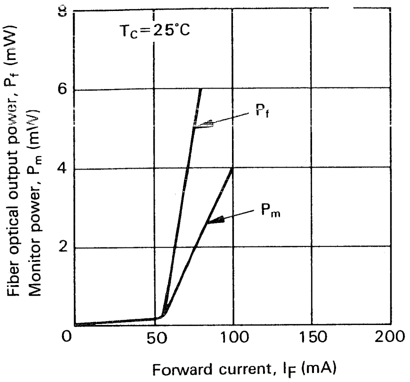
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	6	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C

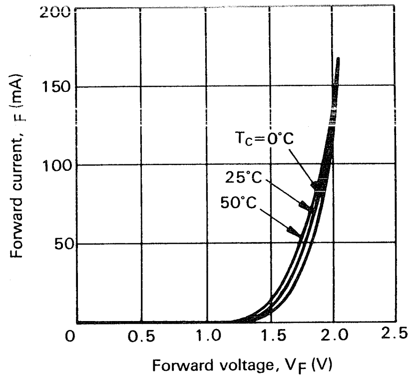
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Fiber optical output power	P_f	6			mW	Kink free
		2	3		mW	$I_F = I_{th} + 25$ mA
Monitor power	P_m	0.5			mW	$I_F = I_{th} + 25$ mA
Lasing wavelength	λ_p	800	830	850	nm	$P_f = 4$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

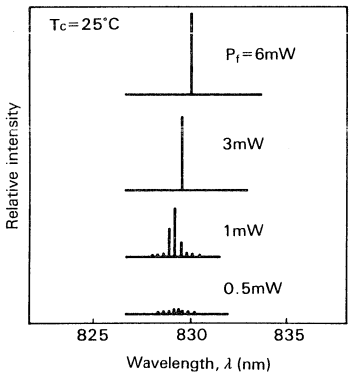
Optical Output Power, Moniter Power vs. Forward Current



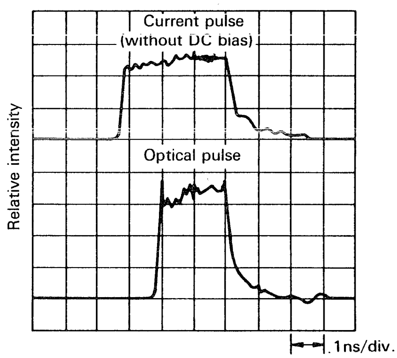
Forward Current vs. Forward Voltage



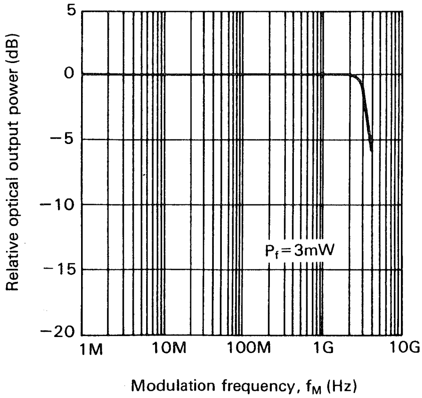
Lasing Spectrum



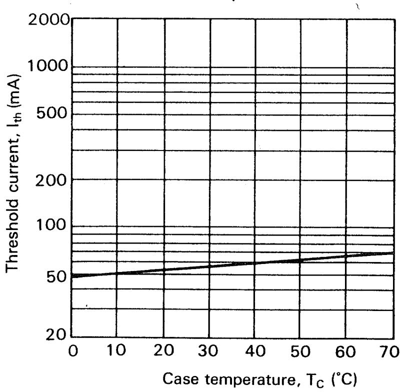
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HLP1600

GaAlAs LD

Description

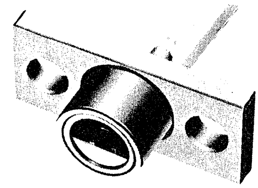
HLP1600 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications, optical disc memories or various other types of optical equipment.

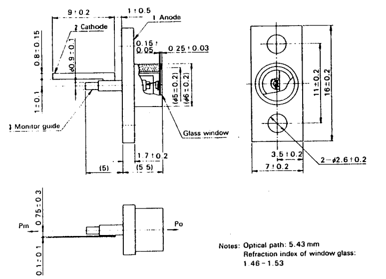
Monitoring power is output from the glass rod as optical output power.

Features

- Infrared light output: $\lambda_p = 800-850$ nm
- 15 mW CW operation at room temperature
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



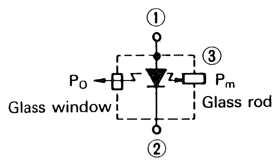
Package Dimensions



C-type

(Unit: mm)

Internal Circuit

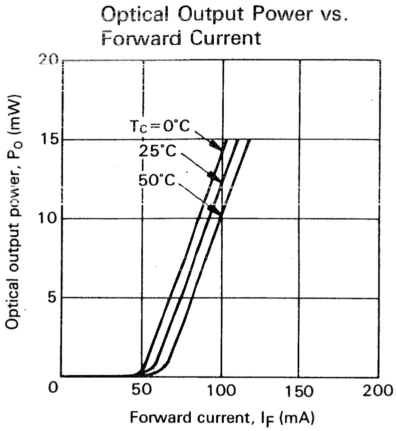


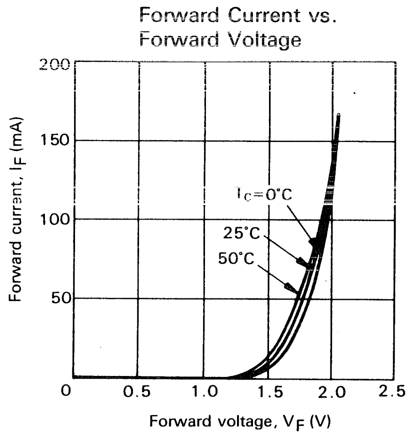
Absolute Maximum Ratings ($T_C = 25°C$)

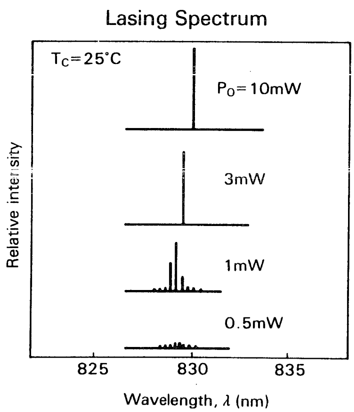
Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

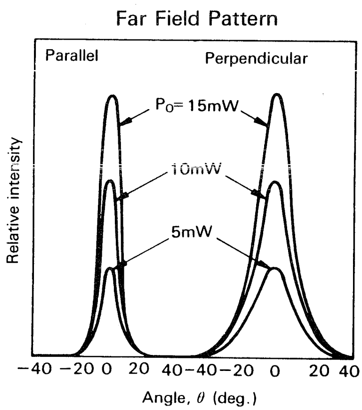
Optical and Electrical Characteristics ($T_C = 25°C$)

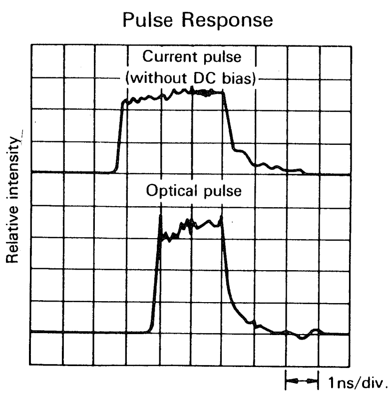
Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
		4	5		mW	$I_F = I_{th} + 25$ mA
Monitor power	P_m	0.2			mW	$I_F = I_{th} + 25$ mA
Lasing wavelength	λ_p	800	830	850	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		25		deg.	$P_O = 10$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

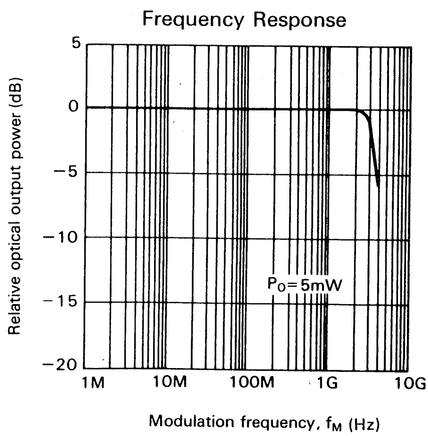

Optical Output Power vs.
Forward Current
Optical output power, Po (mW)
Forward current, IF (mA)
Tc=0°C
25°C
50°C
0
5
10
15
20
50
100
150
200


Forward Current vs.
Forward Voltage
Forward current, IF (mA)
Forward voltage, VF (V)
Tc=0°C
25°C
50°C
50
100
150
200
0
0.5
1.0
1.5
2.0
2.5

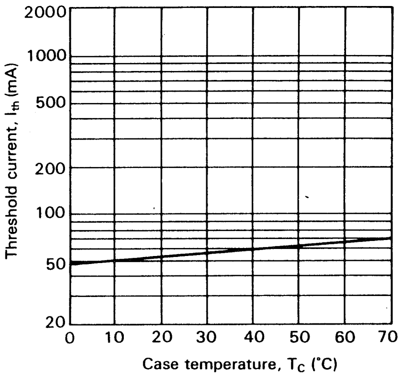

Lasing Spectrum
Tc=25°C
Po=10mW
3mW
1mW
0.5mW
Relative intensity
825
830
835
Wavelength, λ (nm)


Far Field Pattern
Parallel
Perpendicular
Po=15mW
10mW
5mW
Relative intensity
−40 −20 0 20 40−40−20 0 20 40
Angle, θ (deg.)


Pulse Response
Current pulse
(without DC bias)
Optical pulse
Relative intensity
1ns/div.


Frequency Response
Relative optical output power (dB)
Po=5mW
5
0
−5
−10
−15
−20
1M
10M
100M
1G
10G
Modulation frequency, fM (Hz)

Threshold Current vs.
Case Temperature



HL1221A

InGaAsP LD

Description

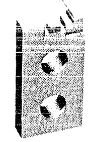
HL1221A is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

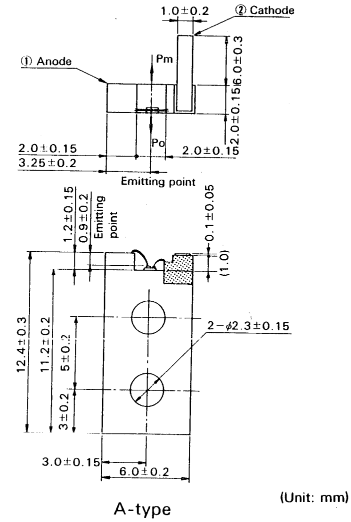
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1170−1230 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns



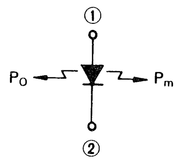
Package Dimensions



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

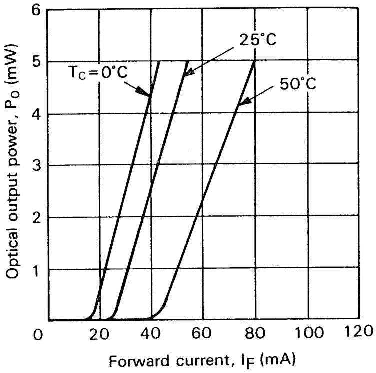
Internal Circuit



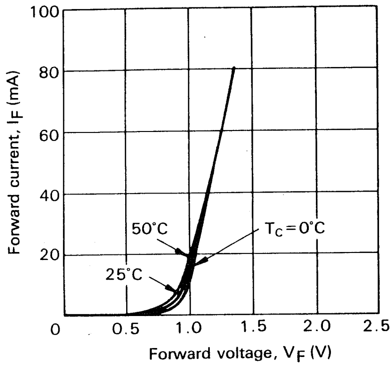
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	1			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

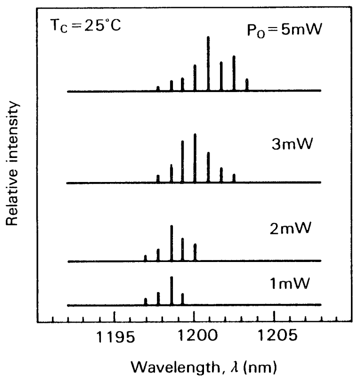
Optical Output Power vs. Forward Current



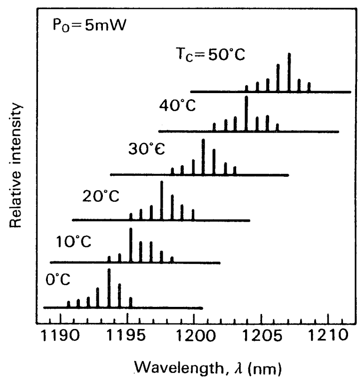
Forward Current vs. Forward Voltage



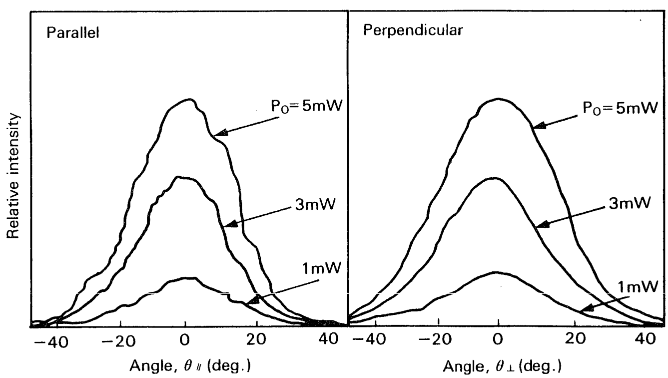
Lasing Spectrum



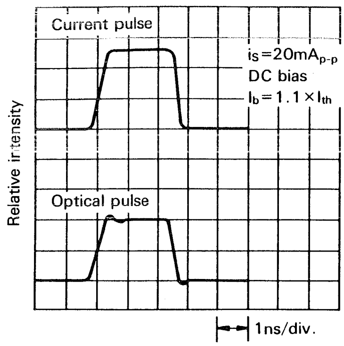
Temperature Dependence of Lasing Spectrum



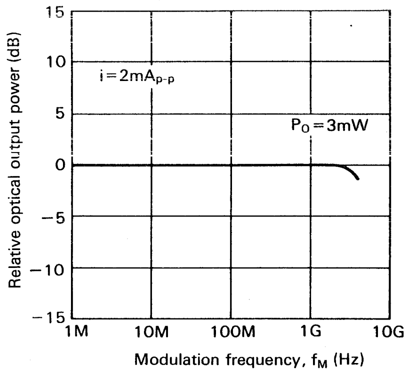
Far Field Pattern



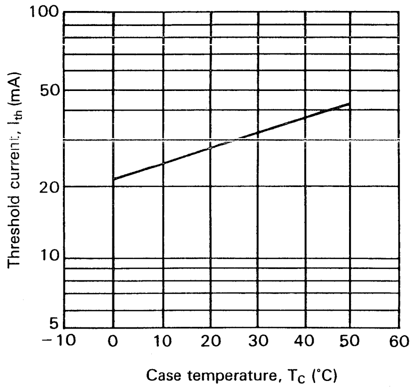
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HL1221AC

InGaAsP LD

Description

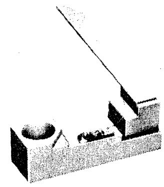
HL1221AC is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

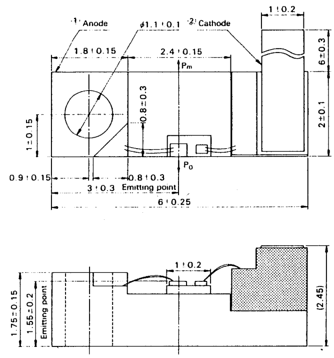
The package is compact to facilitate module assembly.

Features

- Long wavelength light output: λ_p = 1170–1230 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



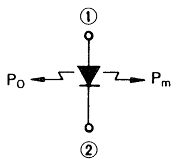
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



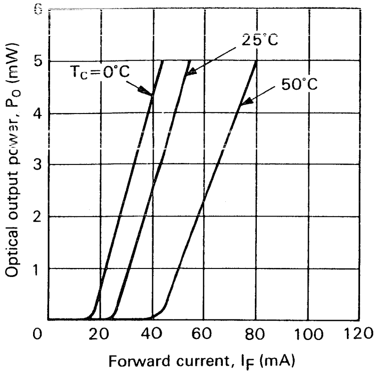
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

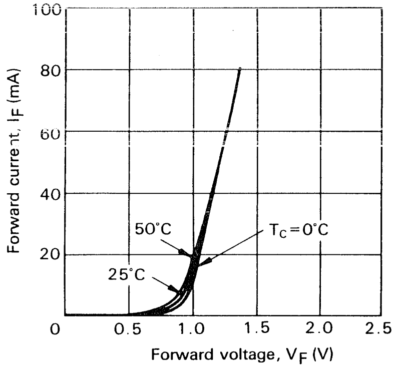
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

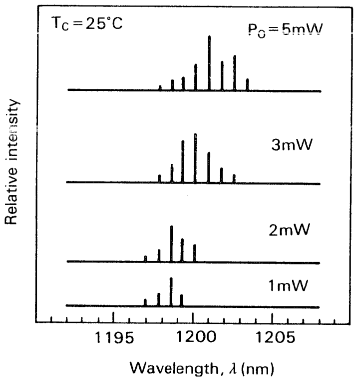
Optical Output Power vs. Forward Current



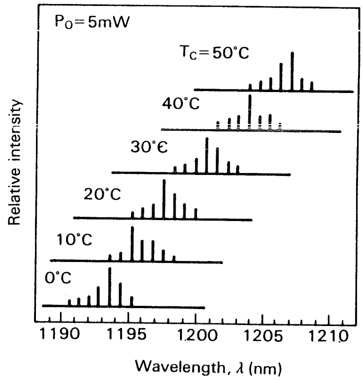
Forward Current vs. Forward Voltage



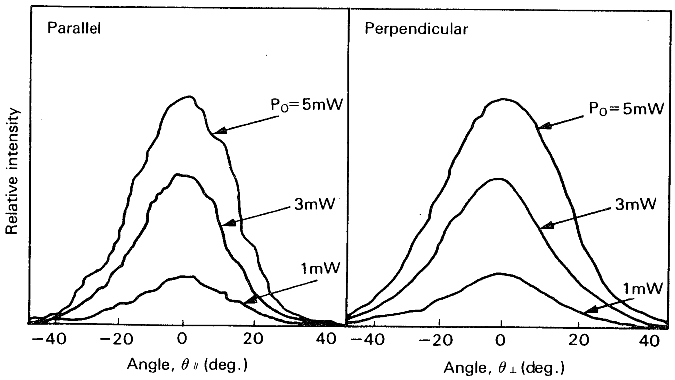
Lasing Spectrum



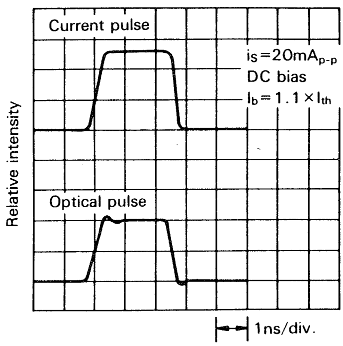
Temperature Dependence of Lasing Spectrum



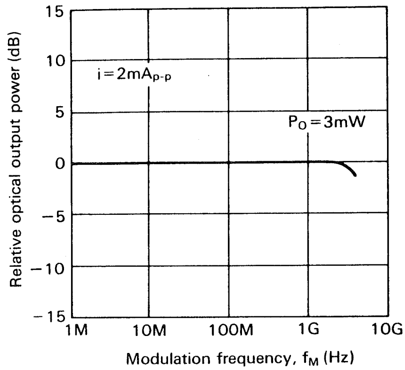
Far Field Pattern



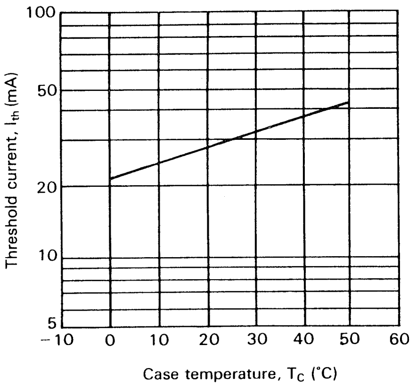
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HL1221B

InGaAsP LD

Description

HL1221B is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications equipment.

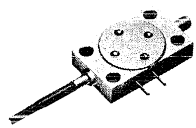
The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

Fiber specifications

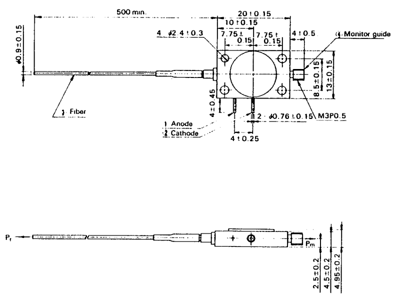
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1170 − 1230 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns



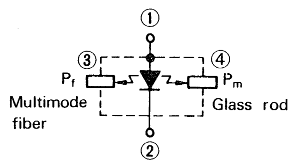
Package Dimensions



(Unit: mm)

B-type

Internal Circuit



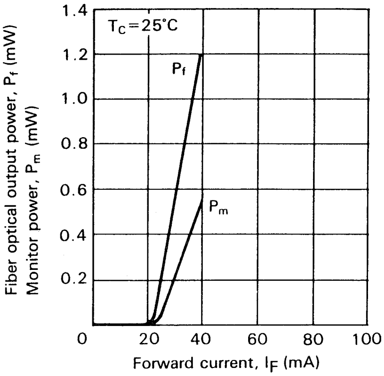
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

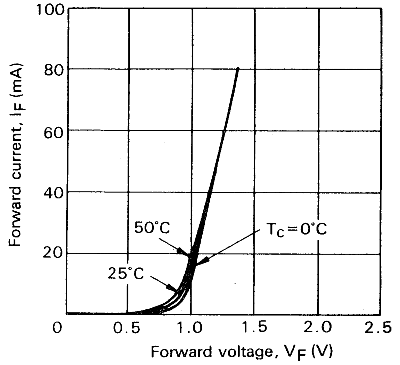
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.4	0.7		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.05			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_f = 0.5 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

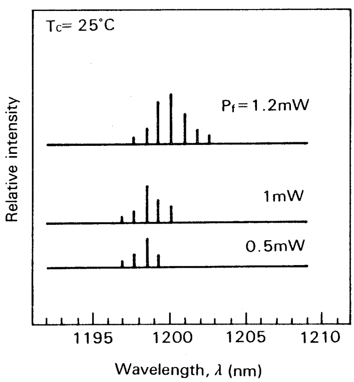
Optical Output Power, Monitor Power vs. Forward Current



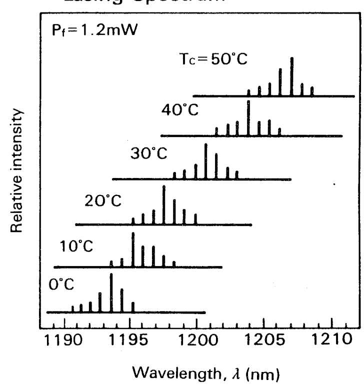
Forward Current vs. Forward Voltage



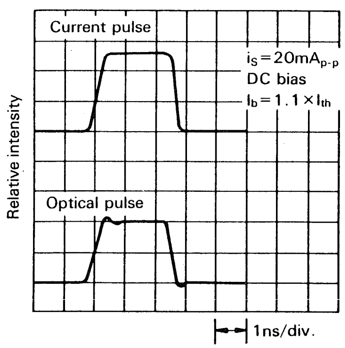
Lasing Spectrum



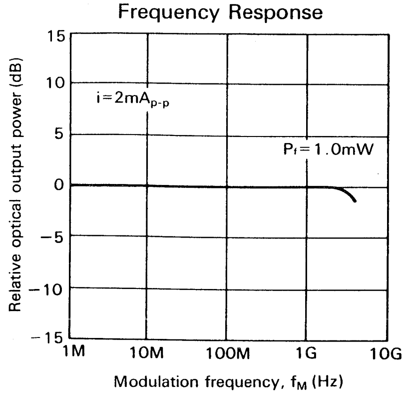
Temperature Dependence of Lasing Spectrum



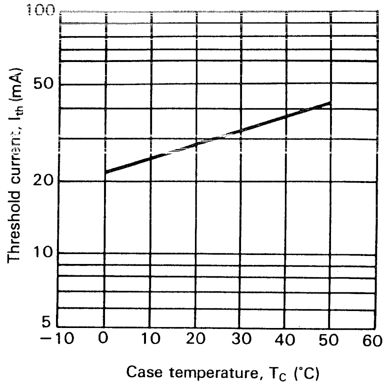
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HL1221C

InGaAsP LD

Description

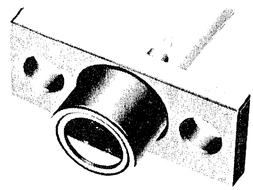
HL1221C is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

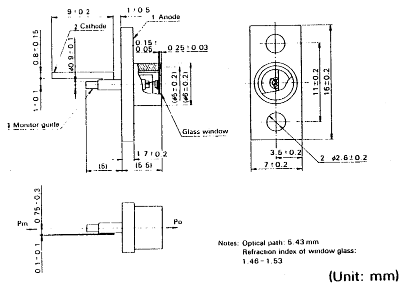
Monitoring power is output from the glass rod as optical output power.

