Opto

Data Book

HITACHI®

Safety Considerations

Be sure to avoid direct exposure of human eyes to high power laser beams emitted from laser diodes. Even though barely visible and/or invisible 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 Chapter I, 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.

DANGER

"VISIBLE AND/OR INVISIBLE LASER RADIATION - AVOID DIRECT EXPOSURE TO BEAM"

PEAK POWER 60 mW
WAVELENGTH 625 ~ 1600 nm

"CLASS IIIb LASER PRODUCT"

This product conforms to FDA regulations 21 CFR Chapter I, Subchapter J.

AVOID EXPOSURE : Visible and/or invisible laser radiation is emitted from glass window, fiber pigtail end or laser chip mounted on top of header. Before use, consult appropriate catalogs or manuals.

LASER SAFETY

This laser device in operation produces visible and/or 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.

MANUFACTURED:
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HITACHY

USER INSTRUCTIONS:
Be sure to avoid direct exposure of human eyes to high power laser beams emitted from laser diodes. Even though barely visible and/or invisible 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 pate is to use a phosphor plate or infrared sensitive camera.

These devices are components to be used in producing complete laser systems. They do not emit radiation unless combined by the end user with other components. Please consult the Opto Data Book for some of the possible uses of these devices.

Because of the small size of the device, the required labels and these instructions are provided in this insert rather than printed on the device.

February 1995 Printed in U.S.A.

Opto Data Book

HITACHI®

February 1995

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Part 1

Optical Semiconductor Devices

Product Lineup

Part Numbers

1. Hitachi optoelectronic device part numbers 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
  - Infreared emitting diode: E
  - Photodiode: R

1

2. Examples 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

H E 8 4 0 3 M L

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

(2) Infrared emitting diode example

H R 1 1 0 4 C X

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

(3) Photodiode example

Product Lineup

	Wavelength	Optical output	Internal circuit	Part number	Main application
Visible and infrared laser diodes	633 nm	3 mW	LD PD	HL6314MG HL6316G HL6411G*	Pointer
			LD PD	HL6315G†	Pointer
		5 mW	LD PD	HL6312G	Bar code reader
			LD PD	HL6313G†	Bar code reader
	670 nm	5 mW	LD PD	HL6720G HL6724MG	Pointer
				HL6712G/MG HL6722G	Bar code reader
				HL6713G	Laser beam printer
		10 mW	LD PD	HL6714G	Bar code reader
	780 nm	5 mW	LD PD	HL7806G HL7843MG	Laesr beam printer
			LD PD	HL7836MG	Laser beam printer
		10 mW	LD PD	HL7812G	Laer beam printer

†: Under development
*: Products not actively promoted

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Wavelength	Optical output	Internal circuit	Part number	Main application
780 nm	40 mW	LD PD	HL7853MG	Optical disc
	50 mW	LD PD	HL7851G	Optical disc
		LD PD	HL7852G	Optical disc
830 nm	40 mW	LD PD	HL8325G	Optical disc

Product Lineup

Long wavelength laser diodes: Structure	Wavelength	Optical output	Part number	Package
Fabry-Perot type	1310 nm	10 mW	HL1322A/AC	Open air
		5 mW	HL1326MF	Can type
			HLP5400 HL1321AC	Open air
		2.0 mW*	HL1326CF†/CN†	Cylindrical type
		1.5 mW*	HL1321DM	Dual-in-line type
		1.2 mW*	HL1321BF	Butterfly type
			HL1321DL	Dual-in-line type
		0.4 mW*	HL1327CF†/CN†	Cylindrical type
		0.3 mW*	HL1323DM	Dual-in-line type
	1550 nm	5 mW	HL1521A/AC	Open air

† : Under development
* : Fiber optical output

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Product Lineup

Structure	Wavelength	Optical output	Part number	Package
DFB type	1310 nm	5 mW	HL1341A/AC	Open air
			HL1352MF†	Can type
			HL1341MF	Can type
		2.0 mW*	HL1352CF†/CN†	Cylindrical type
		1.0 mW*	HL1341BF	Butterfly type
			HL1341DL	Dual-in-line type
	1550 nm	5 mW	HL1541A/AC	Open air
		1.0 mW*	HL1541BF	Butterfly type
			HL1541DL	Dual-in-line type
		1.2 mW*	HL1541DM	Dual-in-line type
$\lambda/4$ phase shifted DFB type	1310 nm	12 mW	HL1362A/AC	Open air
	1550 nm	12 mW	HL1551A/AC	Open air

† : Under development
* : Fiber optical output

Product Lineup

Infrared light emitting diodes

Main application	Wavelength	Optical output	Part number	Package
Auto focusing still camera	880 nm typ.	2.2 mW** min.	HE8813VG	Can type
Auto focusing VTR camera	880 nm typ.	2.2 mW** min.	HE8815VG	Can type
Measurement and general	770 nm typ.	30 mW min.	HE7601SG	Can type
	820 nm typ.	40 mW min.	HE8404SG	Can type
		20 mW min.	HE8811	Can type
	870 nm typ.	40 mW min.	HE8812SG	Can type
	735 to 905 nm	15 to 35 mW min.	HLP20 to 40R	Open air type
		7 to 17 mW min.	HLP20 to 40RG	Can type
Industry	880 nm typ.	10 mW min.	HE8807SG	Can type
		5 mW min.	HE8807SL	Can type with lens
			HE8807CL	Can type with collimator lens
			HE8807FL	Can type with collimator lens

** : Value at 14 degrees of the acceptance angle

Product Lineup

Main application	Wavelength	Optical output	Part number	Package
Communications	840 nm typ.	50 μW* min.	HE8403ML	Can type with microlens
		40 μW* min.	HE8403SG	Can type
	1300 nm typ.	20 μW* min.	HE1303SG	Can type
			HE1303ML	Can type with microlense

* : Fiber optical output

Product Lineup

	Material	Photodetection wavelength	Structure	Photosensitive diameter	Part number	Package
Photo-detectors	Si	600 to 900 nm	PIN	0.8 × 0.8 mm²	HR8101	Can type
				300 μm	HR8102	Can type
			APD	300 μm	HR8202TG	Can type
				800 μm	HR8203KG	Can type
	InGaAs	1000 to 1650 nm	PIN	80 μm	HR1105TG	Can type
					HR1105CR	Cylindrical type with fiber
					HR1105MR	Can type with microlens
				100 μm	HR1103TG	Can type
					HR1103CX	Chip on carrier
				300 μm	HR1104TG	Can type
					HR1104MH	Can type
					HR1104CX	Chip on carrier
			APD	50 μm	HR1201TG	Can type
					HR1201CX	Chip on carrier
					HR1201FR	With fiber