Features

- Long wavelength light output: λ_p = 1170 – 1230 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns



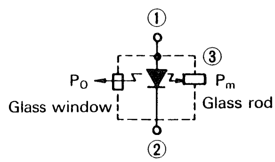
Package Dimensions



(Unit: mm)

C-type

Internal Circuit



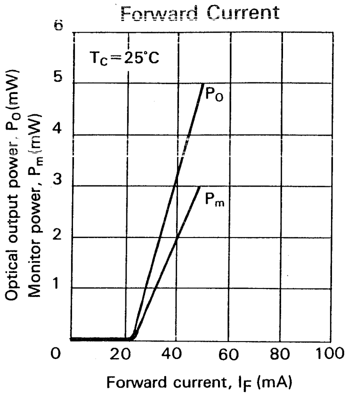
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

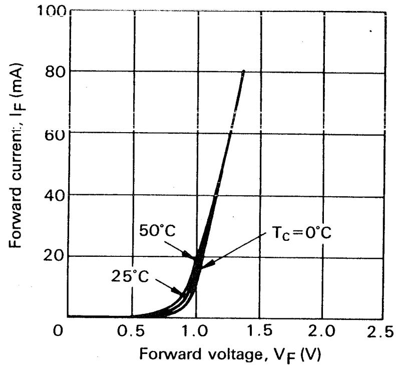
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

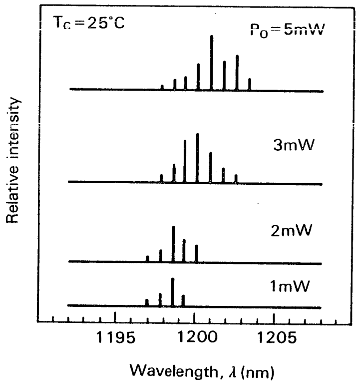
Optical Output Power, Monitor Power vs. Forward Current



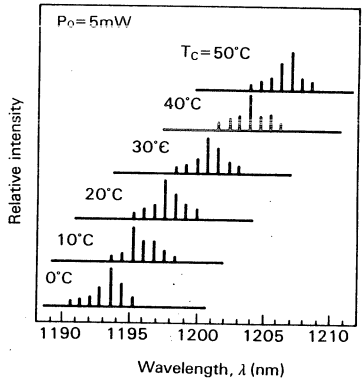
Forward Current vs. Forward Voltage



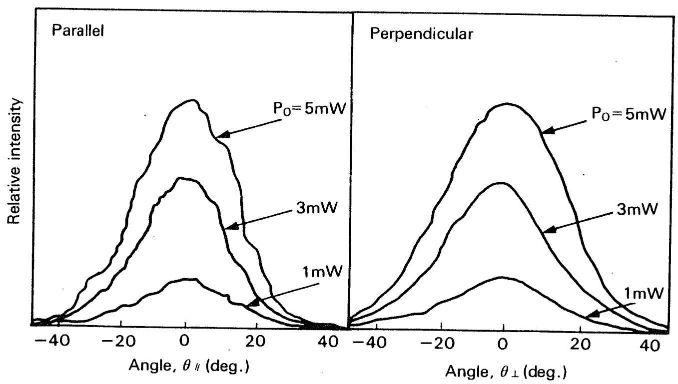
Lasing Spectrum



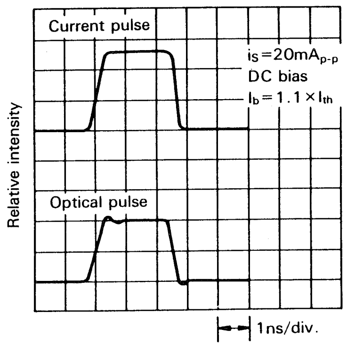
Temperature Dependence of Lasing Spectrum



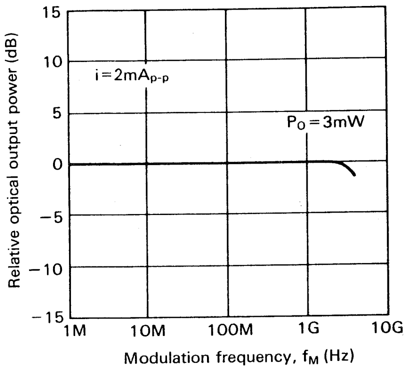
Far Field Pattern



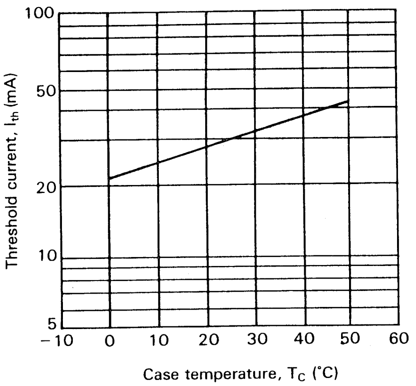
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HLP5400

InGaAsP LD

Description

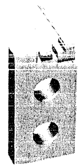
HLP5400 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

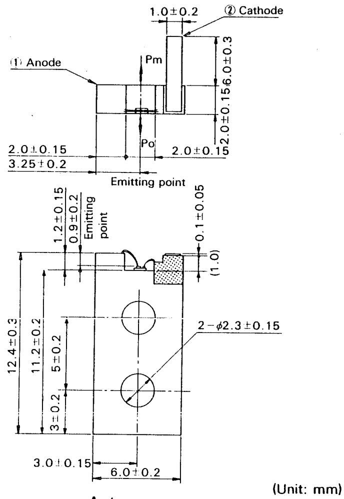
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1270 – 1330 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



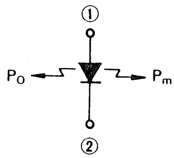
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



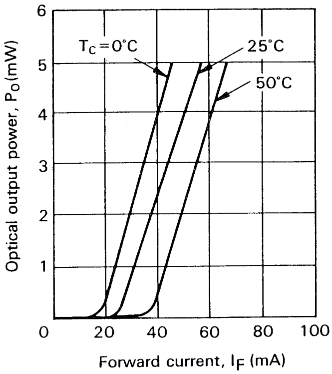
Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

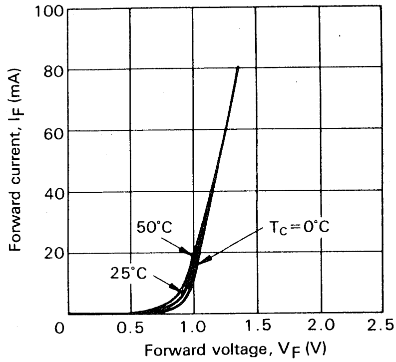
Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

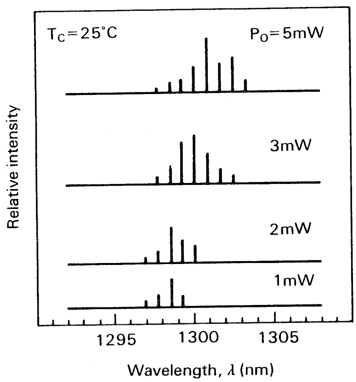
Optical Output Power vs. Forward Current



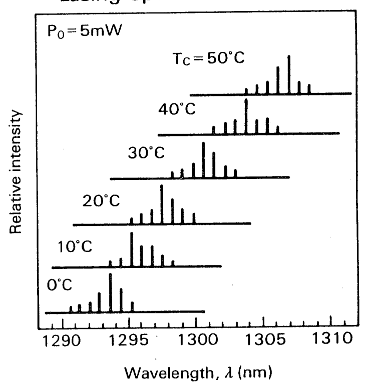
Forward Current vs. Forward Voltage



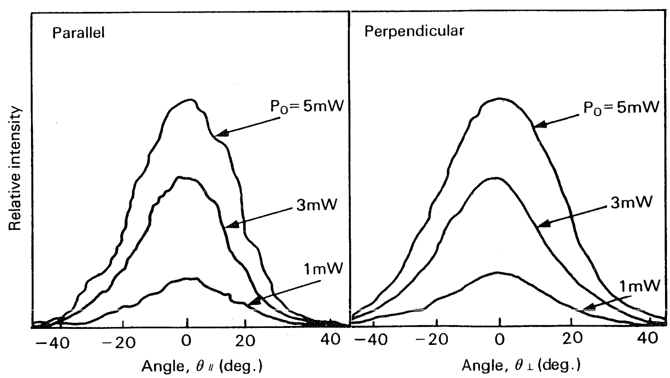
Lasing Spectrum



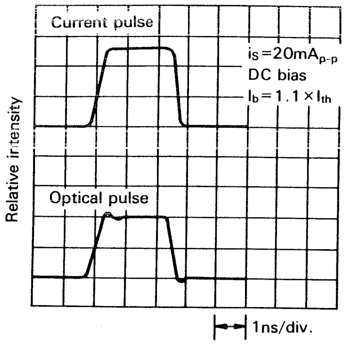
Temperature Dependence of Lasing Spectrum



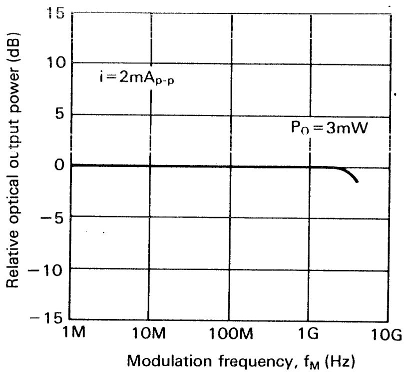
Far Field Pattern



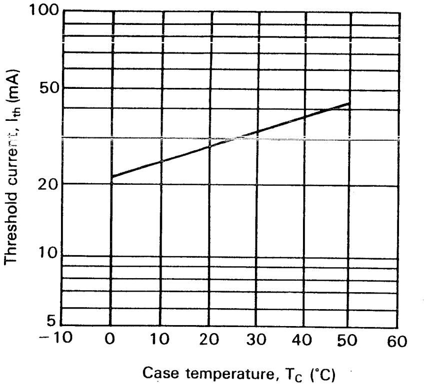
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HLP5500

InGaAsP LD

Description

HLP5500 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

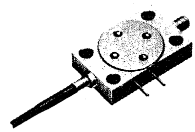
The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

—Fiber specifications—

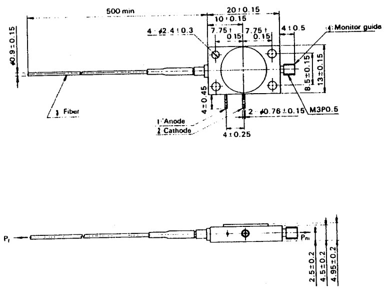
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Long wavelength light output: $\lambda_p = 1270-1330$ nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



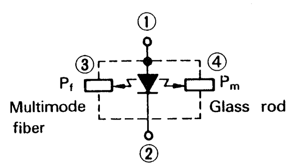
Package Dimensions



(Unit: mm)

B-type

Internal Circuit



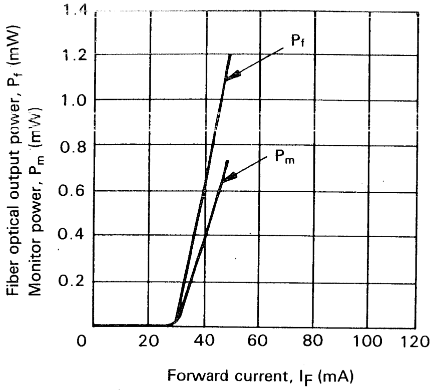
Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

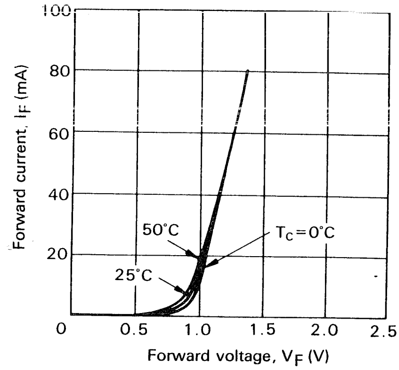
Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.4	0.7		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.05			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	$P_f = 0.5$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_f = 0.5$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

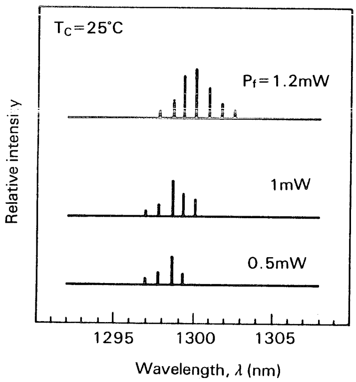
Optical Output Power, Monitor Power vs. Forward Current



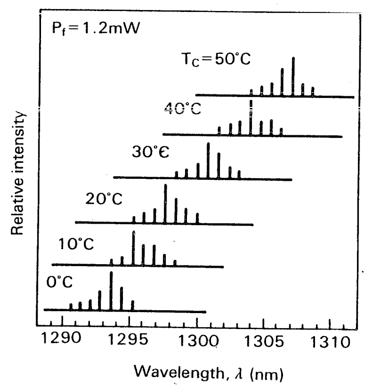
Forward Current vs. Forward Voltage



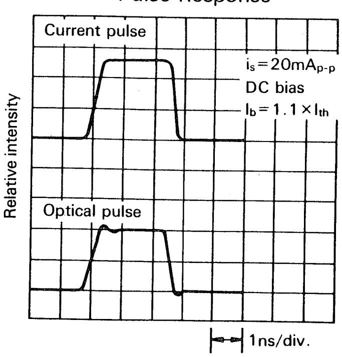
Lasing Spectrum



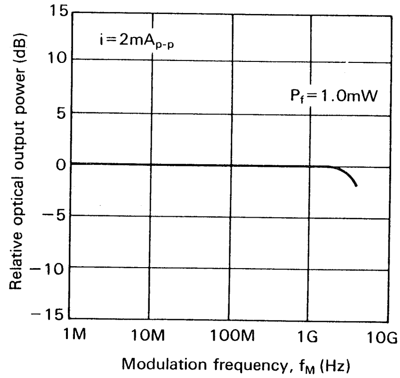
Temperature Dependence of Lasing Spectrum



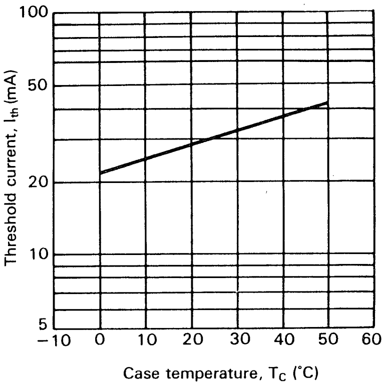
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HLP5600

InGaAsP LD

Description

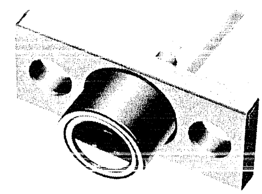
HLP5600 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

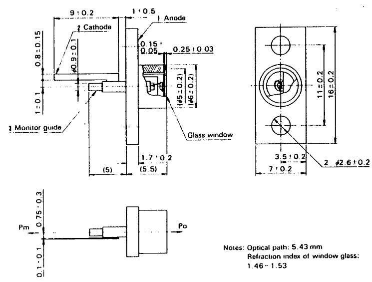
Monitoring power is output from the glass rod as optical output power.

Features

- Long wavelength light output: λ_p = 1270 – 1330 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns



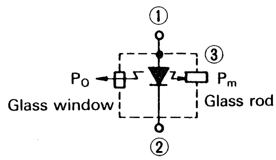
Package Dimensions



(Unit: mm)

C-type

Internal Circuit



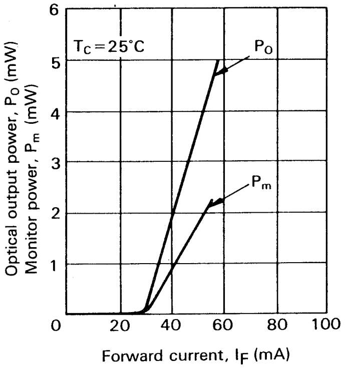
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	–40 to +60	°C

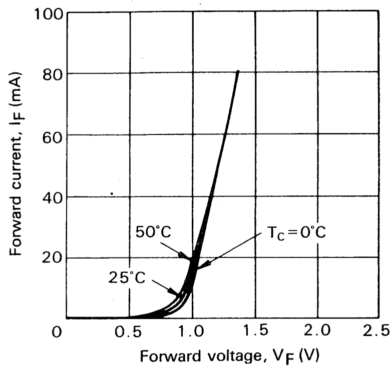
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

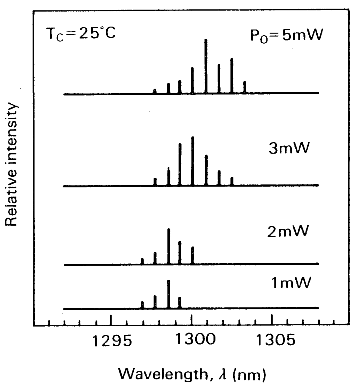
Optical Output Power,
Monitor Power vs.
Forward Current



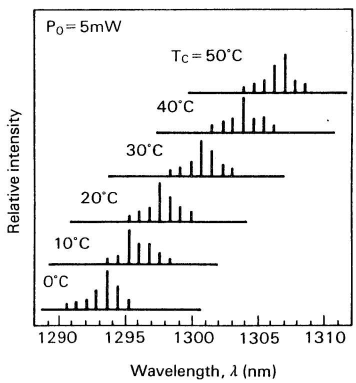
Forward Current vs.
Forward Voltage



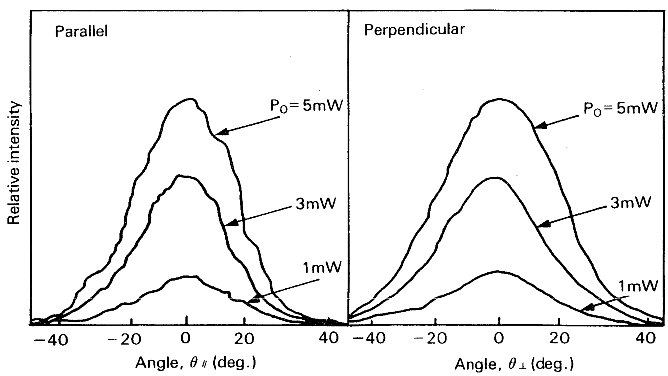
Lasing Spectrum



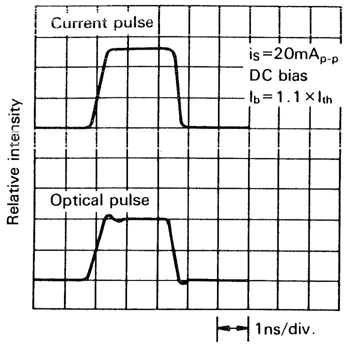
Temperature Dependence of
Lasing Spectrum



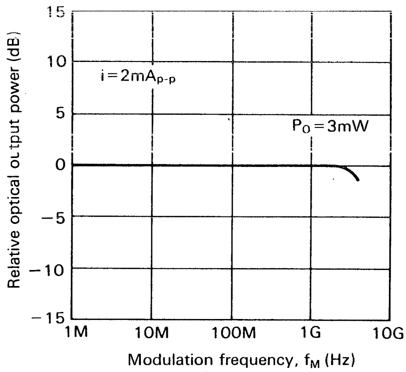
Far Field Pattern



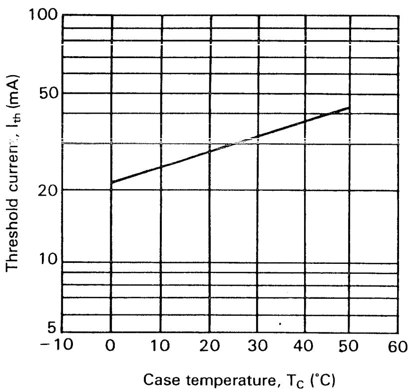
Pulse Response



Frequency Response



Threshold Current vs.
Case Temperature



HL1321AC

InGaAsP LD

Description

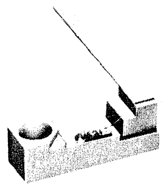
HL1321AC is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

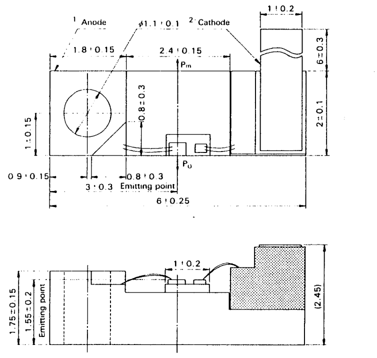
The package is compact to facilitate module assembly.