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 Characreristics: Lasing Wave-length, λ_p (nm) Min	Typ	Max	Beam Diver-gence, $\theta_{//} \times \theta_{\perp}$ (deg.) Typ	Test Condition P_O (mW)	Ref-erence Page
HL6312 series	HL6312G	5	2	–10 to +50	–40 to +85	625	633	640	8 × 31	5	129
HL6313 series	HL6313G†	5	2	–10 to +50	–40 to +85	625	633	640	8 × 31	5	133
HL6314 series	HL6314MG	3	2	–10 to +50	–40 to +85	630	635	640	8 × 30	3	137
HL6315 series	HL6315G†	3	2	–10 to +50	–40 to +85	630	635	640	8 × 30	3	141
HL6316 series	HL6316G	3	2	–10 to +50	–40 to +85	630	635	640	8 × 30	3	145
HL6411 series	HL6411G*	3	2	–10 to +40	–40 to +85	625	633	640	8 × 31	3	339
HL6712 series	HL6712G HL6712MG	5	2	–10 to +50	–40 to +85	–	675	680	8 × 27	5	149
HL6713 series	HL6713G	5	2	–10 to +50	–40 to +85	–	670	680	9 × 30	5	153
HL6714 series	HL6714G	10	2	–10 to +50	–40 to +85	660	670	680	8 × 22	10	156
HL6720 series	HL6720G	5	2	–10 to +50	–40 to +85	660	670	680	9 × 30	5	160
HL6722 series	HL6722G	5	2	–10 to +50	–40 to +85	660	670	680	8 × 30	5	164
HL6724 series	HL6724MG	5	2	–10 to +50	–40 to +85	660	670	680	8 × 30	5	168
HL7806 series	HL7806G	5	2	–10 to +60	–40 to +85	775	785	795	14 × 27	5	172
HL7812 series	HL7812G	10	2	–10 to +60	–40 to +85	770	785	795	11 × 30	10	176
HL7836 series	HL7836MG	5	2	–10 to +60	–40 to +85	770	785	795	11 × 27	5	180
HL7843 series	HL7843MG	5	2	–10 to +60	–40 to +85	775	785	795	10 × 24	5	185

†: Under development

*: Products not actively promoted

Main Characteristics

Laser Diodes (T_C = 25°C) (cont.)

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 Characreristics: Lasing Wave-length, λ_p (nm) Min	Typ	Max	Beam Diver-gence, $\theta_{//} \times \theta_{\perp}$ (deg.) Typ	Test Condition P_O (mW)	Ref-erence Page
HL7851 series	HL7851G	50	2	–10 to +60	–40 to +85	775	785	795	9.5× 23	50	189
HL7852 series	HL7852G	50	2	–10 to +60	–40 to +85	775	785	795	9.5× 23	50	193
HL7853 series	HL7853MG	40	2	–10 to +60	–40 to +85	775	785	795	9.5× 23	40	197
HL8325 series	HL8325G	40	2	–10 to +60	–40 to +85	820	830	840	10 × 22	40	201

†: Under development

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Laser Diodes (T_C = 25°C) (cont.)

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 Characreristics: Lasing Wave-length, λ_p (nm) Min	Typ	Max	Beam Diver-gence, $\theta_{//} \times \theta_{\perp}$ (deg.) Typ	Test Condition P_O (mW)	Ref-erence Page
HL1321 series	HLP5400	5	2	0 to +50	0 to +60	1270	1300	1330	30 × 40	3	205
	HL1321AC			0 to +60	0 to +80						
	HL1321BF	1.2*		0 to +60	–40 to +70	1290	1310	1330		0.5*	
	HL1321DL										
	HL1321DM	1.5*		0 to +65	–20 to +70					1.2*	
HL1322 series	HL1322A	10	2	0 to +60	0 to +80	1290	1310	1330	30 × 40	6	215
	HL1322AC										
HL1323 series	HL1323DM	0.3*	2	0 to +65	–20 to +70	1260	1300	1340		0.15*	219
HL1326 series	HL1326MF	5	2	–40 to +85	–40 to +100	1280	1310	1340	30 × 40	5	223
	HL1326CF†	2*		–40 to +85	–40 to +85					1.5*	229
	HL1326CN†										
HL1327 series	HL1327CF†	0.4*	2	–40 to +85	–40 to +85	1280	1310	1340		0.3*	231
	HL1327CN†										
HL1341 series	HL1341A	5	2	0 to +60	0 to +80	1290	1310	1330	30 × 40	3	233
	HL1341AC										
	HL1341MF				–40 to +80						
	HL1341BF	1.0*			–40 to +70					0.5*	
	HL1341DL										
HL1352 series	HL1352MF†	5	2	–20 to +85	–40 to +100	1290	1310	1330	30 × 40	5	242
	HL1352CF†	2*	2	–20 to +85	–40 to +85					1.5*	244
	HL1352CN†										
HL1362 series	HL1362A	12	2	0 to +60	0 to +80	1290	1310	1330	30 × 40	8	246
	HL1362AC										
HL1521 series	HL1521A	5	2	0 to +60	0 to +80	1530	1550	1570	30 × 40	3	251
	HL1521AC										

†: Under development

*: Fiber optical output power, P_f

Main Characteristics

Laser Diodes (T_C = 25°C) (cont.)

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 Characrerlstics: Lasing Wave-length, λ_p (nm) Min	Typ	Max	Beam Diver-gence, $\theta_{//} \times \theta_{\perp}$ (deg.) Typ282	Test Condition P_O (mW)	Ref-erence Page
HL1541 series	HL1541A	5	2	0 to +60	0 to +80	1530	1550	1570	30 × 40	3	255
	HL1541AC										
	HL1541BF	1.0*			–40 to +70					0.5*	
	HL1541DL										
	HL1541DM	1.2*		0 to +50	–40 to +60						
HL1551 series	HL1551A	12	2	0 to +60	0 to +80	1530	1550	1570	30 × 40	8	265
	HL1551AC										

*: Fiber optical output power, P_f

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Infrared Emitting Diodes (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 Characreristics: Optical Output Power P_O (mW) Min	Peak Wave-length*, λ_p (nm) A	B	C	D	Spectral Width, $\Delta\lambda$ (mA) Typ	Test Condition I_F (mA)	Capaci-tance, C_t (pF) Typ	Test Condition	Ref-erence Page
HLP series	HLP20R	3	–20 to +40	–40 to +60	15	O				30	200	30	V_R = 0 V f = 1 MHz	303
	HLP30R				25	O	O	O	O					
	HLP40R				35		O	O	O					
	HLP20RG	3	–20 to +60	–40 to +80	7	O				30	200	30	V_R = 0 V f = 1 MHz	307
	HLP30RG				12	O	O	O	O					
	HLP40RG				17		O	O	O					
HE7601SG		3	–20 to +60	–40 to +90	30	740 to 800				50	200	30	V_R = 0 V f = 1 MHz	273
HE8403SG		3	–20 to +60	–40 to +90	40 μ**	800 to 900				50	100	10		276
HE8403ML					50 μ**									
HE8404SG		3	–20 to +60	–40 to +90	40	790 to 850				50	200	30		280
HE8807SG		3	–20 to +85	–40 to +100	10	800 to 900				30	150	10		283
HE8807SL					5									
HE8807CL														
HE8807FL														
HE8811		3	–20 to +60	–40 to +90	20	780 to 900				50	150	10		288
HE8812SG		3	–20 to +60	–40 to +90	40	840 to 900				50	200	30		291
HE8813VG		3	–20 to +60	–40 to +90	2.2***	800 to 900				50	150	10		294
HE8815VG		3	–20 to +60	–40 to +90	2.2***	800 to 900				50	150	10		297
HE1303SG		1.0	–20 to +85	–40 to +100	25 μ**	1280 to 1360				150	80	10		300
HE1303ML														

*: HLP series grouped with peak wavelength
**: Fiber optical output power, P_f
***: Output power within 14 degrees of the acceptance angle

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

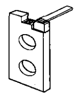
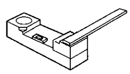
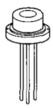
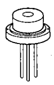
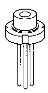
Photodiodes (T_C = 25°C)

Part No.	Absolute Maximum Ratings: Photo-Detection Dia., ø (μm)	Reverse Voltage, V_R (V)	Operating Temp., T_{opr} (°C)	Storage Temp., T_{stg} (°C)	Optical and Electrical Characreristics: 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	0.8 × 0.8 mm^2	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	313
HR8102	300	100	–40 to +80	–45 to +100	0.5	10	1.5	V_R = 10 V f = 1 MHz	0.4	V_R = 10 V λ_p = 830 nm	315
HR8202TG	300	–	–40 to +80	–45 to +100	0.5	0.9 V_B	1.5	V_R = 100 V f = 1 MHz	0.46	M = 1 λ_p = 830 nm	317
HR8203KG†	800	–	–40 to +80	–45 to +100	10	0.9 V_B	4.0	V_R = 0.9 V_B f = 1 MHz	0.43	M = 1 λ_p = 830 nm	320
HR1103TG	100	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	321
HR1103CX							1.2				
HR1104TG	300	20	–40 to +85	–45 to +100	1	5	5	V_R = 5 V f = 1 MHz	0.9 Typ	V_R = 5 V λ_p = 1550 nm	325
HR1104CX											
HR1104MH											
HR1105TG	80	20	–40 to +80	–45 to +100	1	5	0.8	V_R = 5 V f = 1 MHz	0.9 Typ	V_R = 5 V λ_p = 1550 nm	329
HR1105MR											
HR1105CR			–20 to +75	–45 to +80			0.9		0.8 Typ		
HR1201TG	50	–	–40 to +80	–45 to +100	2	0.9 V_B	0.5	V_R = 0.9 V_B f = 1 MHz	0.9 Typ	M = 1 λ_p = 1550 nm	333
HR1201CX							0.7				
HR1201FR			–20 to +75	–40 to +85					0.8 Typ		

†: Under development

Package Variations

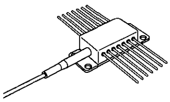
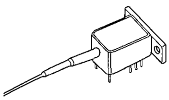
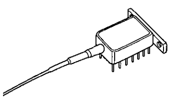
Laser Diodes

	Packages	Features	Applicable Products
Open-air type	 A1-type	• For experimental use • For module assembly	HLP5400, HL1322A, HL1341A, HL1362A, HL1521A, HL1541A, HL1551A
	 AC-type	• For module assembly • Chip carrier stem	HL1321AC, HL1322AC, HL1341AC, HL1362AC, HL1521AC, HL1541AC, HL1551AC
Can type	 G1-type	• With built-in monitor-photodiode • Three leads	HL6712G, HL6713G
	 G2-type	• With built-in monitor-photodiode • Three leads • Short lead length (9 mm)	HL6312G, HL6313G†, HL6315G†, HL6316G, HL6411G*, HL6714G, HL6720G, HL6722G, HL7806G, HL7812G, HL7851G, HL7852G HL8325G
	 MF-type	• With built-in monitor-photodiode • Four leads • Compact size	HL1326MF, HL1341MF, HL1352MF†
	 MG-type	• With built-in monitor-photodiode • Three leads • Compact size	HL6314MG, HL6712MG, HL6724MG, HL7836MG, HL7843MG, HL7853MG

* : Products not actively promoted
† : Under development

Package Variations

Laser Diodes (cont.)

	Packages	Features	Applicable Products
Fiber-pigtail type	 BF-type	• Butterfly-type package • For high frequency • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321BF, HL1341BF, HL1541BF
	 CF-type	• Compact, slim package • With single-mode fiber • With built-in monitor-photodiode • Different pin-out from CN-type	HL1326CF†, HL1327CF†, HL1352CF†
	 CN-type	• Compact, slim package • With single-mode fiber • With built-in monitor-photodiode • Different pin-out from CF-type	HL1326CN†, HL1327CN†, HL1352CN†
	 DL-type	• Dual-in-line type package • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321DL, HL1341DL, HL1541DL
	 DM-type	• Dual-in-line type package • With single-mode fiber • With built-in monitor-photodiode	HL1321DM, HL1323DM, HL1541DM

† : Under development

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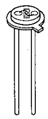
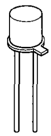
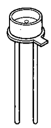
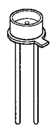
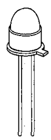
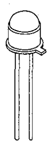
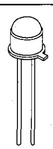
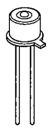
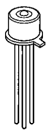
Infrared Emitting Diodes