Features

- Long wavelength light output: λ_p = 1270 − 1330 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



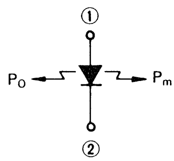
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



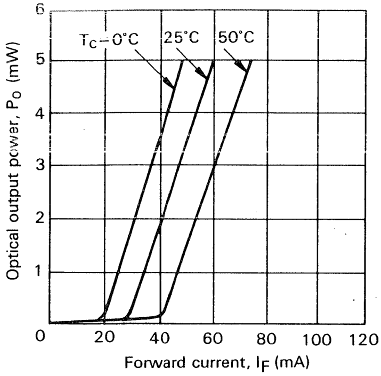
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

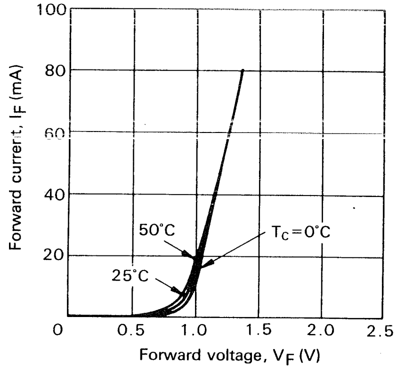
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

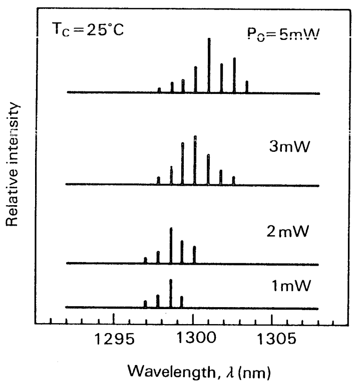
Optical Output Power vs. Forward Current



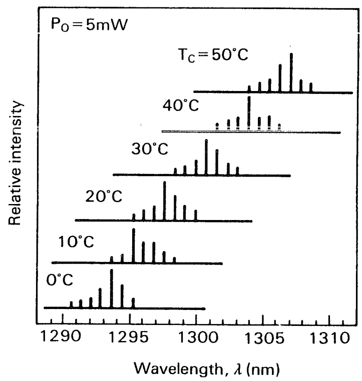
Forward Current vs. Forward Voltage



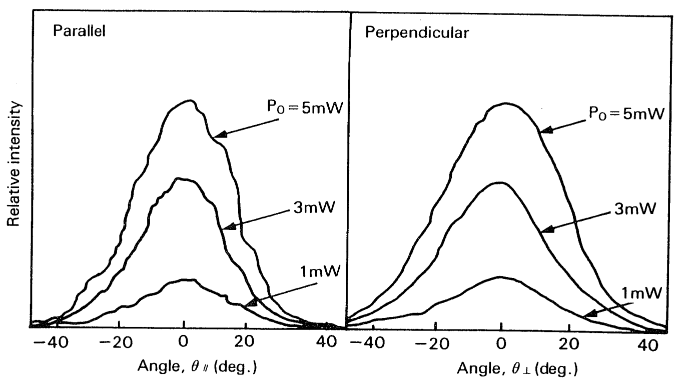
Lasing Spectrum



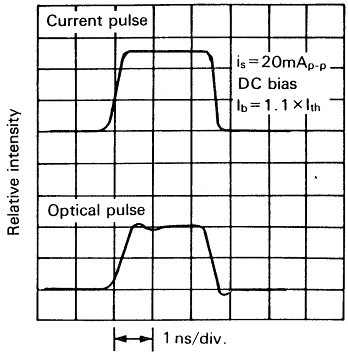
Temperature Dependence of Lasing Spectrum



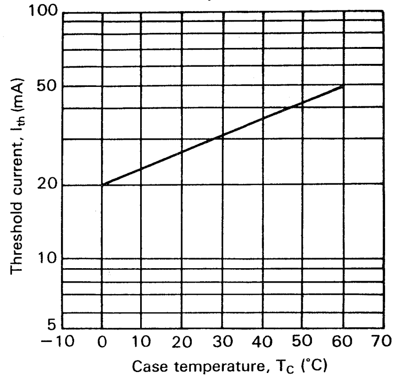
Far Field Pattern



Pulse Response



Threshold Current vs. Case Temperature



HL1321FG

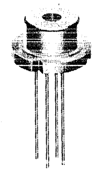
—Under development—
InGaAsP LD

Description

HL1321FG is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

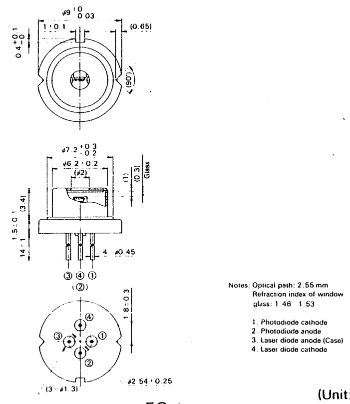
The laser beam is output through the glass window in the package cap. Monitoring current is output from a built-in photodiode.



Features

- Long wavelength light output: λ_p = 1290 – 1330 nm
- 5 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

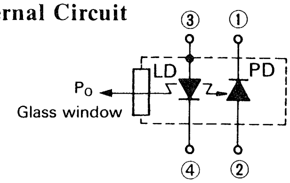
Package Dimensions



(Unit: mm)

FG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	100			μA	$V_{R(PD)}$ = 5 V, P_O = 3 mW
Photodiode capacitance	C_t		15	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 90 to 10%

HL1321P

InGaAsP LD

Description

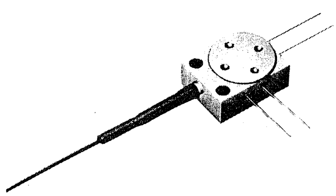
HL1321P is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

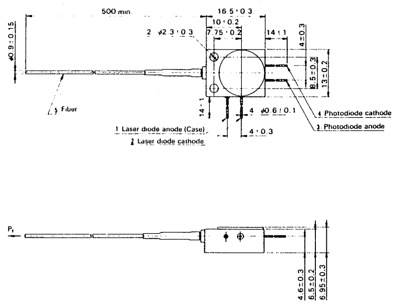
The laser beam is output from the connected multimode fiber. Monitoring current is output from a built-in photodiode.

—Fiber specifications—

Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm



Package Dimensions



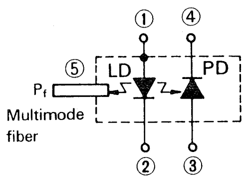
(Unit: mm)

P-type

Features

- Long wavelength light output: λ_p = 1270–1330 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns
- Built-in photodiode for monitoring laser output

Internal Circuit



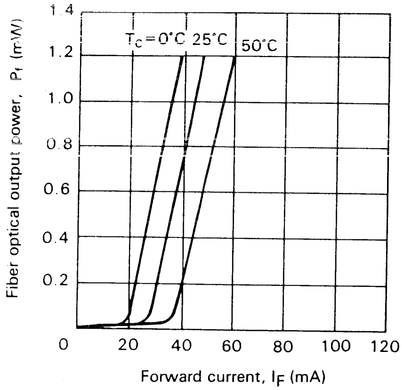
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2.0	V
Photodiode reverse voltage	$V_{R(PD)}$	20	V
Photodiode forward current	$I_{F(PD)}$	1.0	mA
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

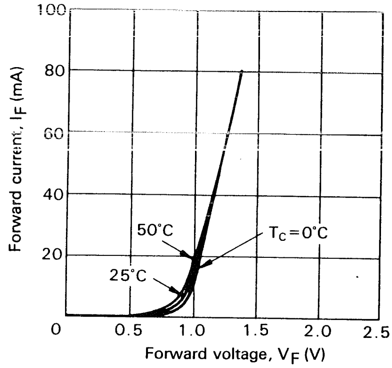
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.7			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_f = 0.5 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Photodiode dark current	I_{DARK}			150	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	70			µA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		3.0	4.0	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

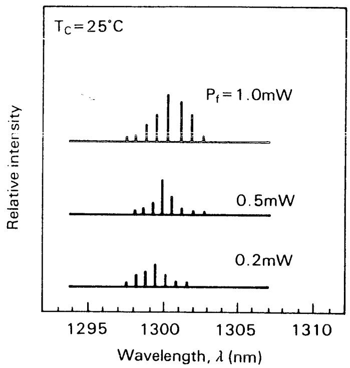
Optical Output Power vs. Forward Current



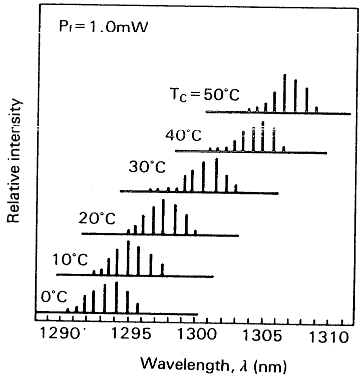
Forward Current vs. Forward Voltage



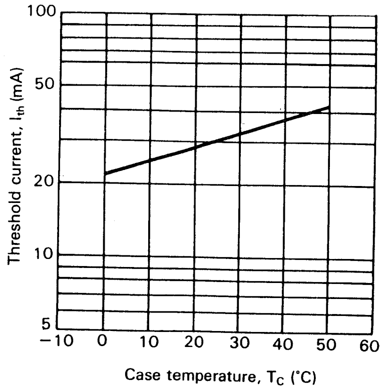
Lasing Spectrum



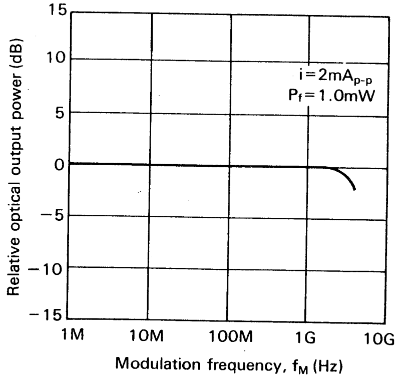
Temperature Dependence of Lasing Spectrum



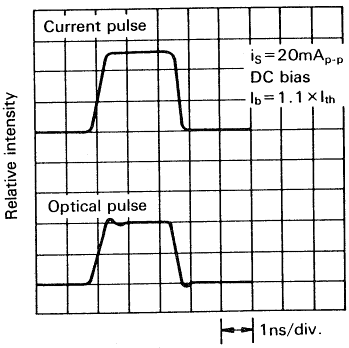
Threshold Current vs. Case Temperature



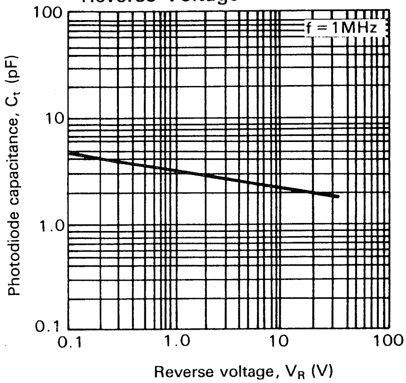
Frequency Response of Laser Diode



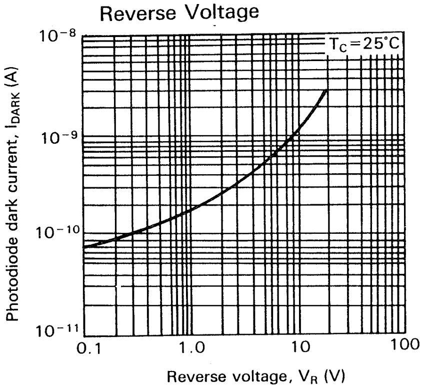
Pulse Response of Laser Diode



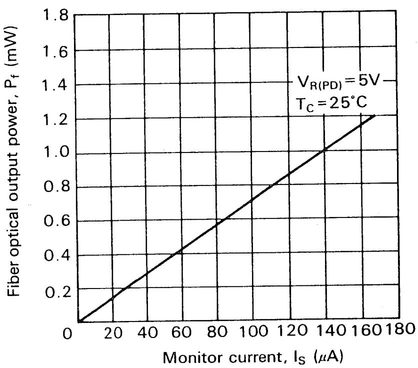
Photodiode Capacitance vs. Reverse Voltage



Photodiode Dark Current vs. Reverse Voltage



Optical Output Power vs. Monitor Current



HL1321SP

InGaAsP LD

Description

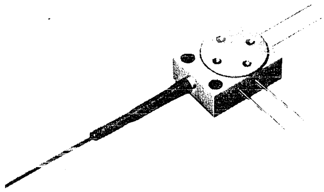
HL1321SP is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

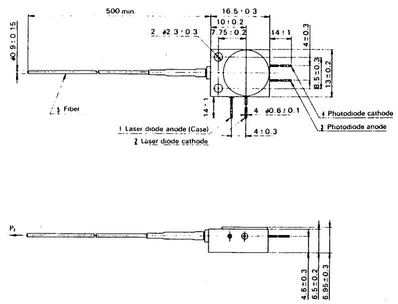
The laser beam is output from the connected single mode fiber. Monitoring current is output from a built-in photodiode.

—Fiber specifications—

Spot size	:	5 μm
λ_c	:	1.10–1.28 μm
Core diameter	:	10 μm
Outer diameter	:	125 μm
Jacket diameter	:	900 μm
Fiber length	:	More than 500 mm



Package Dimensions



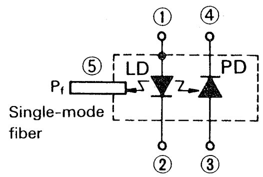
(Unit: mm)

SP-type

Features

- Long wavelength light output: λ_p = 1270–1330 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns
- Built-in photodiode for monitoring laser output

Internal Circuit



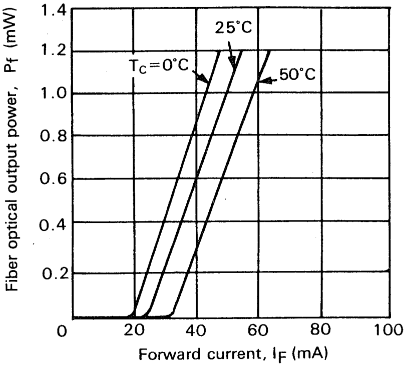
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2.0	V
Photodiode reverse voltage	$V_{R(PD)}$	20	V
Photodiode forward current	$I_{F(PD)}$	1.0	mA
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

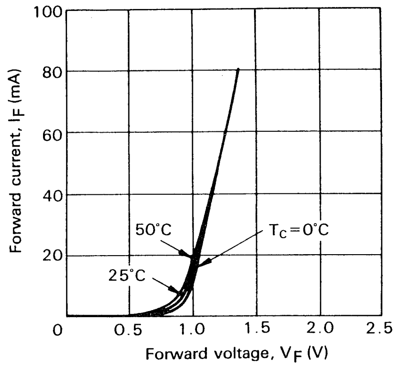
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_f = 1.0 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Photodiode dark current	I_{DARK}			150	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	140			μA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		3.0	4.0	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

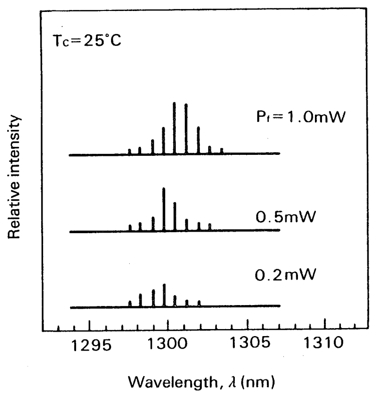
Optical Output Power vs. Forward Current



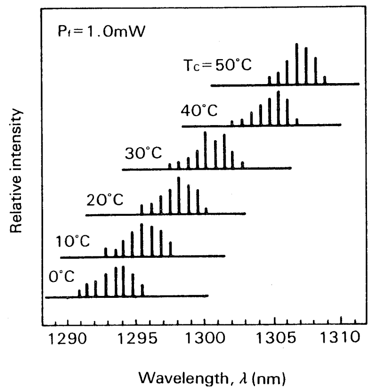
Forward Current vs. Forward Voltage



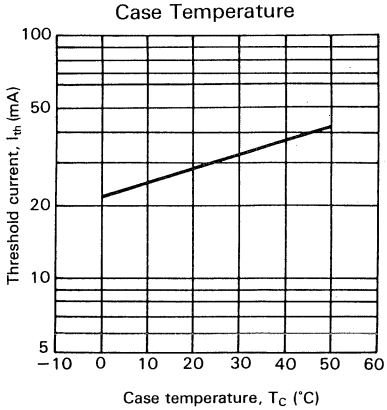
Lasing Spectrum



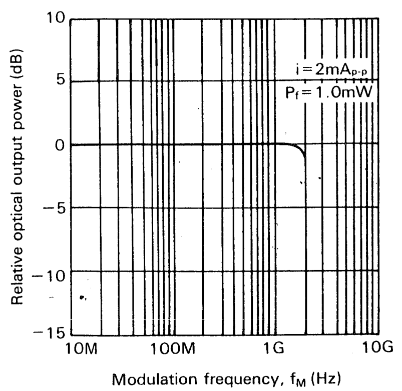
Temperature Dependence of Lasing Spectrum



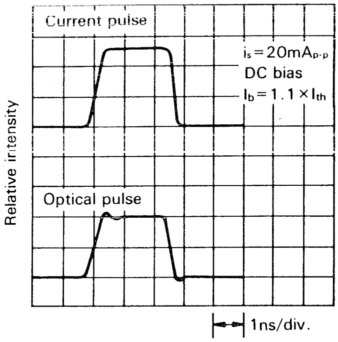
Threshold Current vs. Case Temperature



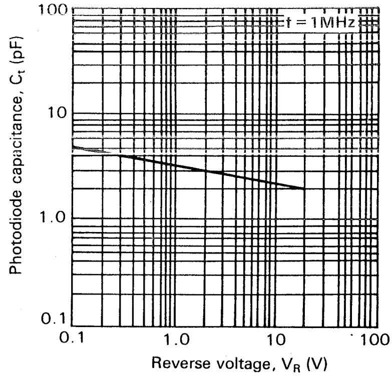
Frequency Response of Laser Diode



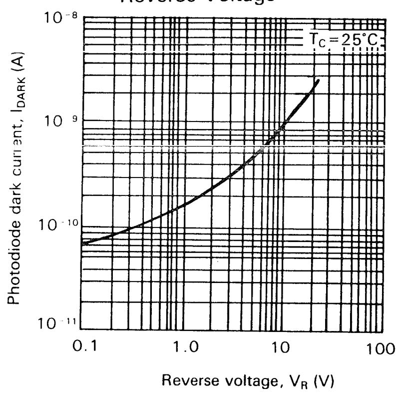
Pulse Response of Laser Diode



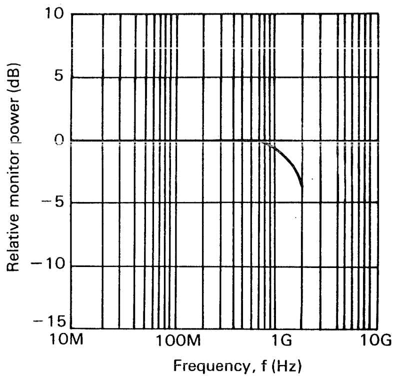
Photodiode Capacitance vs. Reverse Voltage



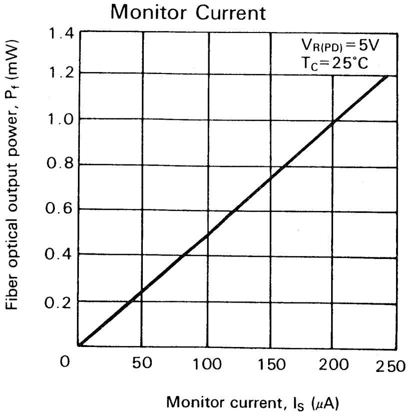
Photodiode Dark Current vs. Reverse Voltage



Frequency Response of Photodiode



Optical Output Power vs. Monitor Current



HL1321BF

—Preliminary—
InGaAsP LD

Description

HL1321BF is a laser-diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

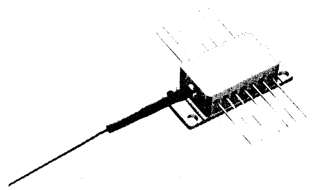
Spot size : 5 μm
λ_c : 1.10–1.28 μm
Core diameter : 10 μm
Outer diameter : 125 μm
Jacket diameter : 900 μm
Fiber length : More than 500 mm

Features

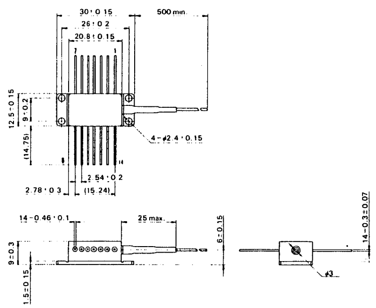
- Long wavelength light output: λ_p = 1290–1330 nm
- 1.2 mW CW and pulse operation at room temperature
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



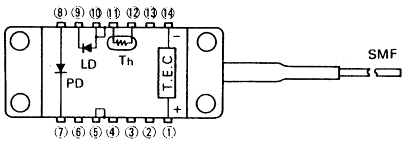
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	$P_f = 1.0$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_f = 1.0$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	300			μA	$V_{R(PD)} = 5$ V, $P_f = 1.0$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$P_f = 1.0$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

HL1321DL

Description

HL1321DL is a laser-diode module in a 14-pin dual-in-line type package with a built-in thermo-electronic controller and connected single-mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

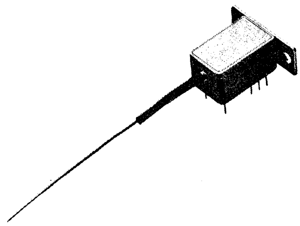
Spot size : 5 μm
λ_c : 1.10—1.28 μm
Core diameter : 10 μm
Outer diameter : 125 μm
Jacket diameter : 900 μm
Fiber length : More than 500 mm

Features

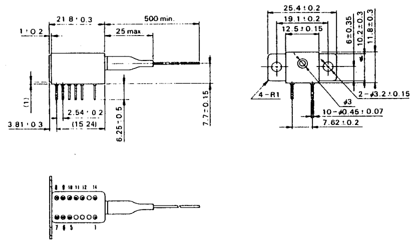
- Long wavelength light output: λ_p = 1290—1330 nm
- 1.2 mW CW and pulse operation at room temperature
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



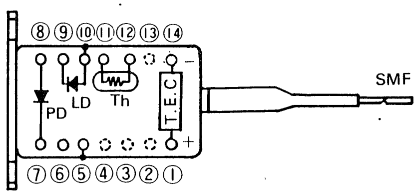
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	$P_f = 1.0$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_f = 1.0$ mW
Rise time	t_r			0.5	ns	$P_f = 1.0$ mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	$P_f = 1.0$ mW, $I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	300			µA	$V_{R(PD)} = 5$ V, $P_f = 1.0$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$P_f = 1.0$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

HL1322A

InGaAsP LD

Description

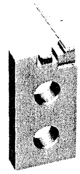
HL1322A is a high-power 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment. The HL1322A emits higher optical power than HLP5400 and HL1321AC.

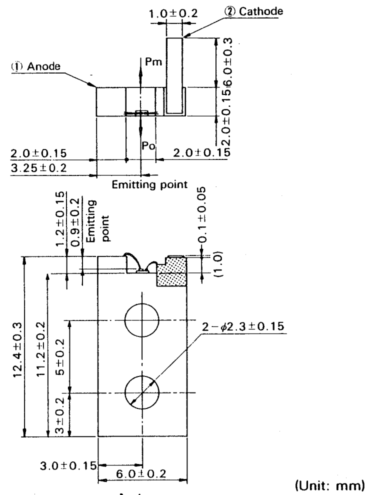
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1290 − 1330 nm
- 10 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions

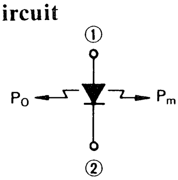


A-type

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

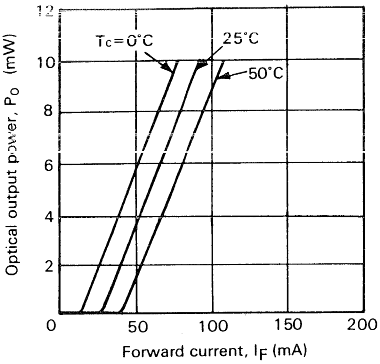
Internal Circuit



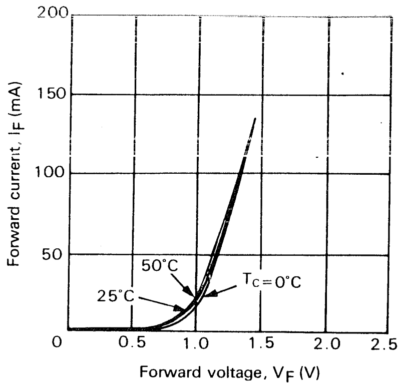
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	10			mW	Kink free
		4			mW	$I_F = I_{th}$ + 40 mA
Monitor power	P_m	2			mW	$I_F = I_{th}$ + 40 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 6 mW
Spectral width	$\Delta\lambda$			5	nm	P_O = 6 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 6 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 6 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

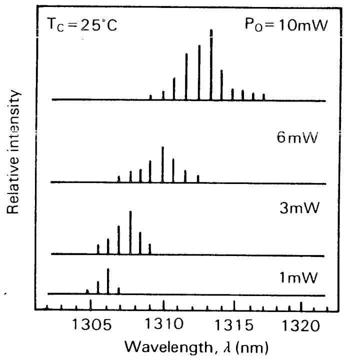
Optical Output Power vs. Forward Current



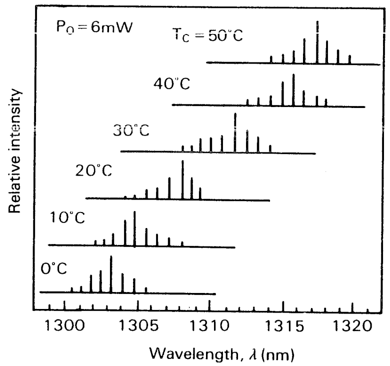
Forward Current vs. Forward Voltage



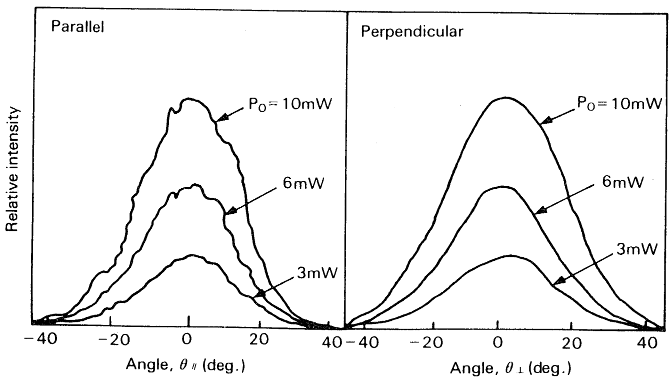
Lasing Spectrum



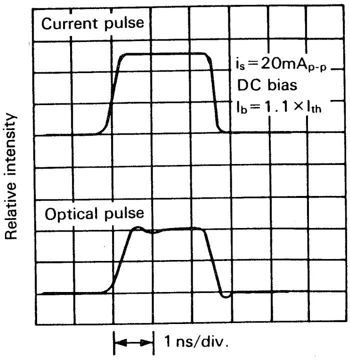
Temperature Dependence of Lasing Spectrum



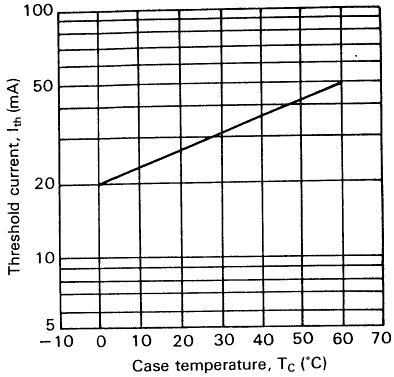
Far Field Pattern



Pulse Response



Threshold Current vs. Case Temperature



HL1322AC

InGaAsP LD

Description

HL1322AC is a high-power 1.3 μm InGaAsP laser diode with double heterojunction structure.

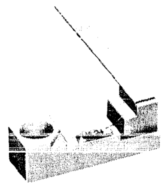
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The HL1322AC emits higher optical power than HLP5400 and HL1321AC.

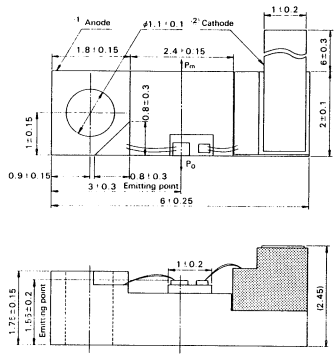
The package is compact to facilitate module assembly.

Features

- Long wavelength light output: λ_p = 1290 – 1330 nm
- 10 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions



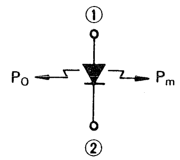
(Unit: mm)

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

AC-type

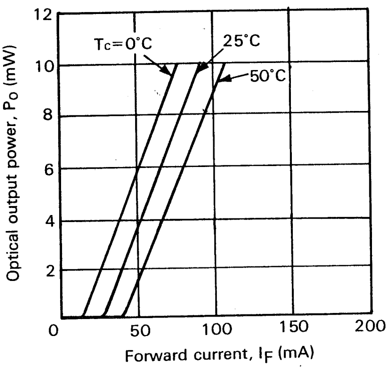
Internal Circuit



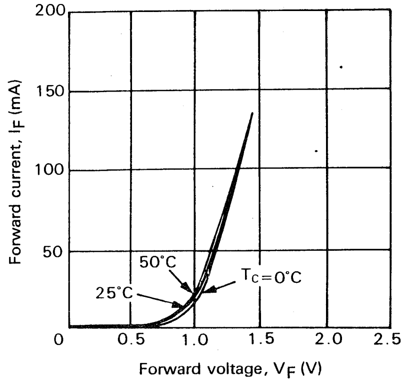
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	10			mW	Kink free
		4			mW	$I_F = I_{th} + 40$ mA
Monitor power	P_m	2			mW	$I_F = I_{th} + 40$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 6 mW
Spectral width	$\Delta\lambda$			5	nm	P_O = 6 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 6 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 6 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

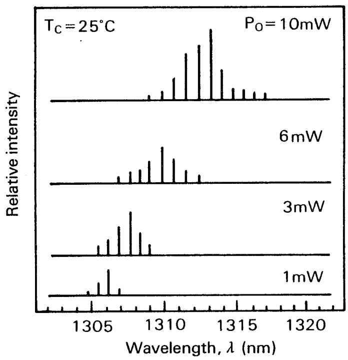
Optical Output Power vs. Forward Current



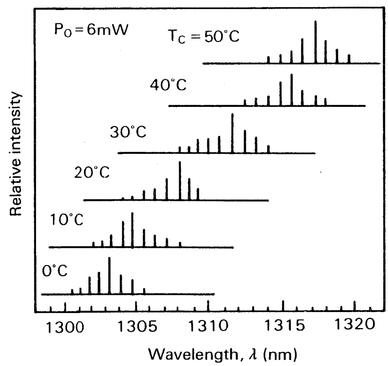
Forward Current vs. Forward Voltage



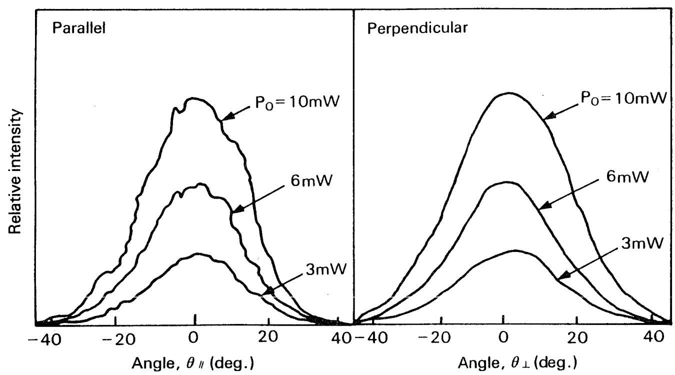
Lasing Spectrum



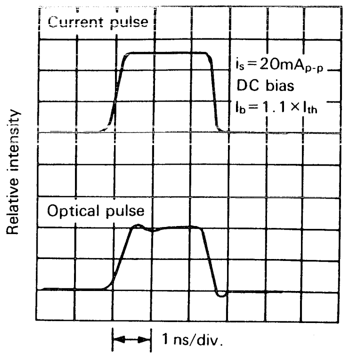
Temperature Dependence of Lasing Spectrum



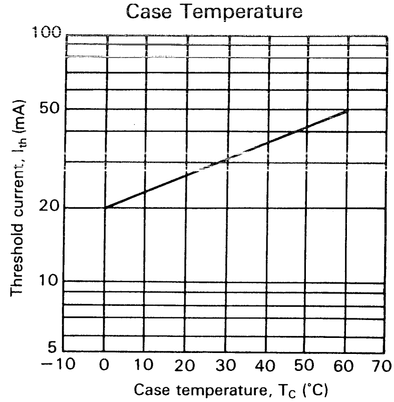
Far Field Pattern



Pulse Response



Threshold Current vs. Case Temperature



HL1341A

—Preliminary—
InGaAsP LD

Description

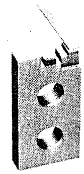
HL1341A is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried heterostructure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

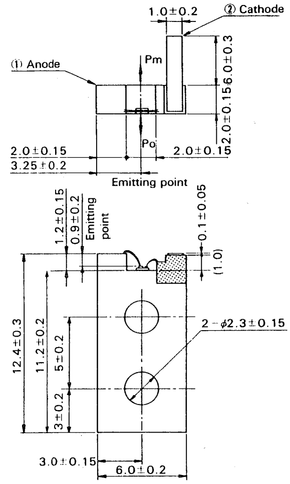
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: $\lambda_p = 1280-1340$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



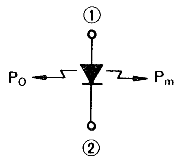
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1280	1310	1340	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r		35		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1341AC

—Preliminary—
InGaAsP LD

Description

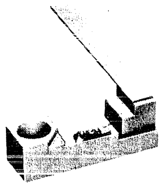
HL1341AC is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

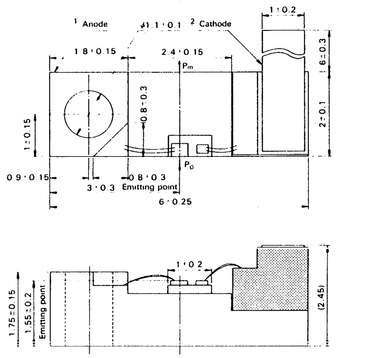
The package is compact to facilitate module assembly.

Features

- Long wavelength light output:
  λ_p = 1280 − 1340 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



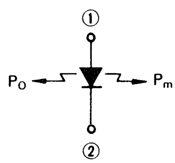
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1280	1310	1340	nm	P_O = 3 mW
Side-mode suppression ratio	S_r		35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1341FG

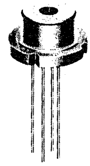
—Under development—
InGaAsP LD

Description

HL1341FG is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

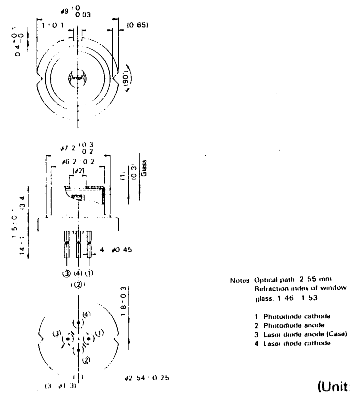
The laser beam is output through the glass window in the package cap. Monitoring current is output from a built-in photodiode.



Features

- Long wavelength light output: λ_p = 1280 – 1340 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, t_f ≦ 0.5 ns

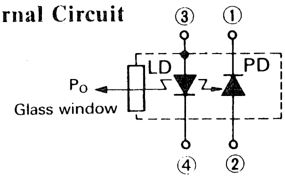
Package Dimensions



(Unit: mm)

FG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1280	1310	1340	nm	P_O = 3 mW
Side-mode suppression ratio	S_r		35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	100			μA	$V_{R(PD)}$ = 5 V, P_O = 3 mW
Photodiode capacitance	C_t		15	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	

HL1341BF

—Under development—
InGaAsP LD

Description

HL1341BF is a laser-diode module in a 14-pin butterfly type package with a built-in thermoelectronic controller and connected single-mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

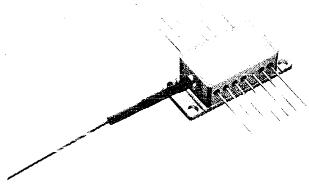
Spot size	: 5 μm
λ_c	: 1.10–1.28 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

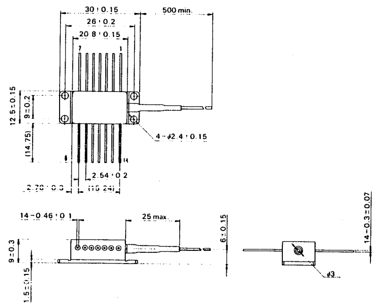
- Long wavelength light output: λ_p = 1280–1340 nm
- 1.2 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



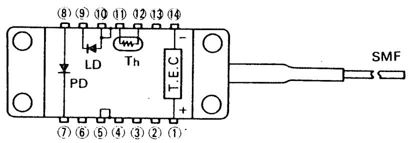
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1280	1310	1340	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r		35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.3			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$T_C = 60°C$, $P_f = 0.5$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

HL1341DL

—Under development—
InGaAsP LD

Description

HL1341DL is a laser-diode module in a 14-pin dual in-line type package with a built-in thermo-electronic controller and connected single-mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

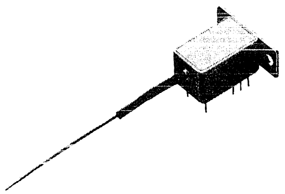
Spot size	: 5 μm
λ_c	: 1.10—1.28 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

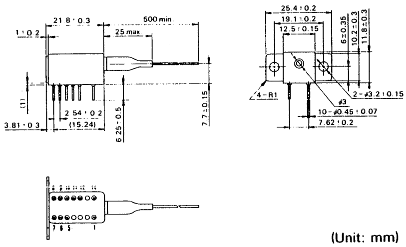
- Long wavelength light output: λ_p = 1280—1340 nm
- 1.2 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



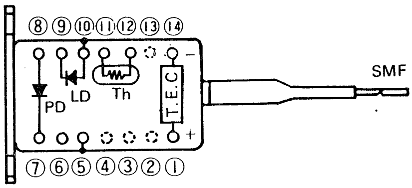
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1280	1310	1340	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r		35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.3			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$T_C = 60°C$, $P_f = 0.5$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

HL1521A

InGaAsP LD

Description

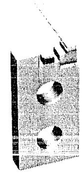
HL1521A is a 1.55 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

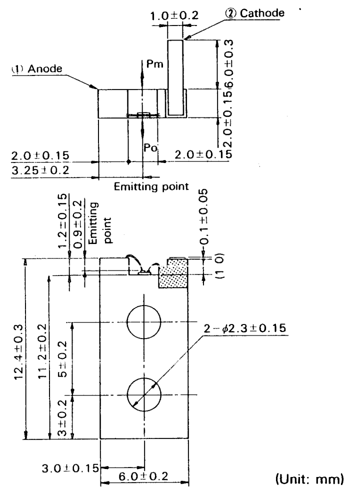
The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: $\lambda_p = 1530 - 1570$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



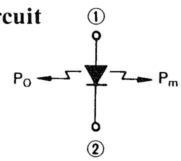
Package Dimensions



A-type

(Unit: mm)

Internal Circuit



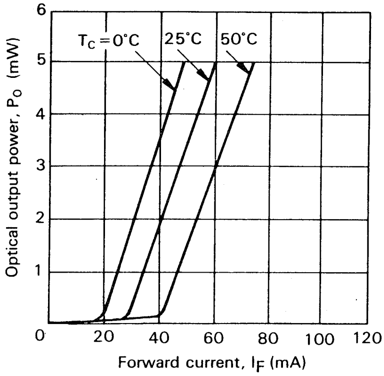
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

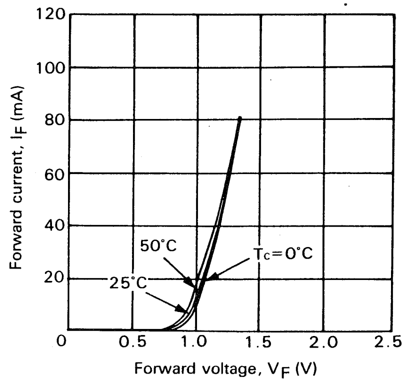
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.0			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.45			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

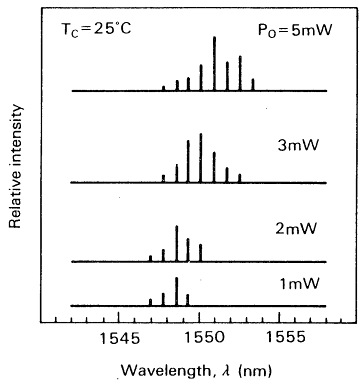
Optical Output Power vs. Forward Current



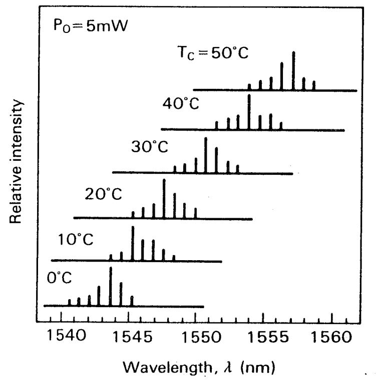
Forward Current vs. Forward Voltage



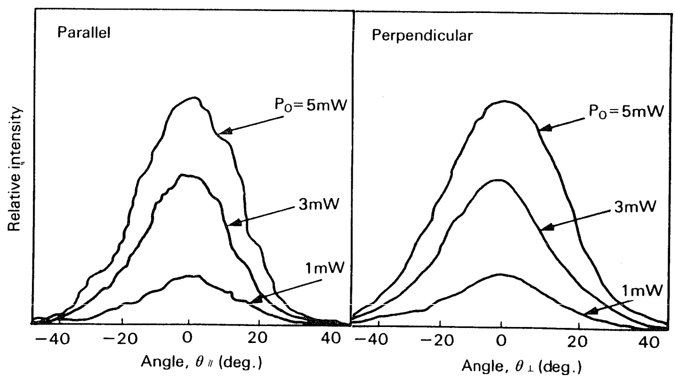
Lasing Spectrum



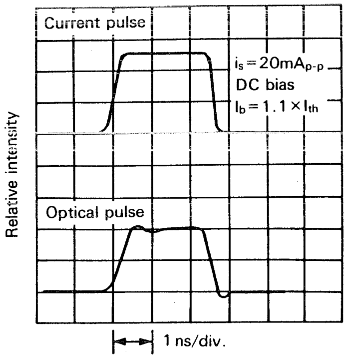
Temperature Dependence of Lasing Spectrum



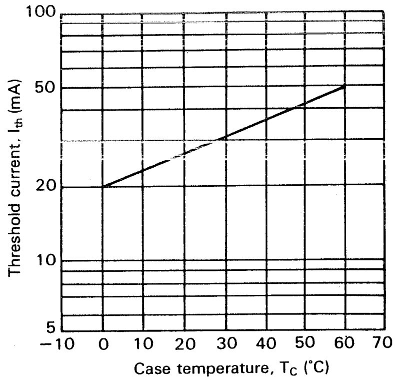
Far Field Pattern



Pulse Response



Threshold Current vs. Case Temperature



HL1521AC

InGaAsP LD

Description

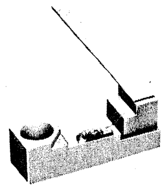
HL1521AC is a 1.55 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

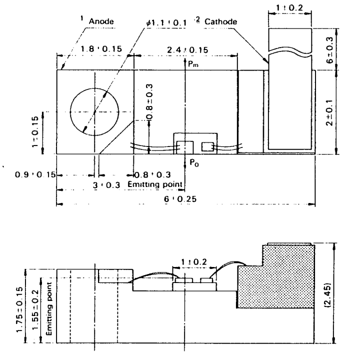
The package is compact to facilitate module assembly.