	Packages	Features	Applicable Products
Open-air type	 R-type	• For experimental use • For module assembly • Two leads	HLP20R, HLP30R, HLP40R
Can with flat glass window type	 RG-type	• Flat glass window • Longer cap than SG-type • Two leads	HLP20RG, HLP30RG, HLP40RG
	 SG-type	• Flat glass window • Two leads	HE7601SG, HE8403SG, HE8404SG, HE8807SG, HE8811, HE8812SG, HE1303SG
	 VG-type	• Flat glass window • Two leads	HE8813VG, HE8815VG
Can with lens cap type	 CL-type	• Lens cap to collimate beam • Two leads	HE8807CL
	 FL-type	• Lens cap to collimate beam • Two leads	HE8807FL
	 SL-type	• With lens cap • Two leads	HE8807SL

Package Variations

Infrared Emitting Diodes (cont.)

	Packages	Features	Applicable Products
Can with ball lens type	 ML1-type	• With micro ball lens • Two leads	HE8403ML
	 ML3-type	• With micro ball lens • Three leads	HE1303ML

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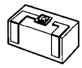
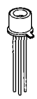
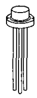
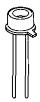
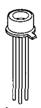
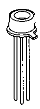
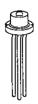
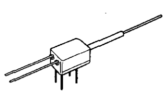
Photodiodes

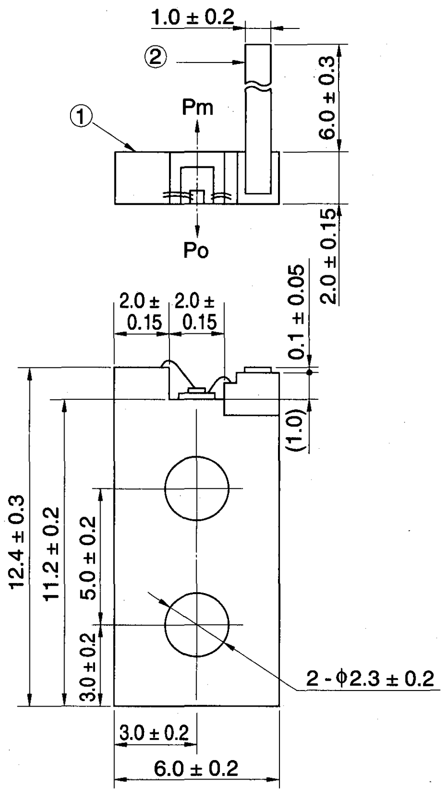
	Packages	Features	Applicable Products
Open-air type	 CX-type	• For module assembly • Chip carrier stem	HR1103CX, HR1104CX, HR1201CX
Can type	 KG-type	• Flat glass window • Three leads	HR8203KG†
	 MH-type	• Flat glass window • Three leads	HR1104MH
	 QG-type	• Flat glass window • Two leads	HR8101
	 TG1-type	• Flat glass window • Three leads	HR8102, HR8202TG
	 TG2-type	• Flat glass window • Three leads	HR1103TG, HR1104TG, HR1105TG, HR1201TG
Can with ball lens type	 MR-type	• With micro ball lens • Compact size • Three leads	HR1105MR
Fiber-pigtail type	 CR-type	• With multi-mode fiber • Three leads	HR1105CR
	 FR-type	• With multi-mode fiber • Two leads	HR1201FR

† : Under development

Package Dimensions

Laser Diodes

A1 - Type



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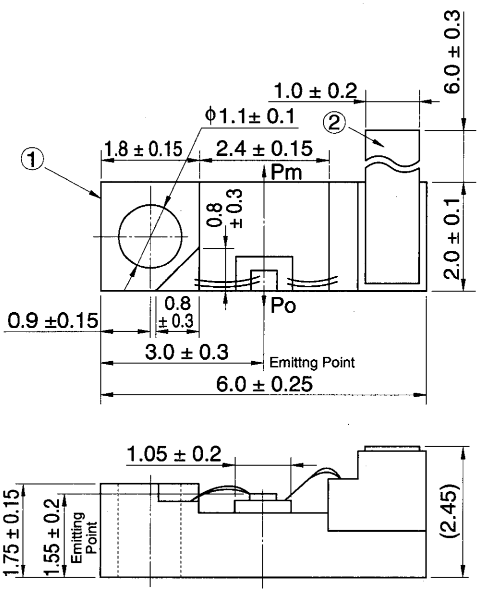
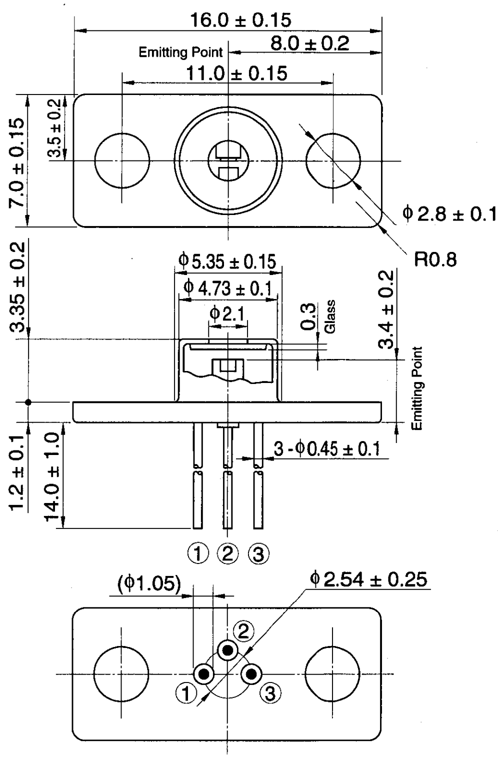
Laser Diodes (cont.)