Features

- Long wavelength light output: λ_p = 1530 – 1570 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions



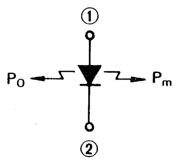
(Unit: mm)

AC-type

Absolute Maximum Ratings (T_C = 25°C)

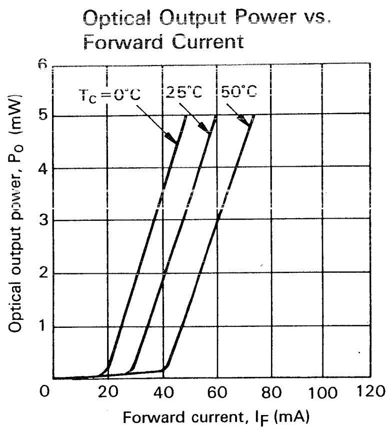
Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

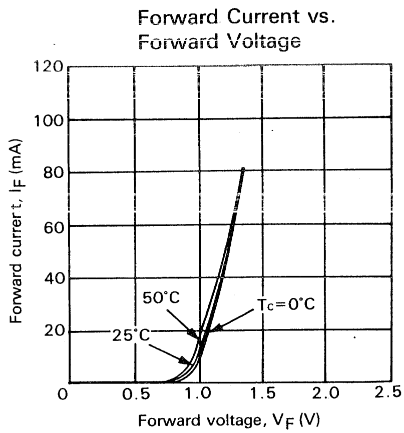
Internal Circuit

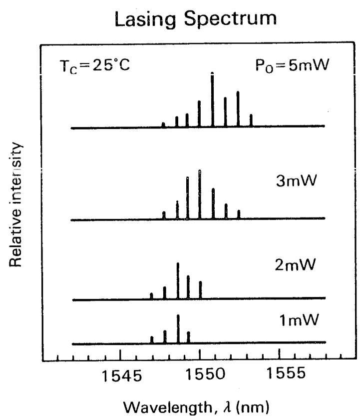


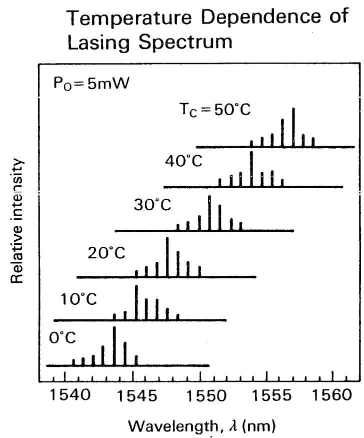
Optical and Electrical Characteristics (T_C = 25°C)

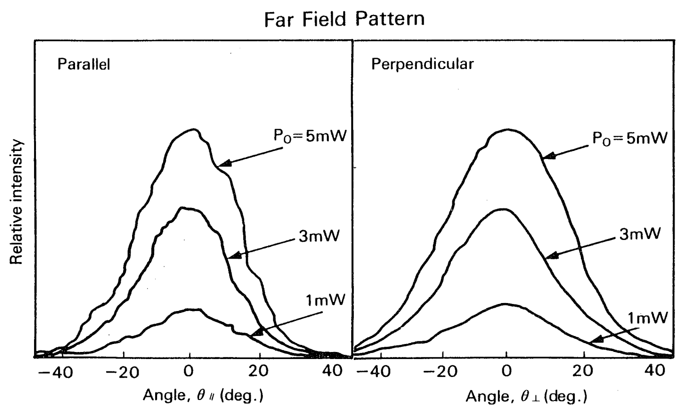
Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.0			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	


Optical Output Power vs.
Forward Current
Tc=0°C
25°C
50°C
Optical output power, Po (mW)
Forward current, IF (mA)
0
20
40
60
80
100
120
1
2
3
4
5
6

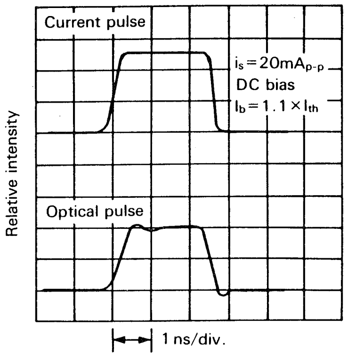

Forward Current vs.
Forward Voltage
Forward current, IF (mA)
Forward voltage, VF (V)
50°C
25°C
Tc=0°C
0
0.5
1.0
1.5
2.0
2.5
20
40
60
80
100
120


Lasing Spectrum
Tc=25°C
Po=5mW
3mW
2mW
1mW
Relative intensity
1545
1550
1555
Wavelength, λ (nm)

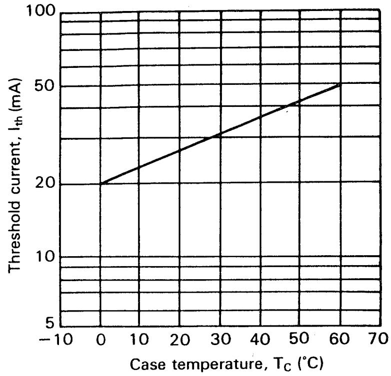

Temperature Dependence of
Lasing Spectrum
Po=5mW
Tc=50°C
40°C
30°C
20°C
10°C
0°C
Relative intensity
1540
1545
1550
1555
1560
Wavelength, λ (nm)


Far Field Pattern
Parallel
Perpendicular
Po=5mW
3mW
1mW
Po=5mW
3mW
1mW
Relative intensity
−40
−20
0
20
40
−40
−20
0
20
40
Angle, θ∥ (deg.)
Angle, θ⊥ (deg.)

Pulse Response



Threshold Current vs. Case Temperature



HL1541A

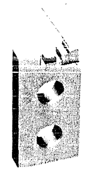
—Preliminary—
InGaAsP LD

Description

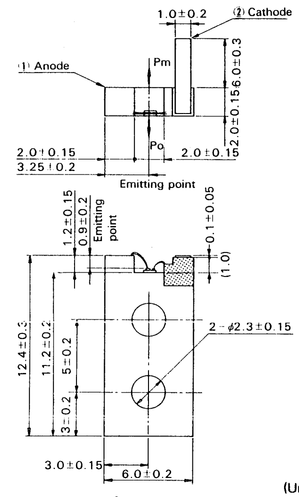
HL1541A is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.



Package Dimensions

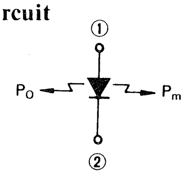


A-type

Features

- Long wavelength light output: λ_p = 1520 – 1580 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1520	1550	1580	nm	P_O = 3 mW
Side-mode suppression ratio	S_r		35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1541AC

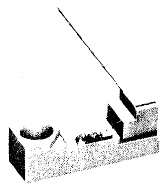
—Preliminary—
InGaAsP LD

Description

HL1541AC is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried heterostructure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

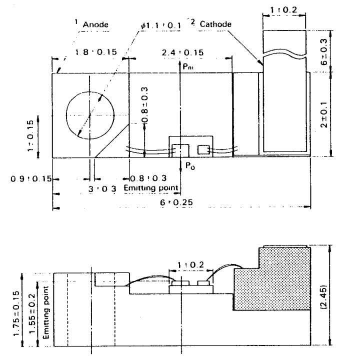
The package is compact to facilitate module assembly.



Features

- Long wavelength light output: λ_p = 1520 − 1580 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Fast pulse response: t_r, t_f ≦ 0.5 ns

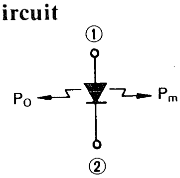
Package Dimensions



AC-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1520	1550	1580	nm	P_O = 3 mW
Side-mode suppression ratio	S_r		35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1541FG

—Under development—
InGaAsP LD

Description

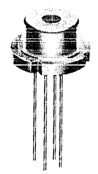
HL1541FG is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

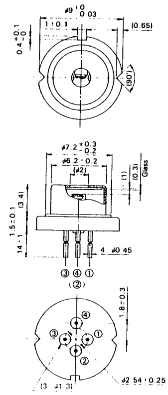
The laser beam is output through the glass window in the package. Monitoring current is output from a built-in photodiode.

Features

- Long wavelength light output: $\lambda_p = 1520 - 1580$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions

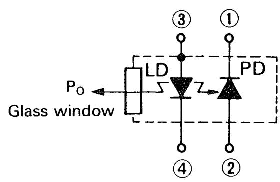


Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 1.53

1. Photodiode cathode
2. Photodiode anode
3. Laser diode anode (Case)
4. Laser diode cathode

FG-type (Unit: mm)

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1520	1550	1580	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r		35		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	100			μA	$V_{R(PD)} = 5$ V, $P_O = 3$ mW
Photodiode capacitance	C_t		15	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	

HL1541BF

—Under development—
InGaAsP LD

Description

HL1541BF is a laser-diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

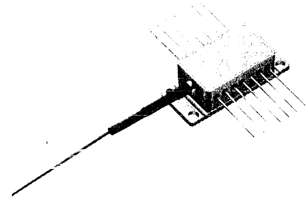
Spot size	: 5 μm
λ_c	: 1.10–1.28 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

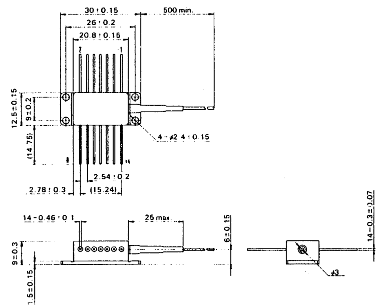
- Long wavelength light output: λ_p = 1520–1580 nm
- 1.2 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



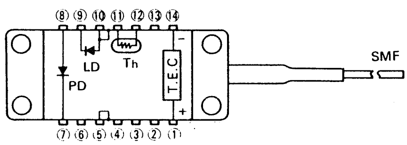
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1520	1550	1580	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r		35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.3			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$T_C = 60°C$, $P_f = 0.5$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

HL1541DL

—Under development—
InGaAsP LD

Description

HL1541DL is a laser-diode module in a 14-pin dual-in-line type package with a built-in thermo-electronic controller and connected single mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

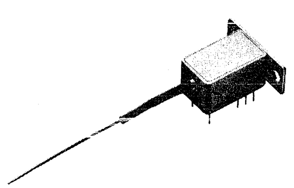
Spot size	: 5 μm
λ_c	: 1.10–1.28 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

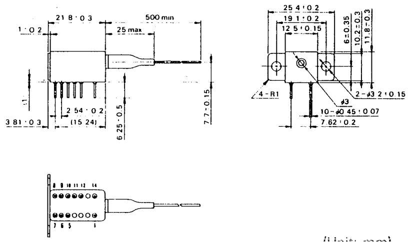
- Long wavelength light output: λ_p = 1520–1580 nm
- 1.2 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



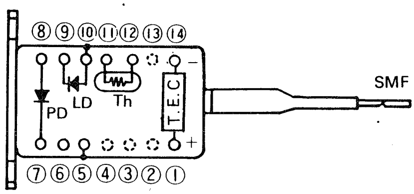
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1520	1550	1580	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r		35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.3			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$T_C = 60°C$, $P_f = 0.5$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

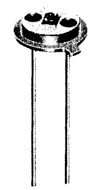
Infrared Emitting Diodes

Product Lineup

Chips	Packages R	RG	SG	VG	ML	SL	F
HLP30	HLP20R —HLP60R	HLP20RG —HLP60RG					
HE8403	HE8403R		HE8403SG		HE8403ML		HE8402F
HE8801			HE8801				
HE8805				HE8805VG			
HE8806				HE8806VG			
HE8807			HE8807SG			HE8807SL	
HE8811			HE8811				
HE1301	HE1301R		HE1301SG		HE1301ML		
HE1302					HE1302ML		

HLP20R, HLP30R, HLP40R, HLP50R, HLP60R

GaAlAs IRED



Description

HLP20R, HLP30R, HLP40R, HLP50R and HLP60R are GaAlAs infrared emitting diodes with single heterojunction structure.

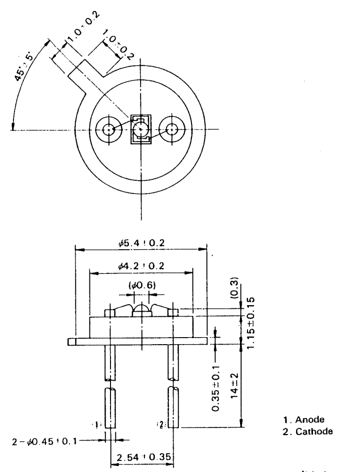
They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

The package should be hermetically sealed before mounting on a system.

Features

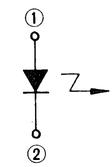
- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width

Package Dimensions



R-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +40**	°C
Storage temperature	T_{stg}	−40 to +60**	°C

* Value for devices with λ_p from 735 nm to 785 nm.
** Value for conditions without condensation.

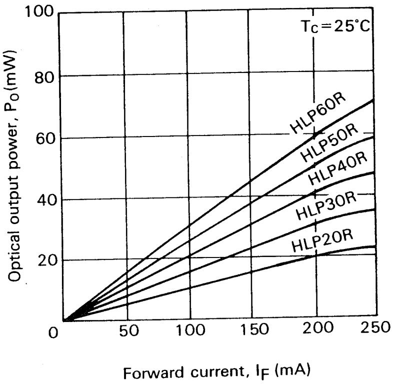
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	$I_F = 200$ mA
Peak wavelength	λ_p		**		nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 200$ mA
Beam divergence	θ_H		180		deg.	$I_F = 200$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 200$ mA
			2.0*	2.6*	V	$I_F = 200$ mA
Reverse current	I_R			30	μA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA
Fall time	t_f		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA

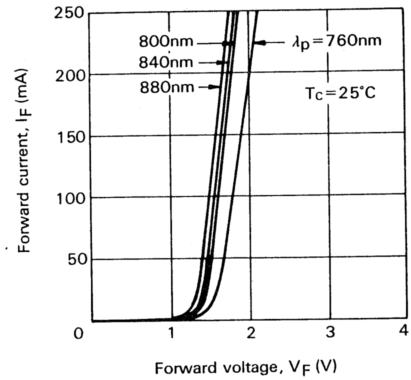
* Value for devices with λ_p from 735 nm to 785 nm.
** HLP20R-HLP60R are grouped with λ_p and P_O as follows.

Grades	λ_p (nm) min.	λ_p (nm) typ.	λ_p (nm) max.	P_O (mW) 15 (min.)	P_O (mW) 25 (min.)	P_O (mW) 35 (min.)	P_O (mW) 45 (min.)	P_O (mW) 55 (min.)
A	735	760	785	HLP20R	HLP30R	HLP40R		
B	775	800	825		HLP30R	HLP40R	HLP50R	HLP60R
C	815	840	865		HLP30R	HLP40R	HLP50R	HLP60R
D	855	880	905		HLP30R	HLP40R	HLP50R	HLP60R

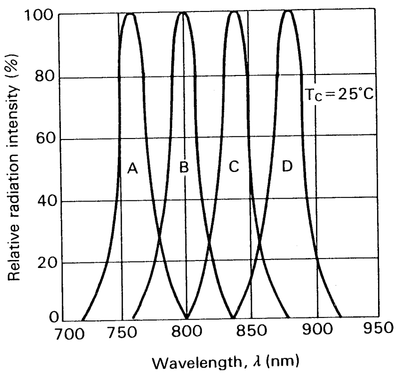
Optical Output Power vs.
Forward Current



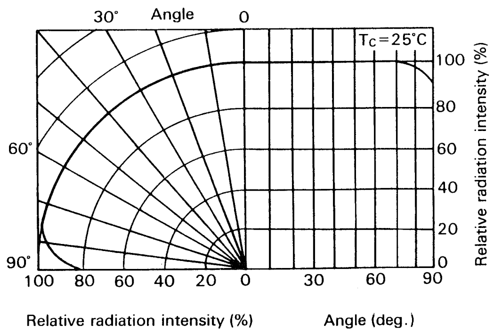
Forward Current vs.
Forward Voltage



Emission Spectra of
Standard Products



Radiation Pattern



HLP20RG, HLP30RG, HLP40RG, HLP50RG, HLP60RG

GaAlAs IRED

Description

HLP20RG, HLP30RG, HLP40RG, HLP50RG and HLP60RG are GaAlAs infrared emitting diodes with single heterojunction structure.

They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

Hermetic sealing of the package achieves high reliability.

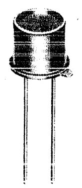
Features

- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width

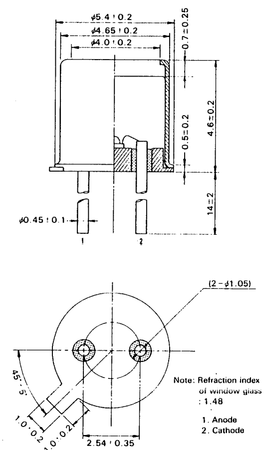
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

* Value for devices with λ_p from 735 nm to 785 nm.



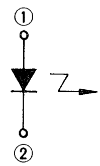
Package Dimensions



(Unit: mm)

RG-type

Internal Circuit



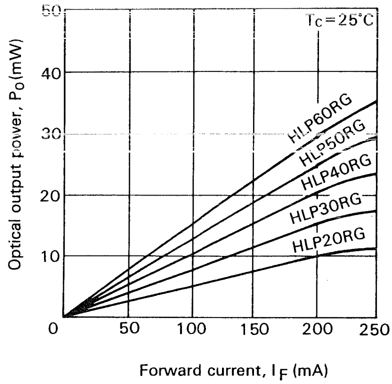
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	$I_F = 200$ mA
Peak wavelength	λ_p		**		nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 200$ mA
Beam divergence	θ_H		120		deg.	$I_F = 200$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 200$ mA
			2.0*	2.6*	V	$I_F = 200$ mA
Reverse current	I_R			30	μA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA
Fall time	t_f		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA

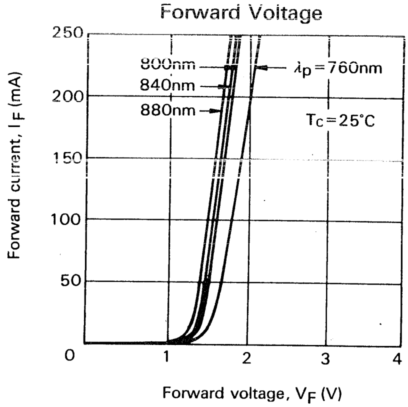
* Value for devices with λ_p from 735 nm to 785 nm.
** HLP20RG-HLP60RG are grouped with λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)				
Grades	min.	typ.	max.	7 (min.)	12 (min.)	17 (min.)	22 (min.)	27 (min.)
A	735	760	785	HLP20RG	HLP30RG	HLP40RG		
B	775	800	825		HLP30RG	HLP40RG	HLP50RG	HLP60RG
C	815	840	865		HLP30RG	HLP40RG	HLP50RG	HLP60RG
D	855	880	905		HLP30RG	HLP40RG	HLP50RG	HLP60RG

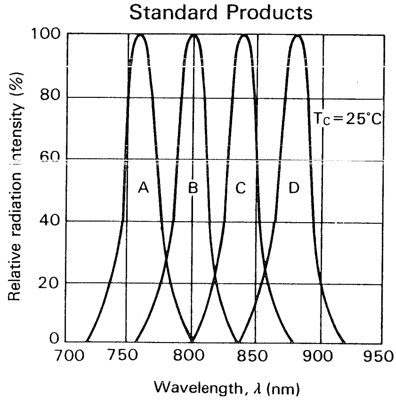
Optical Output Power vs. Forward Current



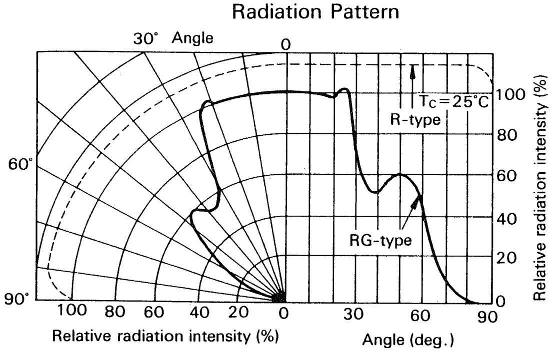
Forward Current vs. Forward Voltage



Emission Spectra of Standard Products



Radiation Pattern



HE8402F

GaAlAs IRED

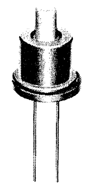
Description

HE8402F is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

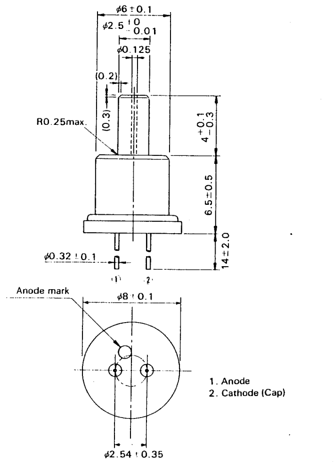
The package can be easily connected to optical fiber, and is suitable as a light source in fiberoptic communications equipment.

Features

- Optical fiber rod (50 μm of core dia., GI) included in ferrule (2.5 mm dia.)
- Ease in fiber coupling
- High frequency response
- Excellent light-current linearity



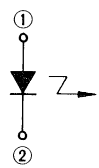
Package Dimensions



(Unit: mm)

F-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

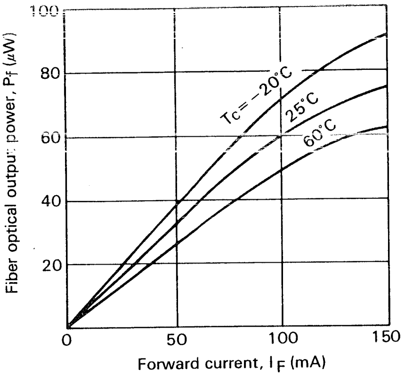
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

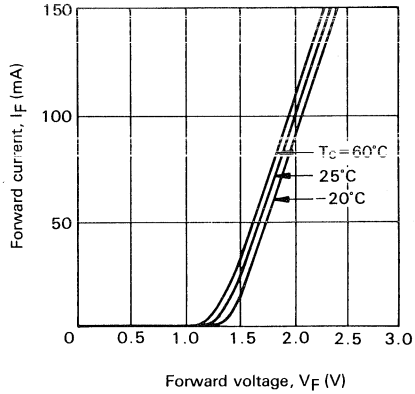
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	40	60		μW	$I_F = 100$ mA
Peak wavelength	λ_p	800	840	900	nm	$I_F = 100$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 100$ mA
Forward voltage	V_F			2.5	V	$I_F = 100$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

* At GI 50/125 fiber end.

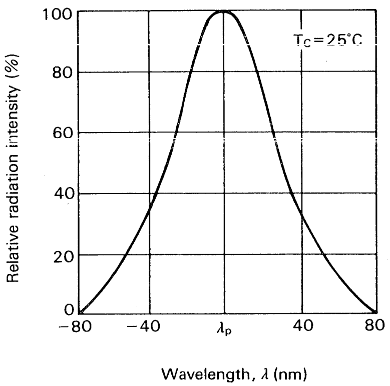
Optical Output Power vs. Forward Current



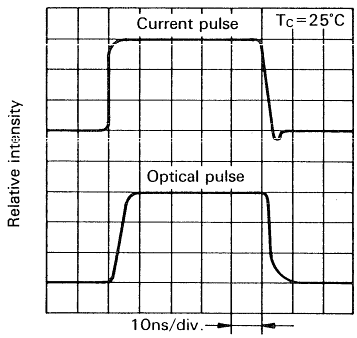
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8403R

GaAlAs IRED

Description

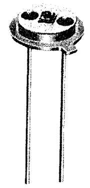
HE8403R is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical fiber can be close to the chip, achieving high coupling efficiency; suitable as a light source in fiberoptic communications equipment.

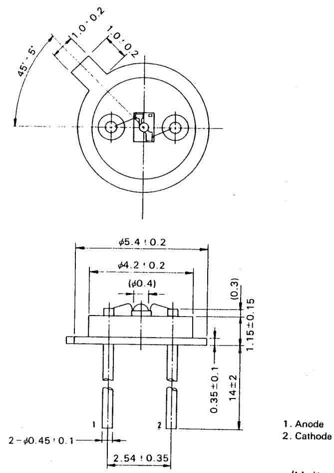
The package should be hermetically sealed before mounting on a system.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity



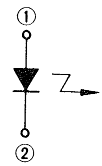
Package Dimensions



R-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +40*	°C
Storage temperature	T_{stg}	−40 to +60*	°C

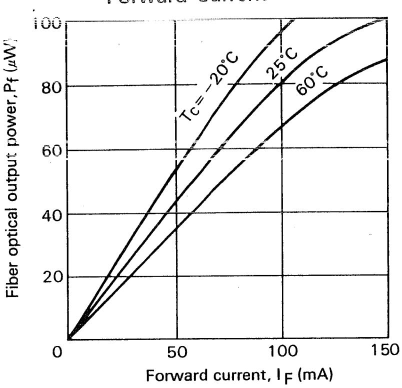
* Value for conditions without condensation.

Optical and Electrical Characteristics ($T_C = 25°C$)

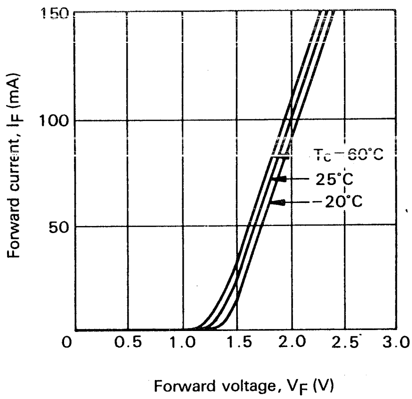
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	50	80		μW	$I_F = 100$ mA
Peak wavelength	λ_p	800	840	900	nm	$I_F = 100$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 100$ mA
Forward voltage	V_F			2.5	V	$I_F = 100$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

* At GI 50/125 fiber end.

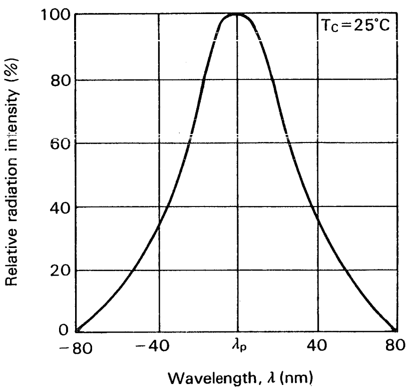
Optical Output Power vs. Forward Current



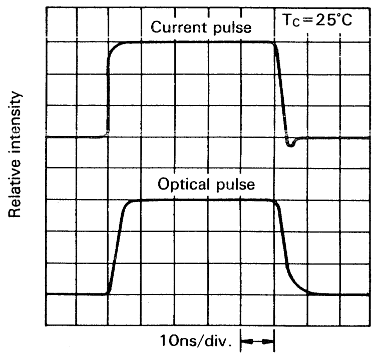
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8403SG

GaAlAs IRED

Description

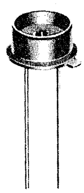
HE8403SG is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

High coupling efficiency can be realized using a rod lens; suitable as a light source in fiberoptic communications equipment.

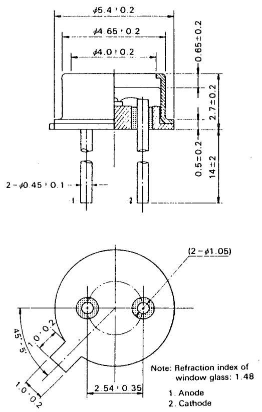
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity



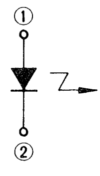
Package Dimensions



(Unit: mm)

SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

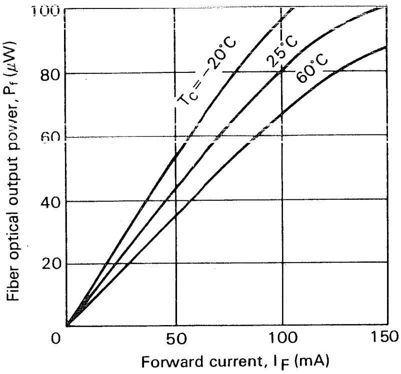
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

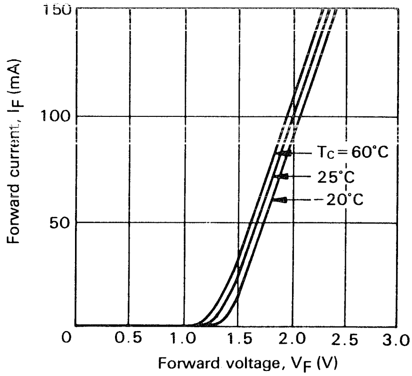
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	40	80		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end through rod lens.

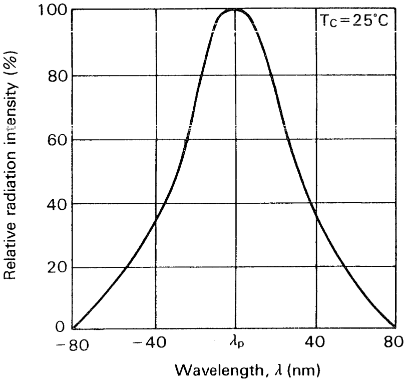
Optical Output Power vs. Forward Current



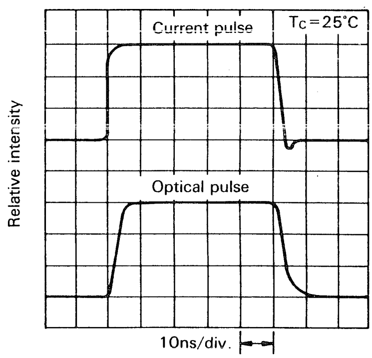
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8403ML

GaAlAs IRED

Description

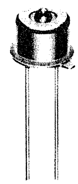
HE8403ML is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

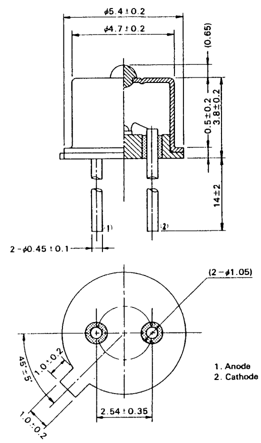
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity



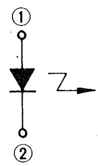
Package Dimensions



ML-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

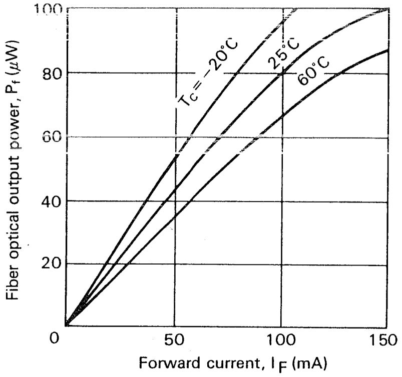
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

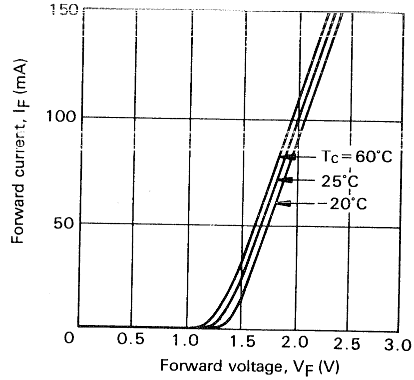
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	50	80		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end.

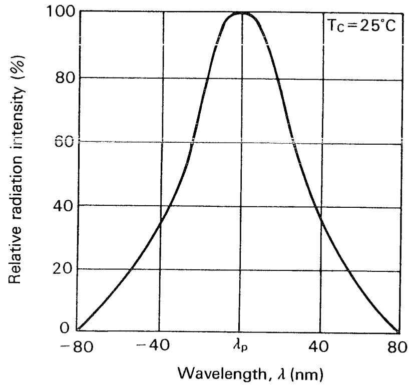
Optical Output Power vs. Forward Current



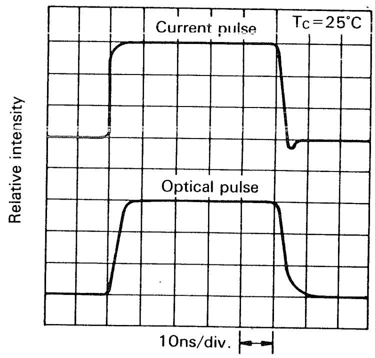
Forward Current vs. Forward Voltage



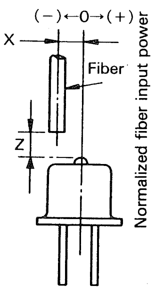
Spectral Distribution

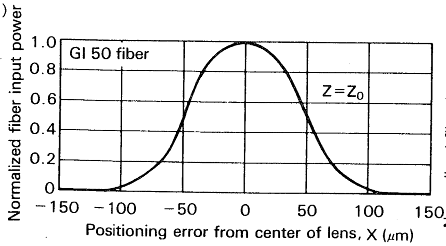


Pulse Response



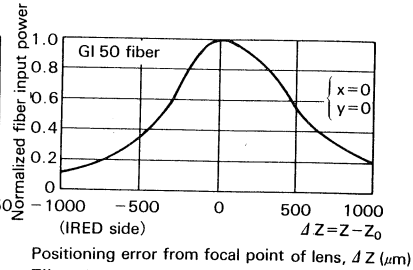
Coupling Characteristics





Fiber input deviation due to lateral fiber positioning error

Z_0: Focal point of lens



Fiber input deviation due to horizontal fiber positioning error

HE8801

GaAlAs IRED

Description

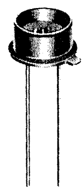
HE8801 is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

Wide radiant directionality makes it suitable as a light source in various types of optical equipment.

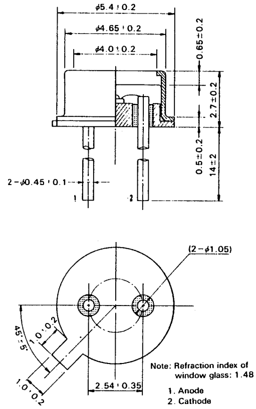
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality



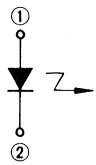
Package Dimensions



(Unit: mm)

SG-type

Internal Circuit



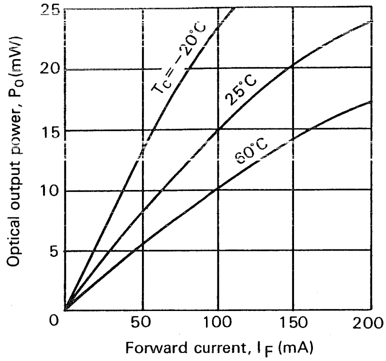
Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	400	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

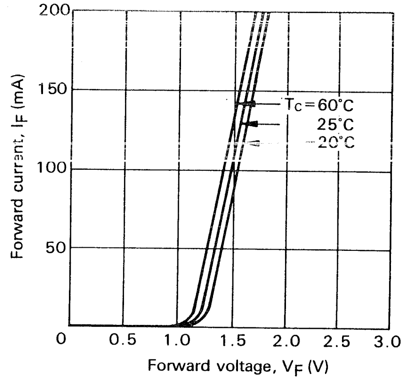
Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	6	20		mW	$I_F = 150$ mA
Peak wavelength	λ_p	800	880	900	nm	$I_F = 150$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 150$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 150$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		12		ns	$I_F = 50$ mA
Fall time	t_f		12		ns	$I_F = 50$ mA

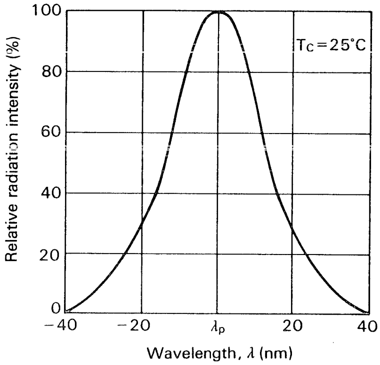
Optical Output Power vs. Forward Current



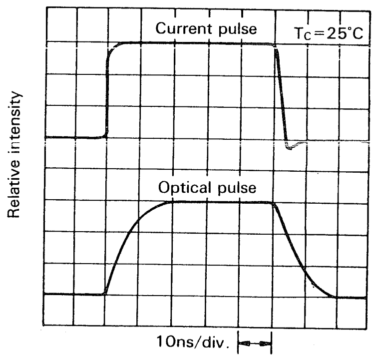
Forward Current vs. Forward Voltage



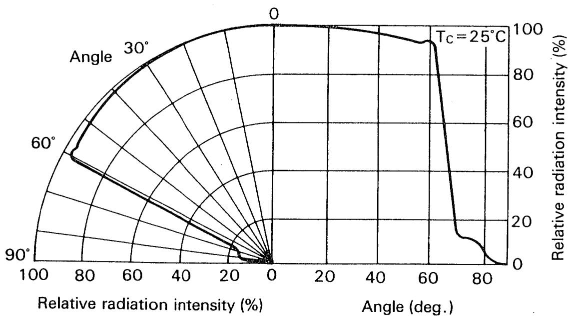
Spectral Distribution



Pulse Response



Radiation Pattern



HE8805VG

GaAlAs IRED

Description

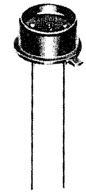
HE8805VG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

It is suitable as a light source in autofocusing still cameras.

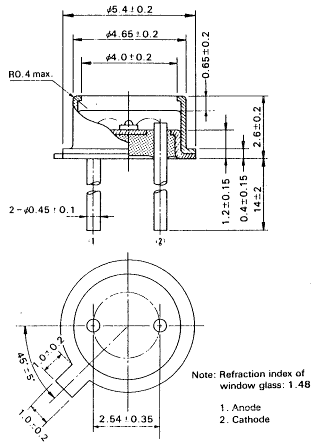
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality



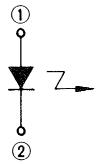
Package Dimensions



VG-type

(Unit: mm)

Internal Circuit



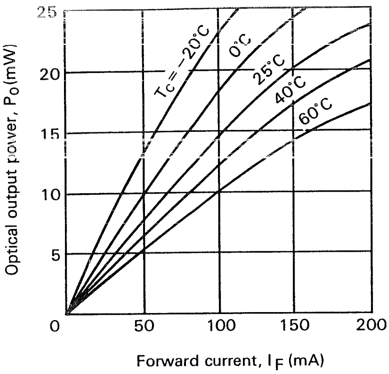
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

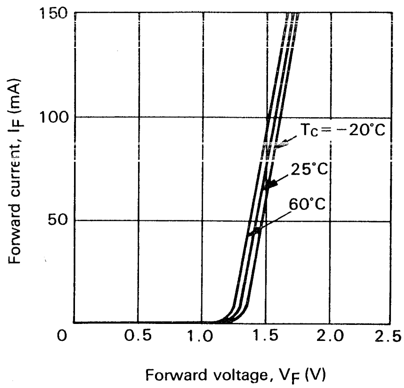
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	6	20		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

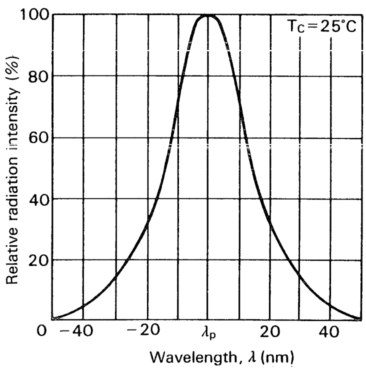
Optical Output Power vs. Forward Current



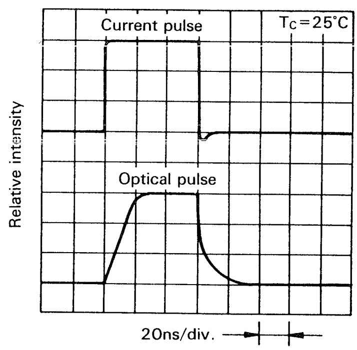
Forward Current vs. Forward Voltage



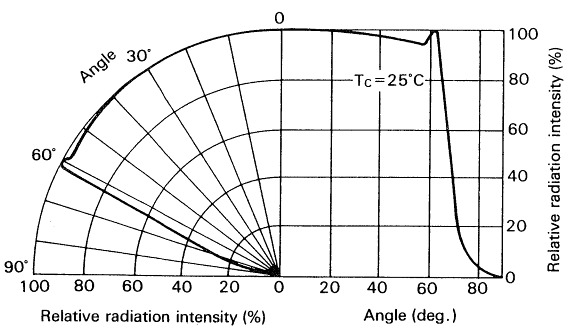
Spectral Distribution



Pulse Response



Radiation Pattern



HE8806VG

GaAlAs IRED

Description

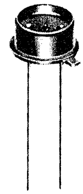
HE8806VG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

It is suitable as a light source in autofocusing VTR cameras.

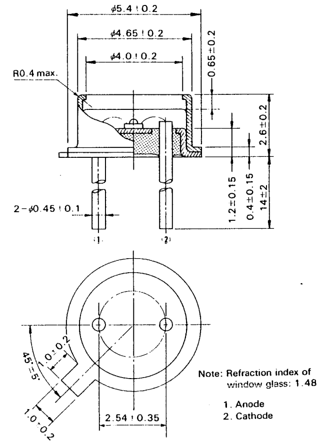
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality



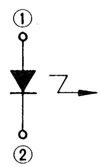
Package Dimensions



(Unit: mm)

VG-type

Internal Circuit



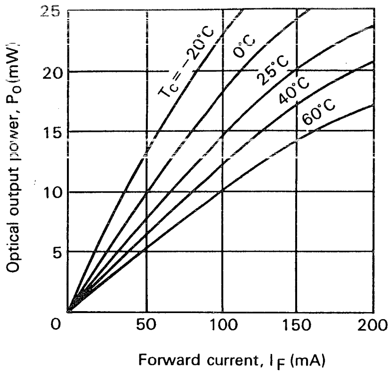
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

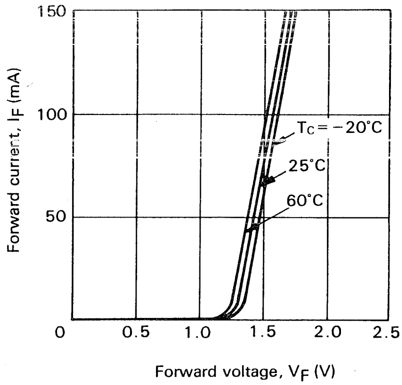
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	12	20		mW	$I_F = 150$ mA
Peak wavelength	λ_p	800	880	900	nm	$I_F = 150$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 150$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 150$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		20		ns	$I_F = 50$ mA
Fall time	t_f		20		ns	$I_F = 50$ mA

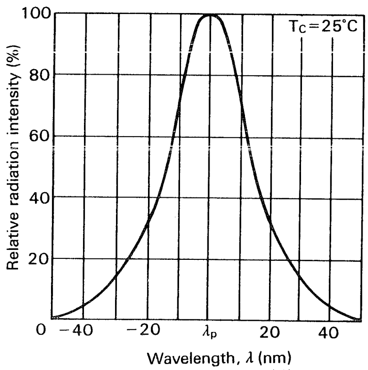
Optical Output Power vs. Forward Current



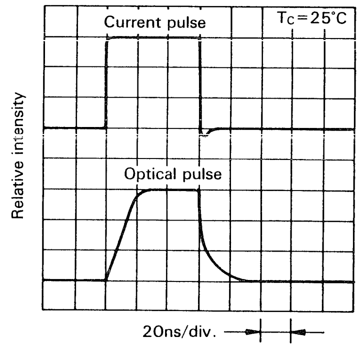
Forward Current vs. Forward Voltage



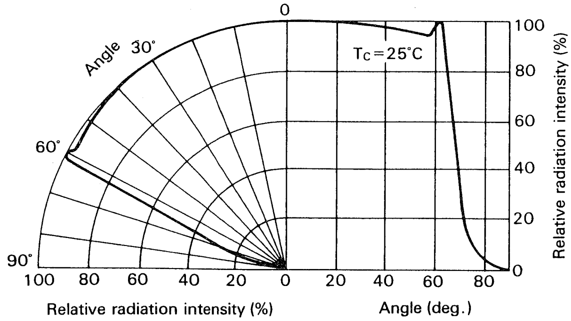
Spectral Distribution



Pulse Response



Radiation Pattern



HE8807SG

—Preliminary—
GaAlAs IRED

Description

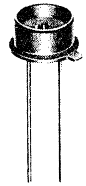
HE8807SG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

Radiant directionality is wide and radiant intensity is high; suitable as a light source in encoders and sensors.

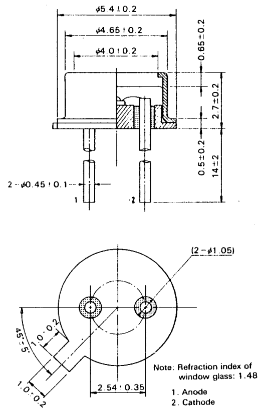
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width



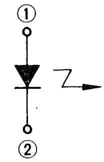
Package Dimensions



(Unit: mm)

SG-type

Internal Circuit



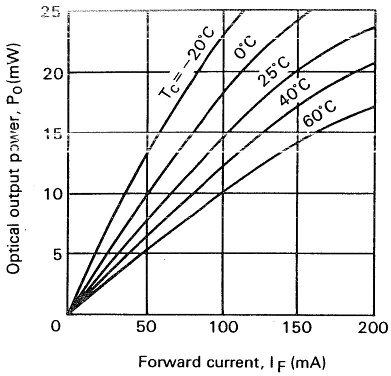
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

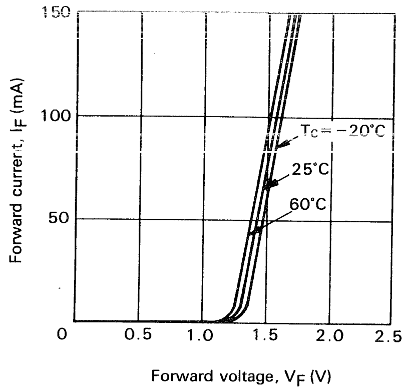
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	10	20		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

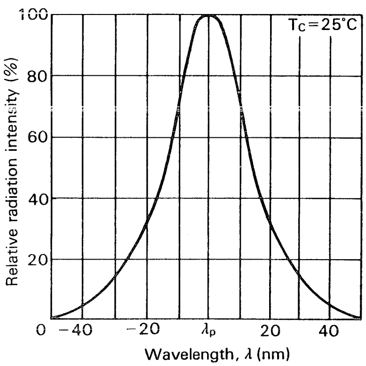
Optical Output Power vs. Forward Current



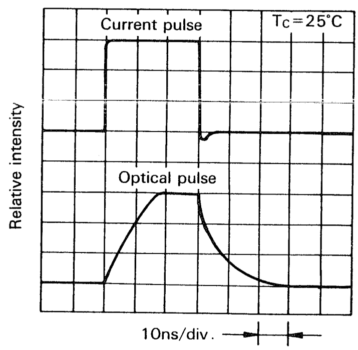
Forward Current vs. Forward Voltage



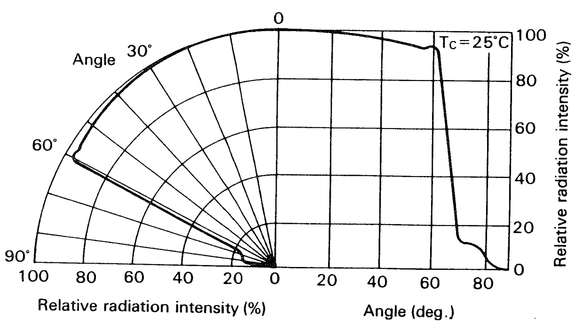
Spectral Distribution



Pulse Response



Radiation Pattern



HE8807SL

—Preliminary—
GaAlAs IRED

Description

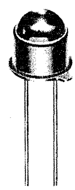
HE8807SL is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

Radiant directionality is narrow and radiant intensity is high; suitable as a light source in encoders and sensors.