AC - Type

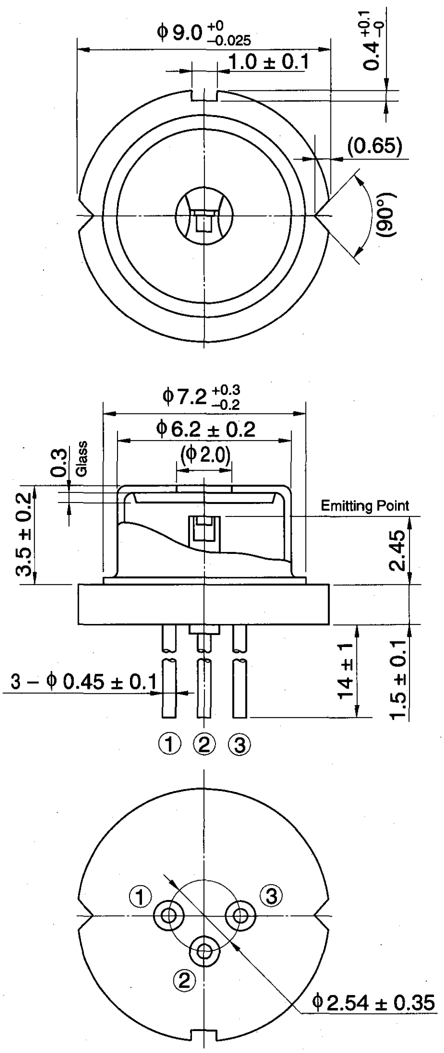


E - Type

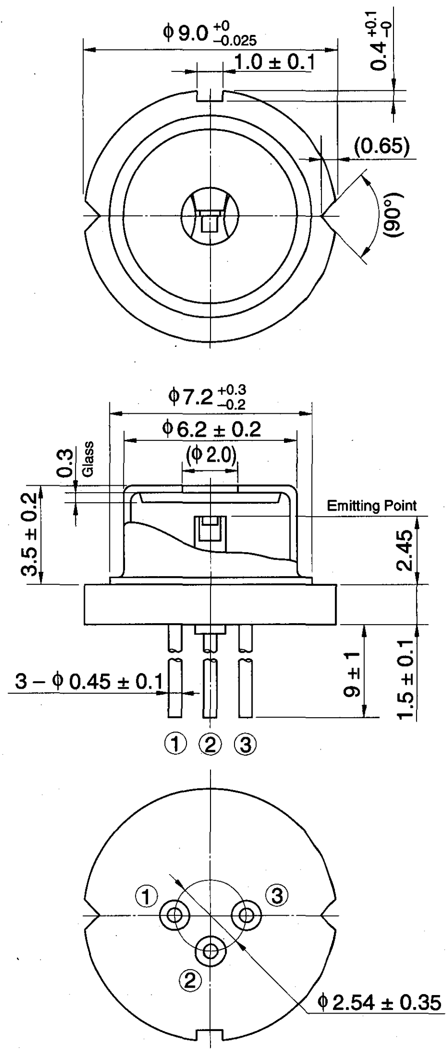


Laser Diodes (cont.)

G1 - Type

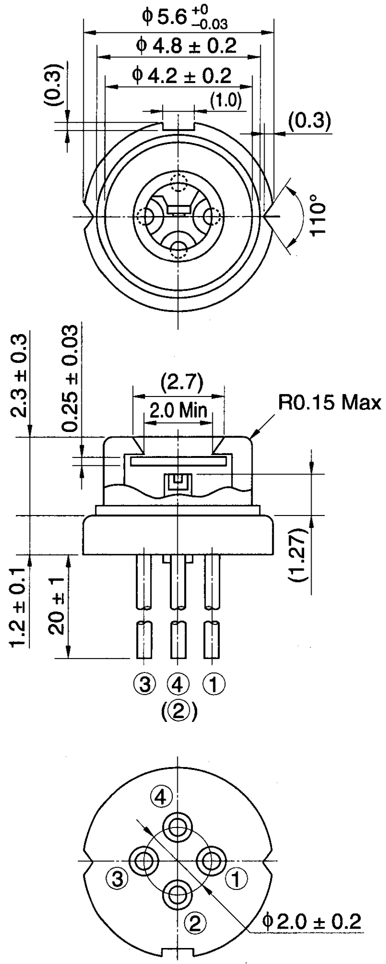


G2 - Type

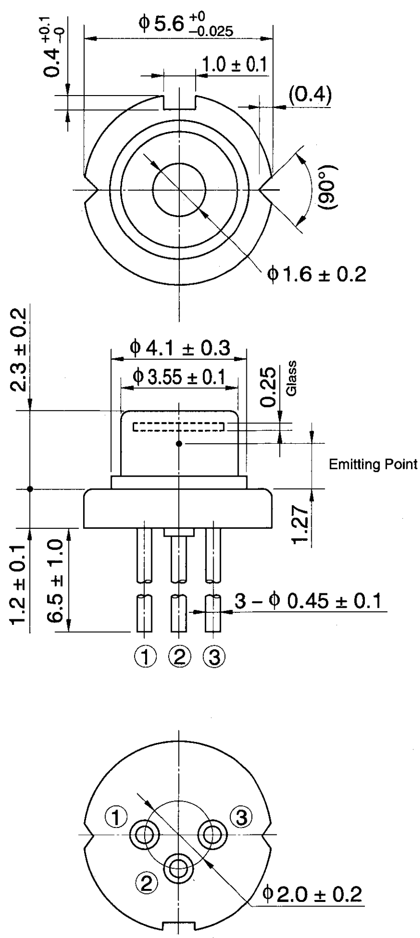


Laser Diodes (cont.)