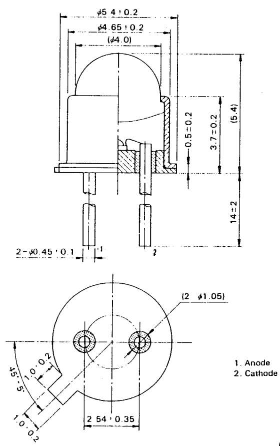
The package is hermetically sealed with the cap and lens, achieving high reliability.

Features

- High efficiency and high power output
- Narrow spectral width



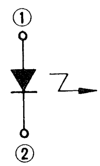
Package Dimensions



(Unit: mm)

SL-type

Internal Circuit

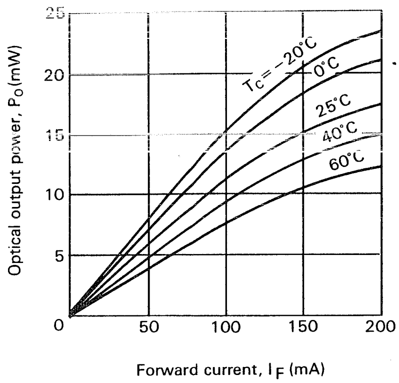


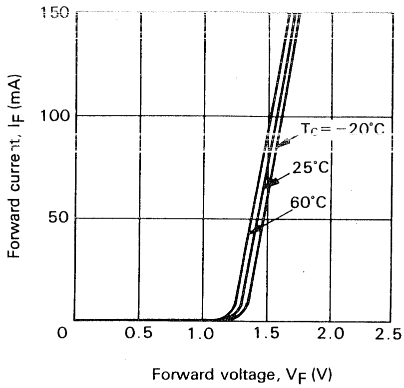
Absolute Maximum Ratings ($T_C = 25°C$)

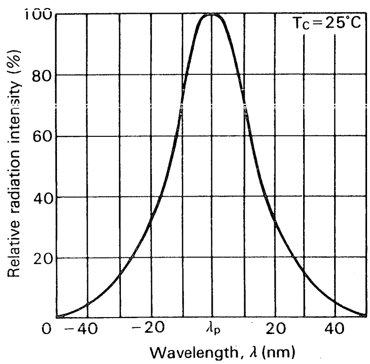
Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

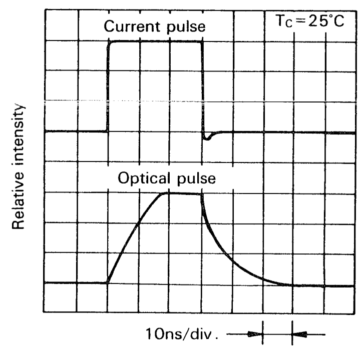
Optical and Electrical Characteristics ($T_C = 25°C$)

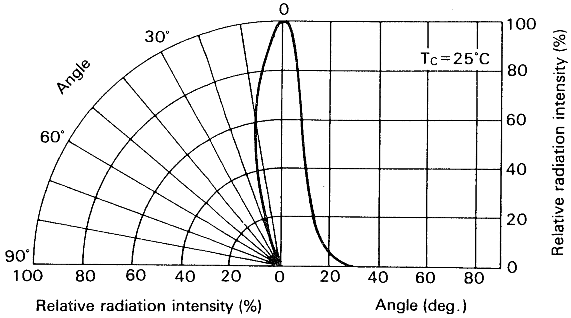
Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	5	15		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA


Optical Output Power vs.
Forward Current
Optical output power, Po (mW)
Forward current, IF (mA)
0
5
10
15
20
25
50
100
150
200
Tc=−20°C
0°C
25°C
40°C
60°C


Forward Current vs.
Forward Voltage
Forward current, IF (mA)
Forward voltage, VF (V)
0
50
100
150
0.5
1.0
1.5
2.0
2.5
Tc=−20°C
25°C
60°C


Spectral Distribution
Relative radiation intensity (%)
Wavelength, λ (nm)
Tc=25°C
0
20
40
60
80
100
−40
−20
λp
20
40


Pulse Response
Current pulse
Optical pulse
Tc=25°C
Relative intensity
10ns/div.


Radiation Pattern
0
30°
60°
90°
Angle
Tc=25°C
100
80
60
40
20
0
Relative radiation intensity (%)
Angle (deg.)

HE8811

GaAlAs IRED

Description

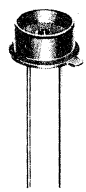
HE8811 is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure. High brightness output, high power output and high speed response can be obtained.

It is suitable as a light source in measuring and beam communications equipment.

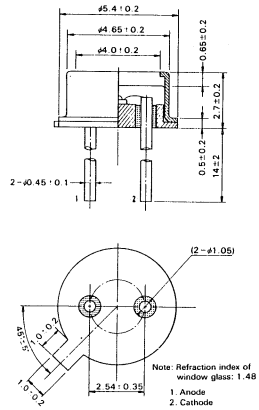
Hermetic sealing of the package achieves high reliability.

Features

- High frequency response
- High power output, high efficiency and high brightness output
- No radiant directionality



Package Dimensions



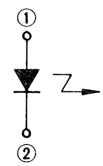
(Unit: mm)

SG-type

Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	400	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

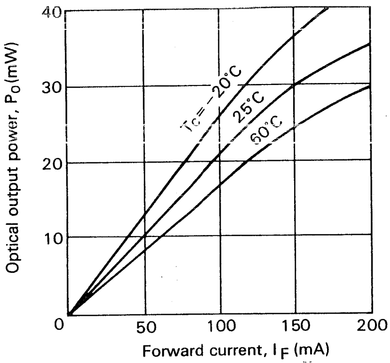
Internal Circuit



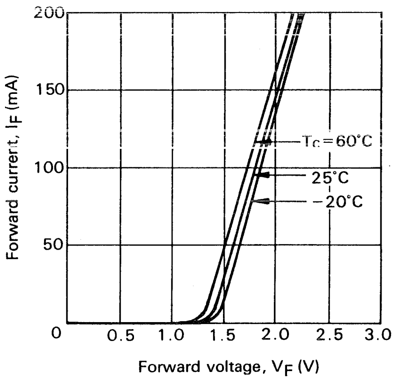
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	20	30		mW	$I_F = 150$ mA
Peak wavelength	λ_p	780	820	900	nm	$I_F = 150$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 150$ mA
Forward voltage	V_F			2.5	V	$I_F = 150$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

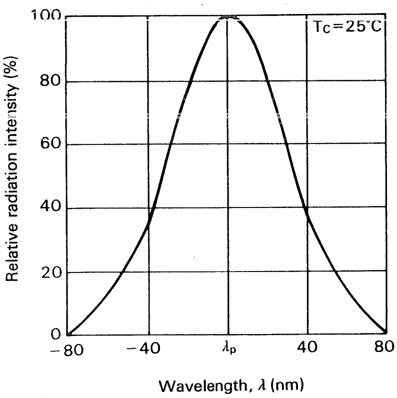
Optical Output Power vs. Forward Current



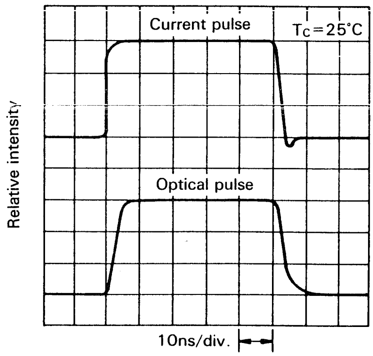
Forward Current vs. Forward Voltage



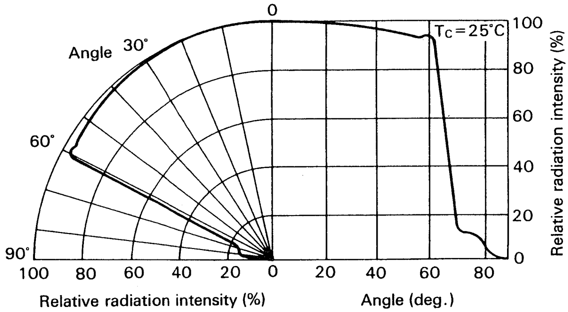
Spectral Distribution



Pulse Response



Radiation Pattern



HE1301R

InGaAsP IRED

Description

HE1301R is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

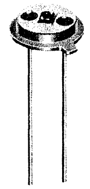
It is suitable as a light source in high-speed digital link (up to 200 Mb/s) of fiberoptic communications equipment.

Optical fiber can be close to the chip, achieving high coupling efficiency.

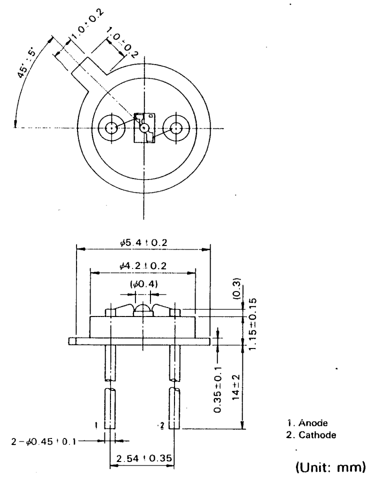
The package should be hermetically sealed before mounting on a system.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response



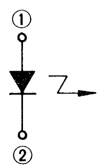
Package Dimensions



(Unit: mm)

R-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +40*	°C
Storage temperature	T_{stg}	−40 to +60*	°C

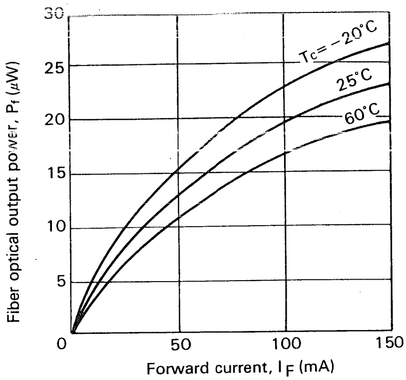
* Value for conditions without condensation.

Optical and Electrical Characteristics ($T_C = 25°C$)

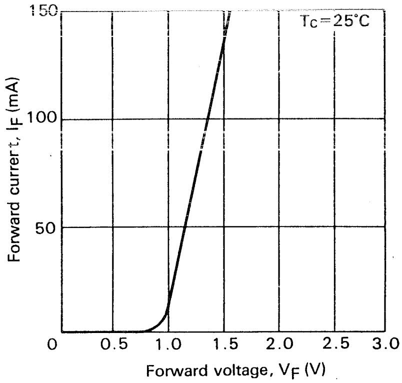
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

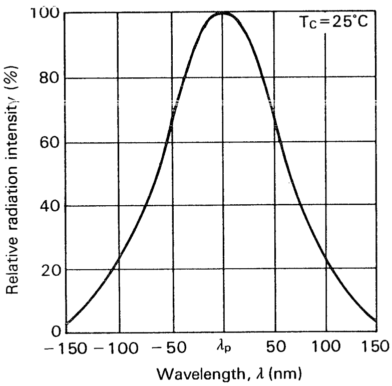
Optical Output Power vs.
Forward Current



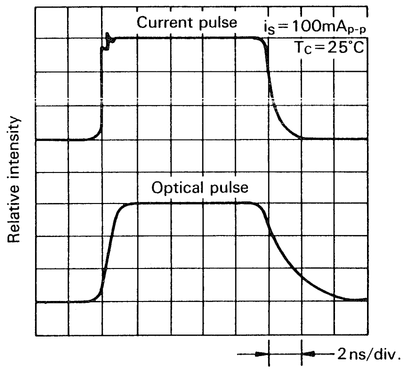
Forward Current vs.
Forward Voltage



Spectral Distribution



Pulse Response



HE1301SG

InGaAsP IRED

Description

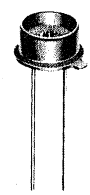
HE1301SG is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

High coupling efficiency can be realized using a rod lens; suitable as a light source in fiberoptic communications equipment.

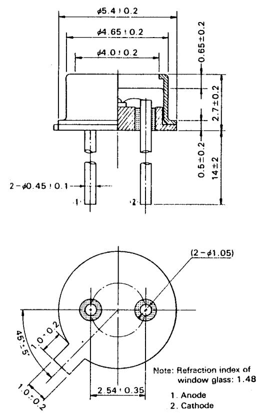
Hermetic sealing of the package achieves high reliability.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response



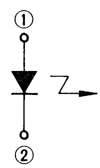
Package Dimensions



(Unit: mm)

SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

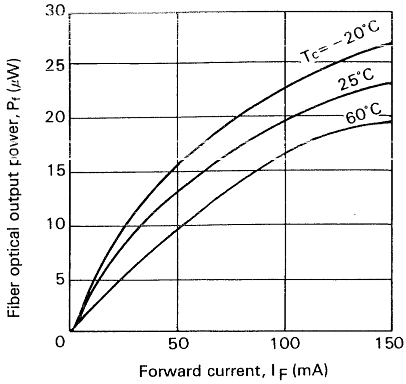
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

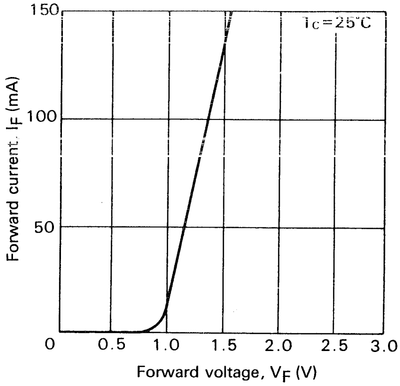
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

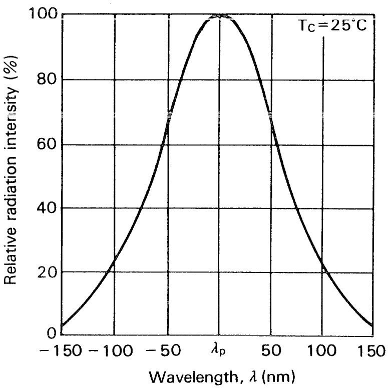
Optical Output Power vs. Forward Current



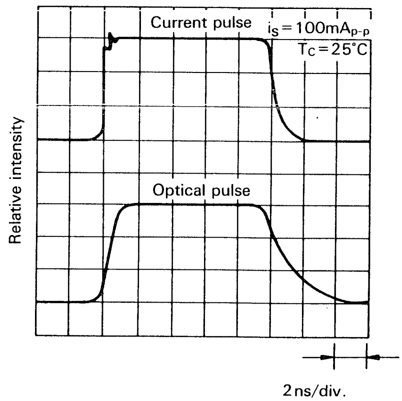
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE1301ML

InGaAsP IRED

Description

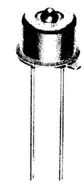
HE1301ML is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

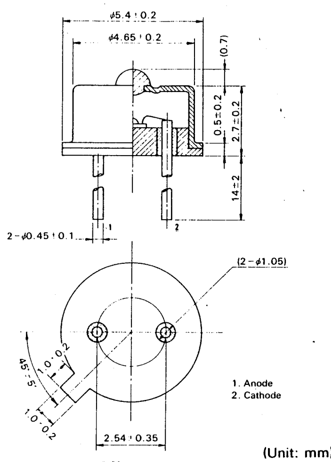
Hermetic sealing of the package achieves high reliability.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response



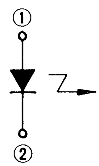
Package Dimensions



(Unit: mm)

ML-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

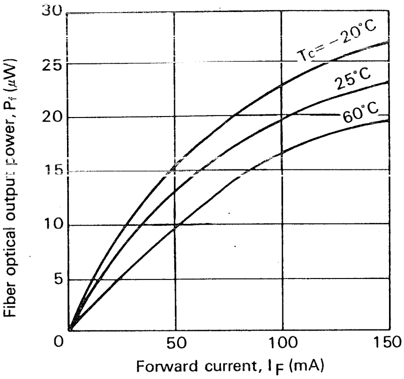
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

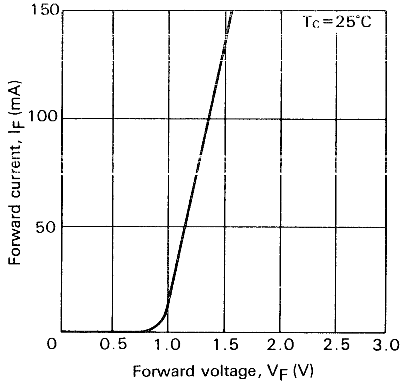
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

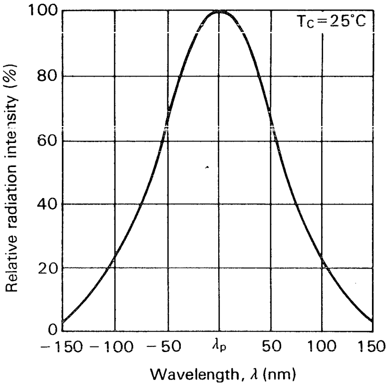
Optical Output Power vs. Forward Current



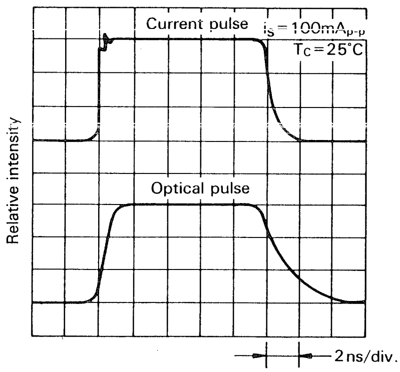
Forward Current vs. Forward Voltage



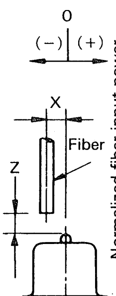
Spectral Distribution

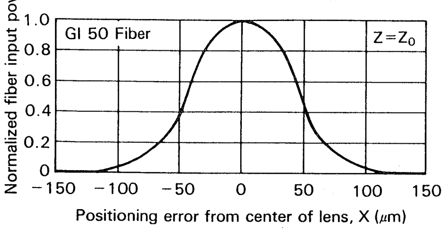


Pulse Response



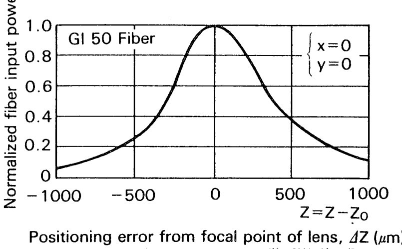
Coupling Characteristics





Fiber input deviation due to lateral fiber positioning error

Z_0: Focal point of lens



Fiber input deviation due to horizontal fiber positioning error

HE1302ML

—Preliminary—
InGaAsP IRED

Description

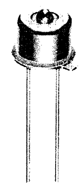
HE1302ML is a high-power 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

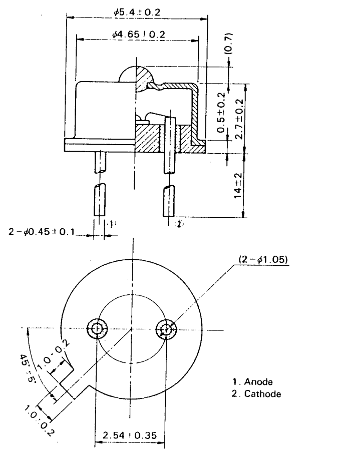
Hermetic sealing of the package achieves high reliability.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response

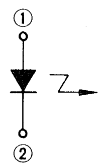


Package Dimensions



ML-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	30			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

Photodiodes

Product Lineup

	Packages		
Chips	OG	TG	CX
HR8101	HR8101		
HR8102		HR8102	
HR8202		HR8202TG	
HR1101		HR1101	
HR1102		HR1102	HR1102CX
HR1103		HR1103TG	HR1103CX
HR1104		HR1104TG	HR1104CX
HR1105		HR1105TG	

HR8101

Si PIN Photodiode

Description

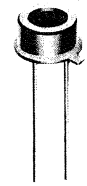
HR8101 is a Si PIN photodiode for detecting 0.6–0.9 μm light.

It is suitable as an optical monitor in measuring and fiberoptic communications and various other types of optical equipment.

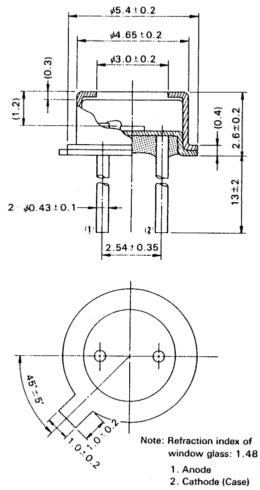
Hermetic sealing of the package achieves high reliability.

Features

- High speed pulse response: t_r, t_f = 30 ns typ.
- Photodetectable area: 0.8 × 0.8 mm□



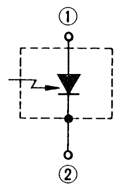
Package Dimensions



(Unit: mm)

QG-type

Internal Circuit



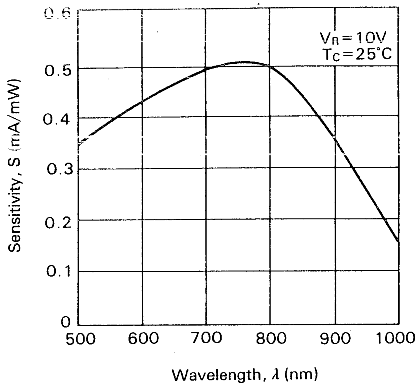
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

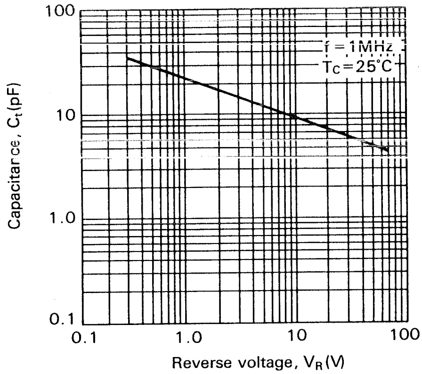
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		2	10	nA	V_R = 10 V
Capacitance	C_t		10	15	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4			mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r		30		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f		30		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

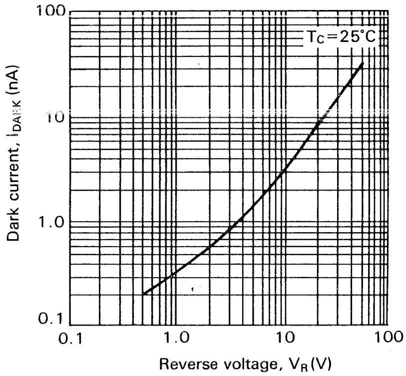
Sensitivity vs. Wavelength



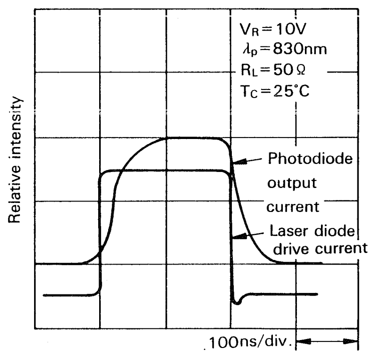
Capacitance vs. Reverse Voltage



Dark Current vs. Reverse Voltage



Pulse Response



HR8102 — Si PIN Photodiode

Description

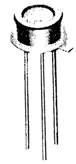
HR8102 is a Si PIN photodiode for detecting 0.6−0.9 μm light.