MF - Type



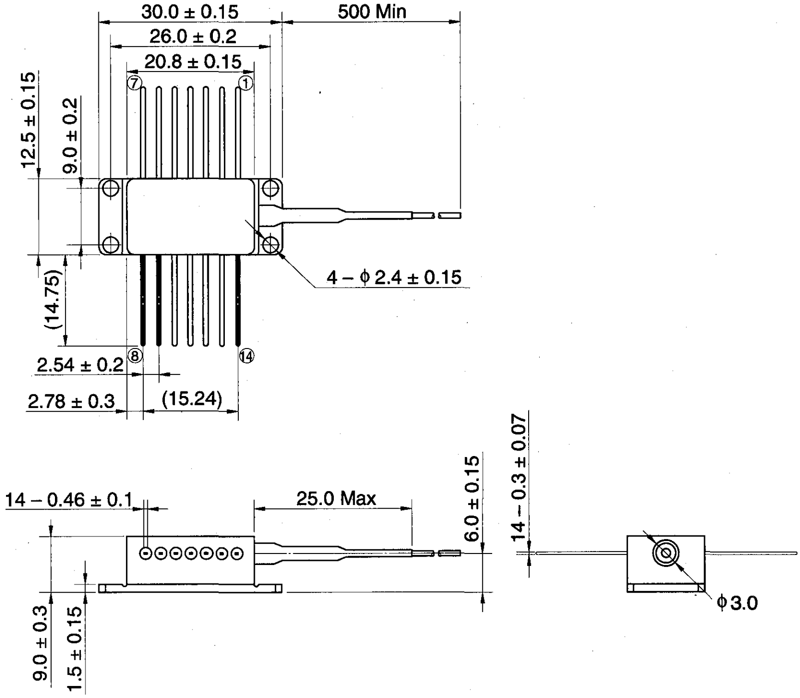
MG - Type



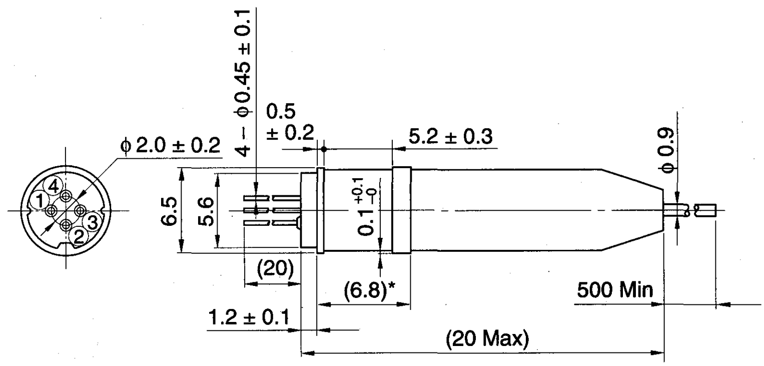
Package Dimensions

Laser Diodes (cont.)

BF - Type



CF - Type



* HL1326/1352: (10.2)
HL1327: (6.8)

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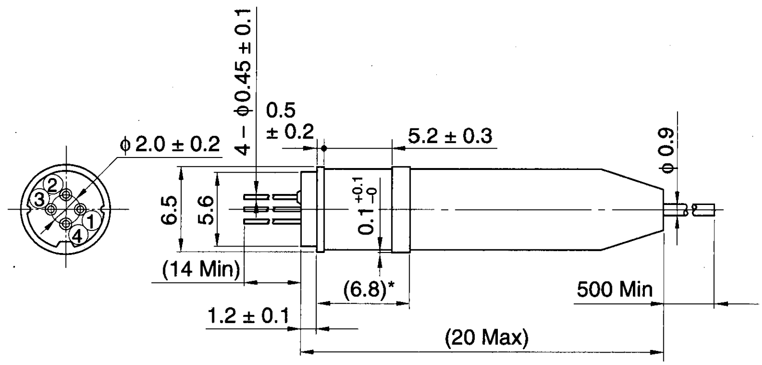
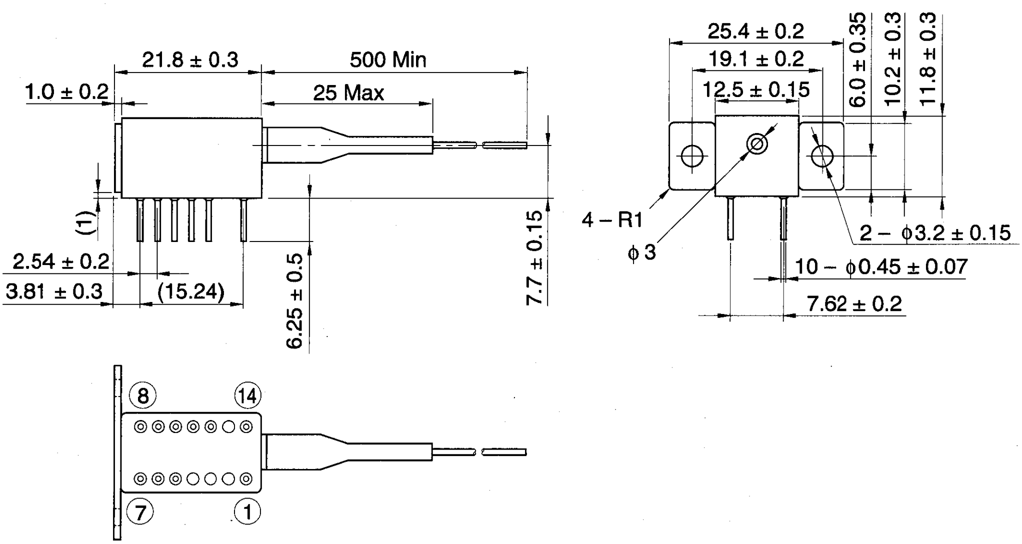
Laser Diodes (cont.)

CN - Type



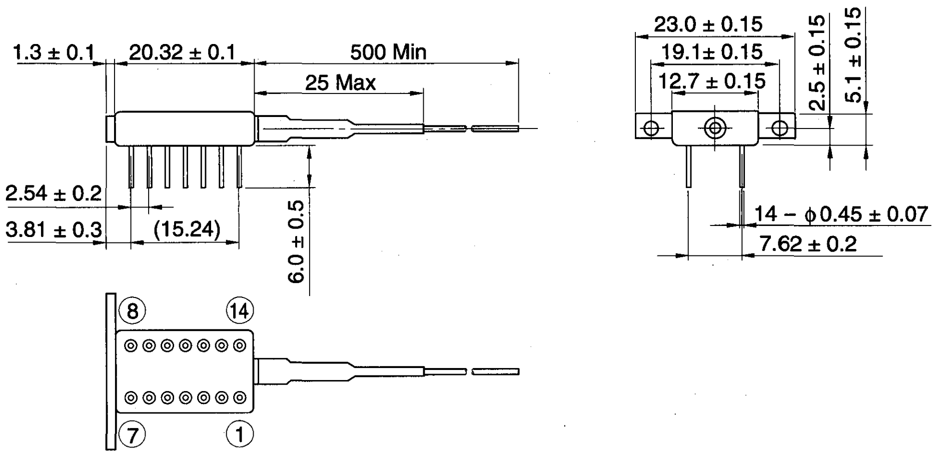
* HL1326/1352: (10.2)
HL1327: (6.8)

DL - Type



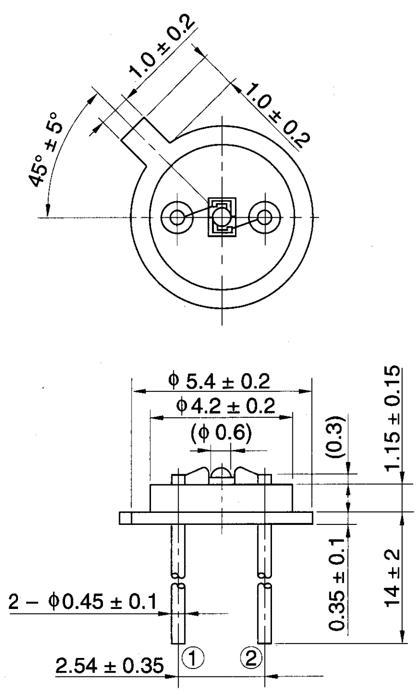
Laser Diodes (cont.)

DM - Type

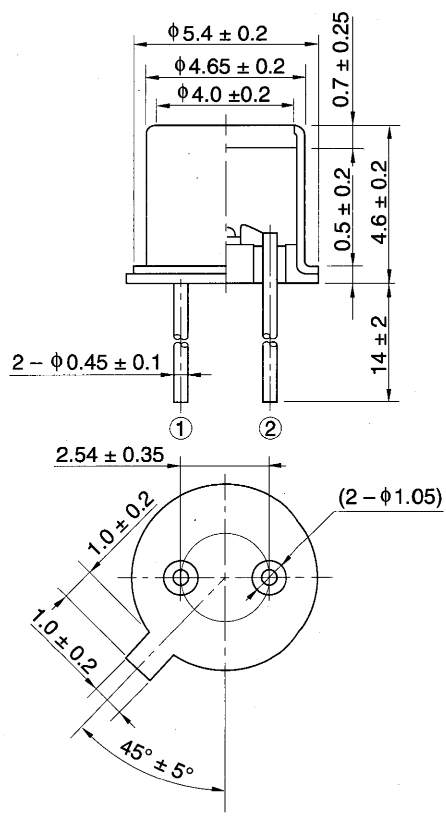


Infrared Emitting Diodes

R - Type

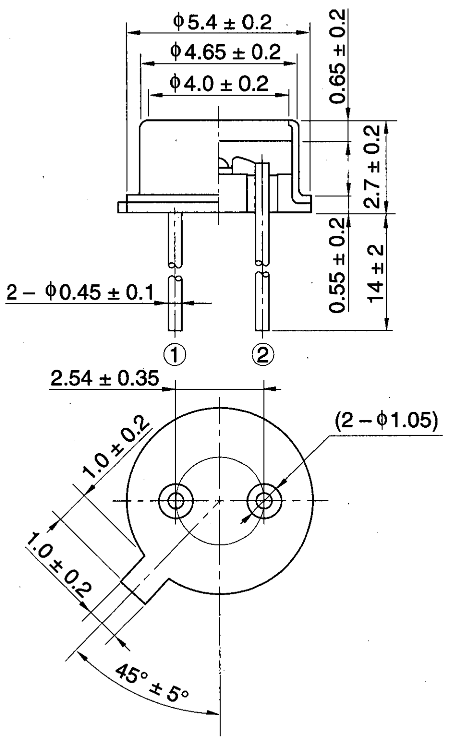


RG - Type

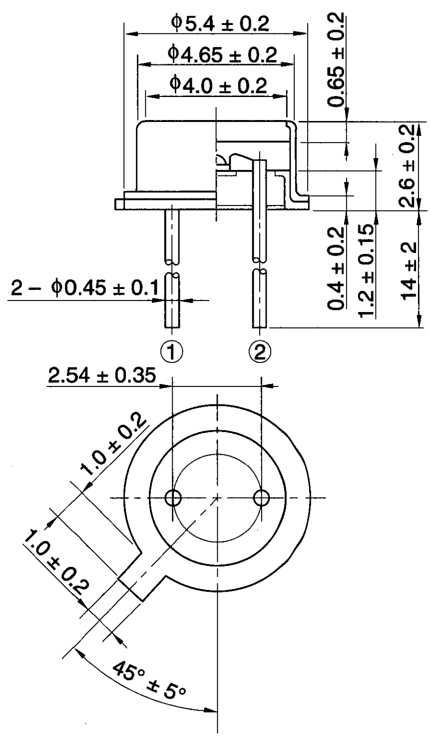


Infrared Emitting Diodes (cont.)

SG- Type

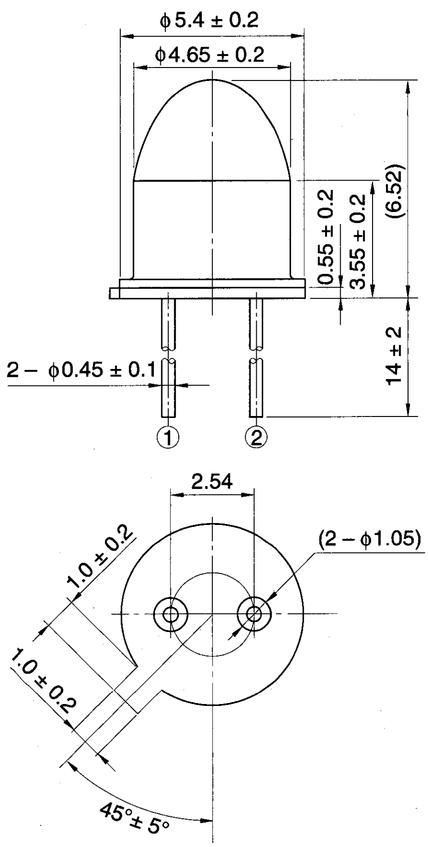


VG- Type

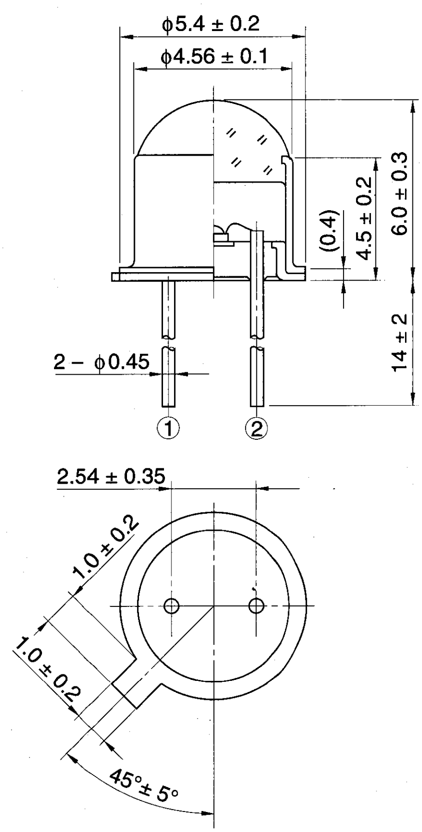


Infrared Emitting Diodes (cont.)