Its high speed pulse response makes it especially suitable as an optical signal detector in high-bit-rate fiberoptic communications equipment.

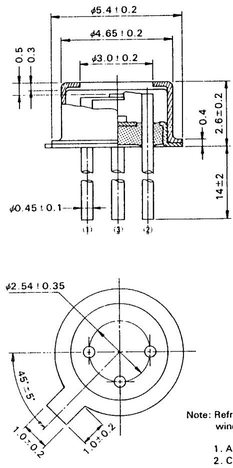
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity to wide wavelength range
- High speed pulse response: t_r, t_f = 1 ns typ.
- 5 V of low voltage operation
- Photodetectable area: 300 μm dia.



Package Dimensions



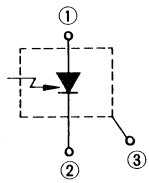
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



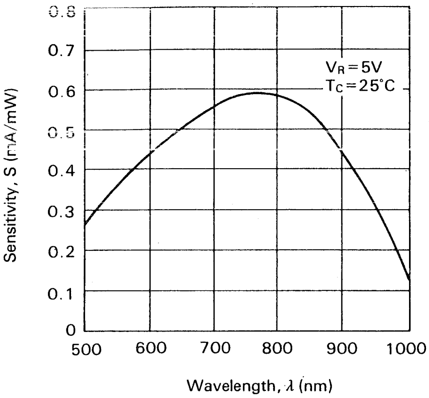
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

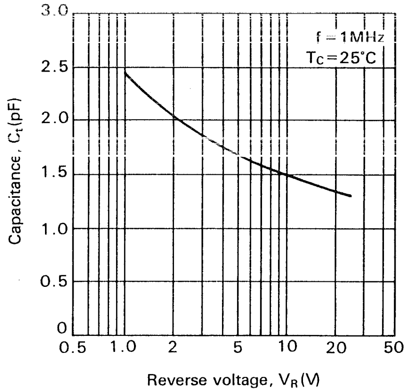
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		0.5	3	nA	V_R = 10 V
Capacitance	C_t		1.5	3	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4			mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r		1.0		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

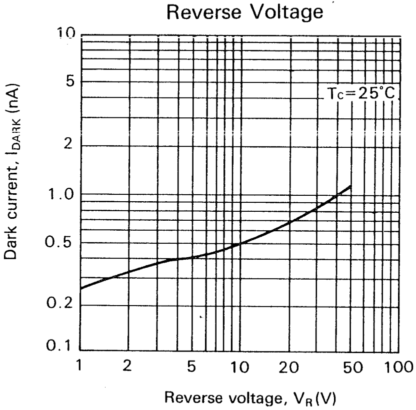
Sensitivity vs. Wavelength



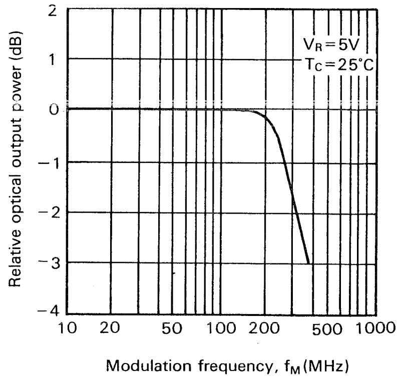
Capacitance vs. Reverse Voltage



Dark Current vs. Reverse Voltage



Frequency Response



HR8202TG

—Preliminary— Si Avalanche Photodiode

Description

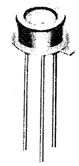
HR8202TG is a Si avalanche photodiode for detecting 0.6−0.9 μm light.

Its high frequency characteristics make it especially suitable as an optical signal detector in analog fiberoptic communications equipment.

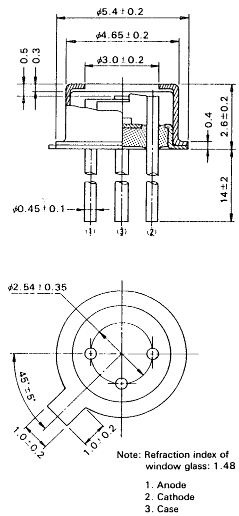
Hermetic sealing of the package achieves high reliability.

Features

- High quantum efficiency: More than 70%
- High speed response : More than 300 MHz
- Low dark current : Less than 3 nA
- Low operation voltage : Less than 200 V
- Photodetectable area : 300 μm dia.

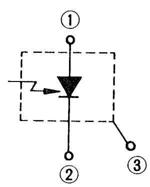


Package Dimensions



TG-type (Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	100	mA
Reverse current	I_R	200	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		0.5	3	nA	$V_R = 0.9 \times V_B$
Quantum efficiency	η	70			%	V_R = 150 V, λ_p = 830 nm
Breakdown voltage	V_B	150		200	V	I_{DARK} = 100 μA
Multiplication factor	M	30				$V_R = 0.9 \times V_B$, λ_p = 830 nm
Capacitance	C_t		1.5		pF	V_R = 150 V, f = 1 MHz

HR1101

InGaAsP PIN Photodiode

Description

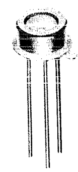
HR1101 is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

Its high-speed pulse response makes it especially suitable as a light signal detector in high-bit-rate fiberoptic communications equipment.

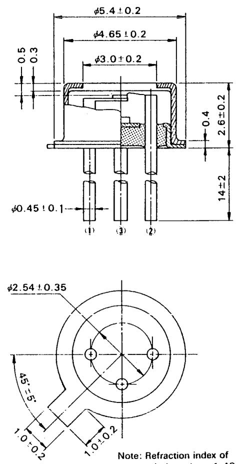
Hermetic sealing of the package achieves high reliability.

Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S ≧ 0.45 mA/mW
- Low dark current : I_{DARK} = 7 nA typ.
- Small capacitance : C_t = 2.0 pF typ.
- Photodetectable area : 100 μm dia.



Package Dimensions



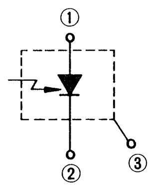
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



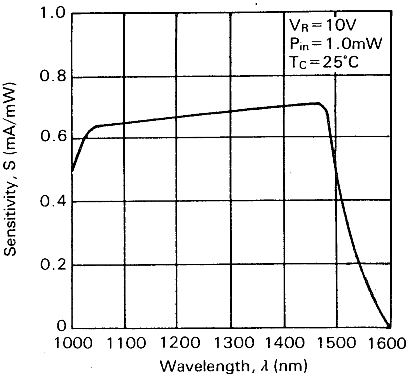
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

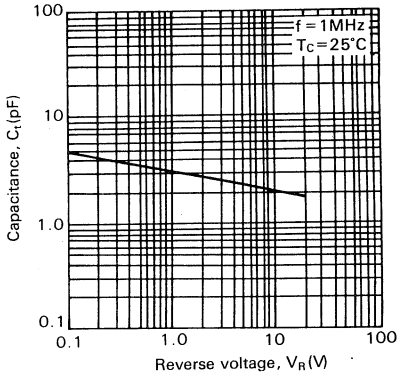
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		7	200	nA	V_R = 10 V
Capacitance	C_t		2.0	3.0	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.45	0.7		mA/mW	V_R = 10 V, λ_p = 1300 nm P_{in} = 1.0 mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω

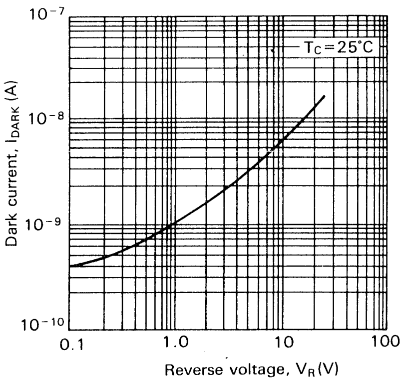
Sensitivity vs.
Wavelength



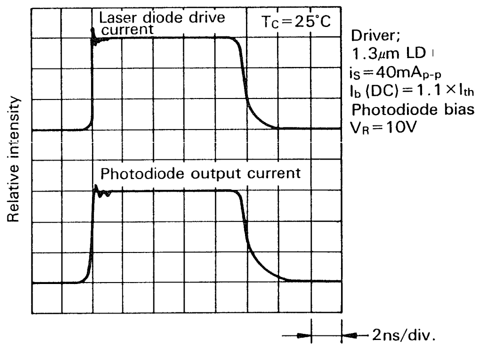
Capacitance vs.
Reverse Voltage



Dark Current vs.
Reverse Voltage



Pulse Response



HR1102

InGaAsP PIN Photodiode

Description

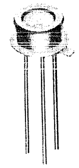
HR1102 is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

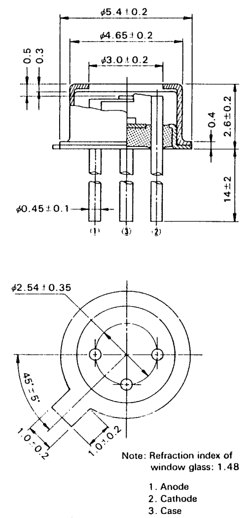
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity : $S \geqq 0.45$ mA/mW
- Low dark current : $I_{DARK} = 20$ nA typ.
- Photodetectable area : 300 μm dia.



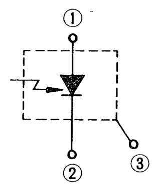
Package Dimensions



(Unit: mm)

TG-type

Internal Circuit



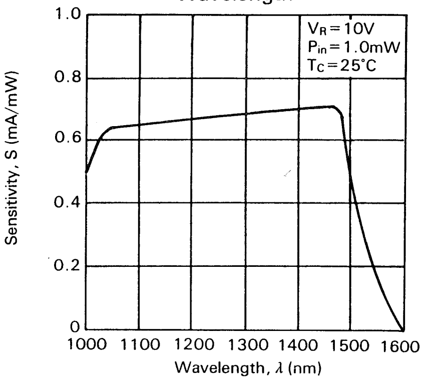
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Reverse voltage	V_R	15	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

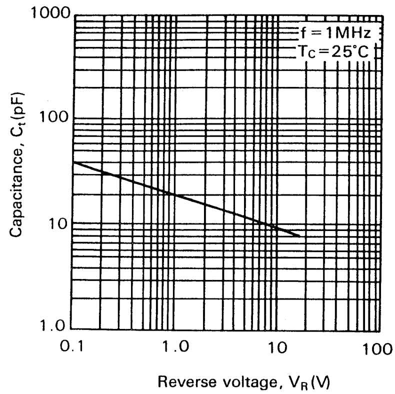
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		20	500	nA	$V_R = 10$ V
Capacitance	C_t		9	15	pF	$V_R = 10$ V, f = 1 MHz
Sensitivity	S	0.45	0.7		mA/mW	$V_R = 10$ V, $\lambda_p = 1300$ nm $P_{in} = 1.0$ mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.2		ns	$V_R = 10$ V, $\lambda_p = 1300$ nm $R_L = 50\ \Omega$
Fall time	t_f		1.2		ns	$V_R = 10$ V, $\lambda_p = 1300$ nm $R_L = 50\ \Omega$

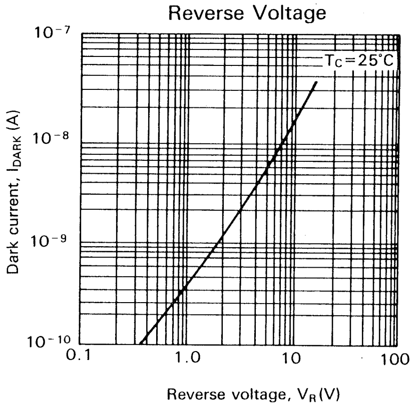
Sensitivity vs.
Wavelength



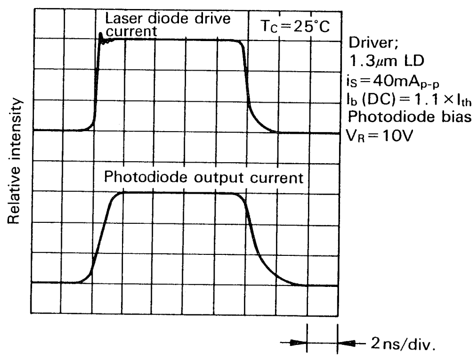
Capacitance vs.
Reverse Voltage



Dark Current vs.
Reverse Voltage

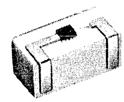


Pulse Response



HR1102CX

InGaAsP PIN Photodiode



Description

HR1102CX is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

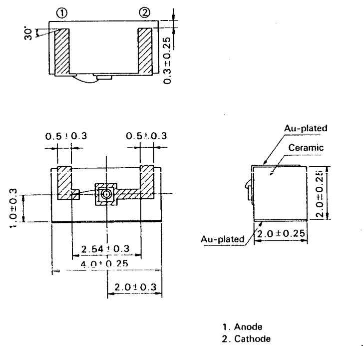
It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

The package is compact for ease in module assembly.

Features

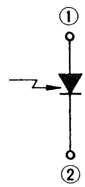
- High sensitivity : S ≧ 0.6 mA/mW
- Low dark current : I_{DARK} = 20 nA typ.
- Photodetectable area : 300 μm dia.

Package Dimensions



CX-type

Internal Circuit

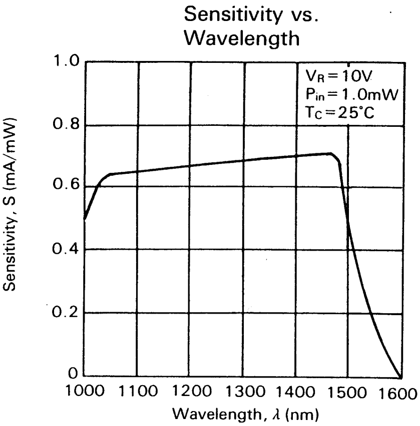


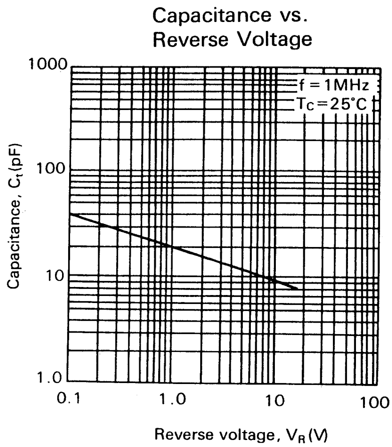
Absolute Maximum Ratings (T_C = 25°C)

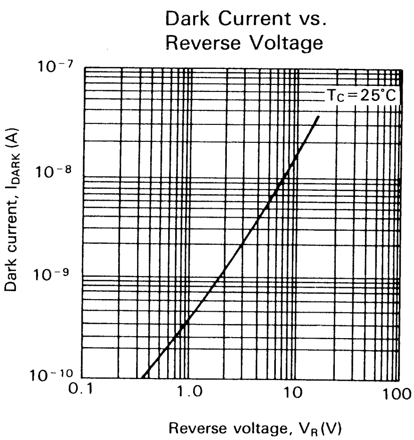
Items	Symbols	Values	Units
Reverse voltage	V_R	15	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

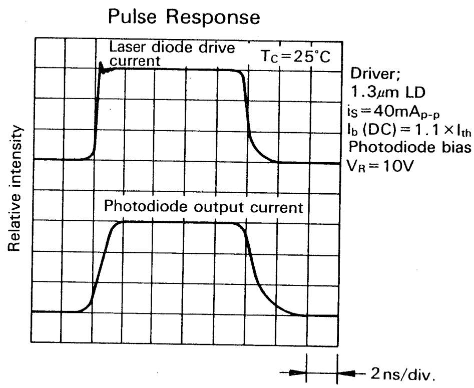
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		20	100	nA	V_R = 10 V
Capacitance	C_t		10		pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.6	0.7		mA/mW	V_R = 10 V, λ_p = 1300 nm P_{in} = 1.0 mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω


Sensitivity vs.
Wavelength
VR = 10V
Pin = 1.0mW
Tc = 25°C
Sensitivity, S (mA/mW)
1.0
0.8
0.6
0.4
0.2
0
1000 1100 1200 1300 1400 1500 1600
Wavelength, λ (nm)


Capacitance vs.
Reverse Voltage
f = 1MHz
Tc = 25°C
Capacitance, Ct (pF)
1000
100
10
1.0
0.1
1.0
10
100
Reverse voltage, VR (V)


Dark Current vs.
Reverse Voltage
Tc = 25°C
Dark current, IDARK (A)
10⁻⁷
10⁻⁸
10⁻⁹
10⁻¹⁰
0.1
1.0
10
100
Reverse voltage, VR (V)


Pulse Response
Laser diode drive current
Tc = 25°C
Driver;
1.3μm LD
is = 40mAp-p
Ib (DC) = 1.1 × Ith
Photodiode bias
VR = 10V
Relative intensity
Photodiode output current
2 ns/div.

HR1103TG

—Preliminary— InGaAs PIN Photodiode

Description

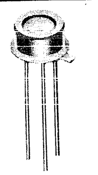
HR1103TG is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

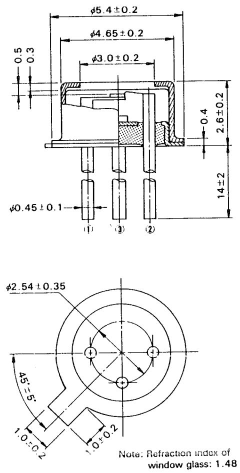
Hermetic sealing of the package achieves high reliability.

Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 1.0 pF typ.
- Photodetectable area : 100 μm dia.



Package Dimensions



Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

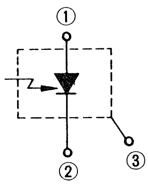
(Unit: mm)

TG-type

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Internal Circuit



Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	20	nA	V_R = 5 V
Capacitance	C_t		1.0	1.5	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

HR1103CX

—Preliminary—
InGaAs PIN Photodiode

Description

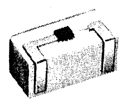
HR1103CX is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

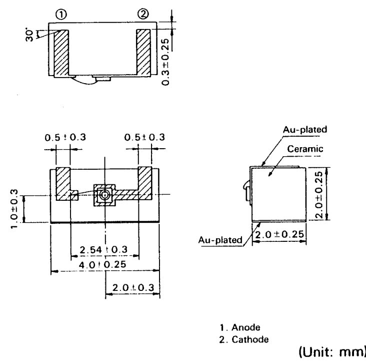
The package is compact for ease in module assembly.

Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 1.2 pF typ.
- Photodetectable area : 100 μm dia.

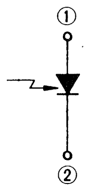


Package Dimensions



CX-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	50	nA	V_R = 5 V
Capacitance	C_t		1.2	2.0	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω

HR1104TG

—Preliminary— InGaAs PIN Photodiode

Description

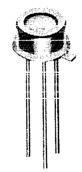
HR1104TG is an InGaAs PIN photodiode for detecting 1.0 – 1.65 μm light.

It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

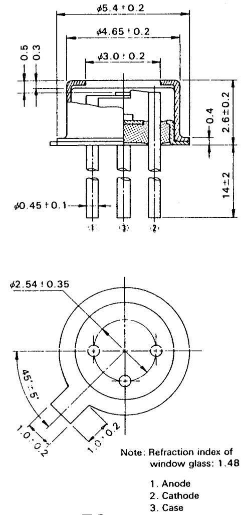
Hermetic sealing of the package achieves high reliability.

Features

- Fast pulse response : t_r, t_f = 1.0 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 5 nA typ.
- Small capacitance : C_t = 5 pF typ.
- Photodetectable area : 300 μm dia.

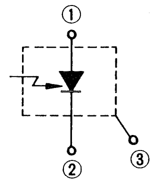


Package Dimensions



TG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		5	100	nA	V_R = 5 V
Capacitance	C_t		5	10	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω

HR1104CX

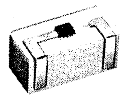
—Preliminary—
InGaAs PIN Photodiode

Description

HR1104CX is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

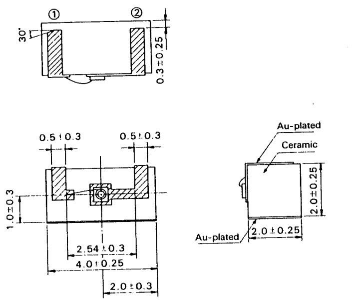
The package is compact for ease in module assembly.



Features

- Fast pulse response : t_r, t_f = 1.0 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 5 nA typ.
- Small capacitance : C_t = 6 pF typ.
- Photodetectable area : 300 μm dia.

Package Dimensions

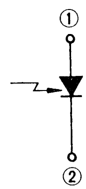


1. Anode
2. Cathode

(Unit: mm)

CX-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		5	100	nA	V_R = 5 V
Capacitance	C_t		6		pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω

HR1105TG

—Under development— InGaAs PIN Photodiode

Description

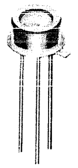
HR1105TG is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

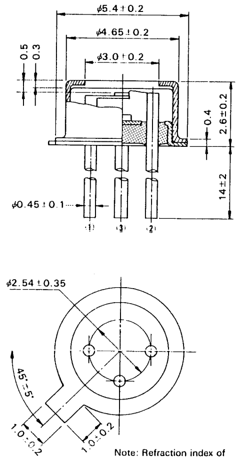
Hermetic sealing of the package achieves high reliability.

Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 0.8 pF typ.
- Photodetectable area : 80 μm dia.



Package Dimensions



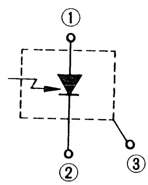
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1.0	10	nA	V_R = 5 V
Capacitance	C_t		0.8	1.2	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

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HITACHI

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