CL- Type

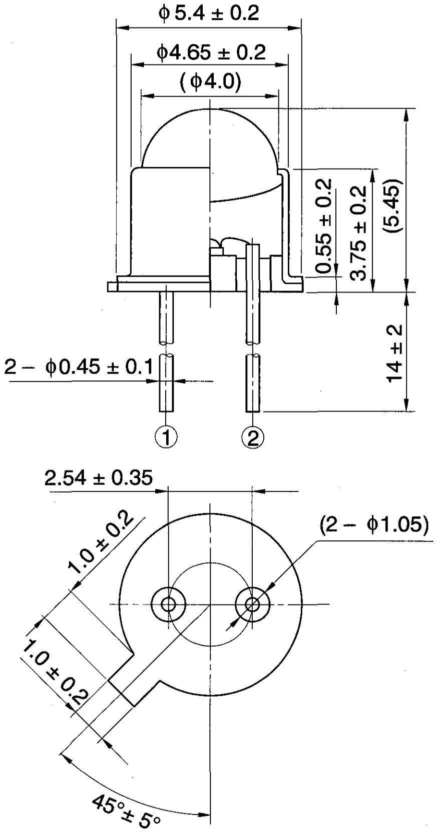


FL- Type

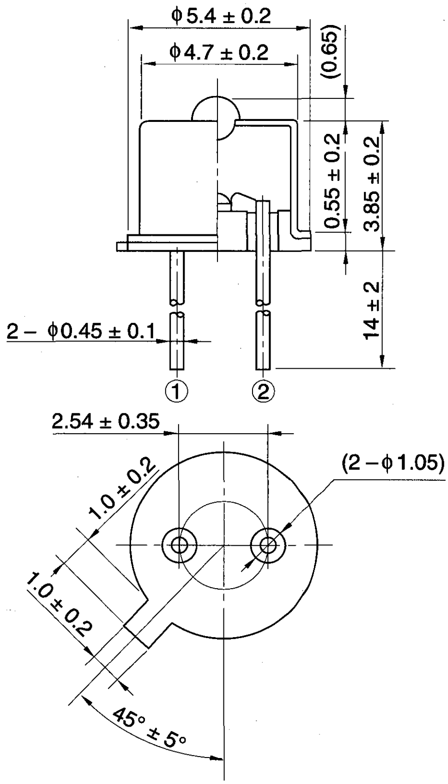


Infrared Emitting Diodes (cont.)

SL- Type

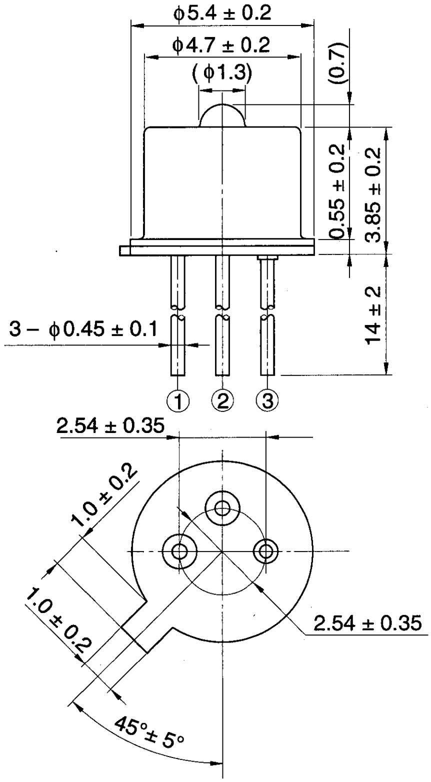


ML1 - Type



Infrared Emitting Diodes (cont.)

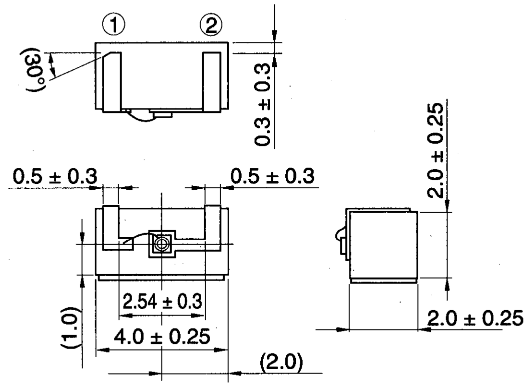
ML3 - Type



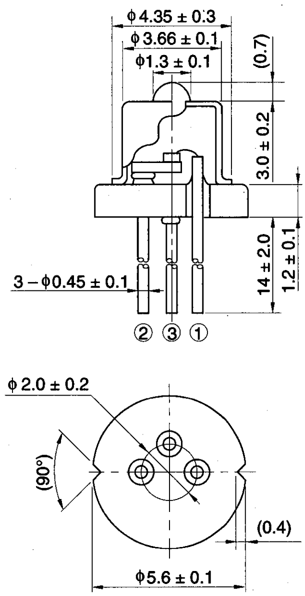
Package Dimensions

Photodiodes

CX - Type



MR- Type



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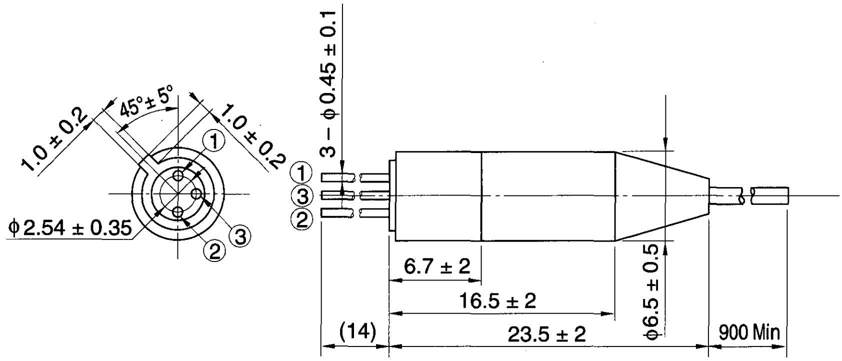
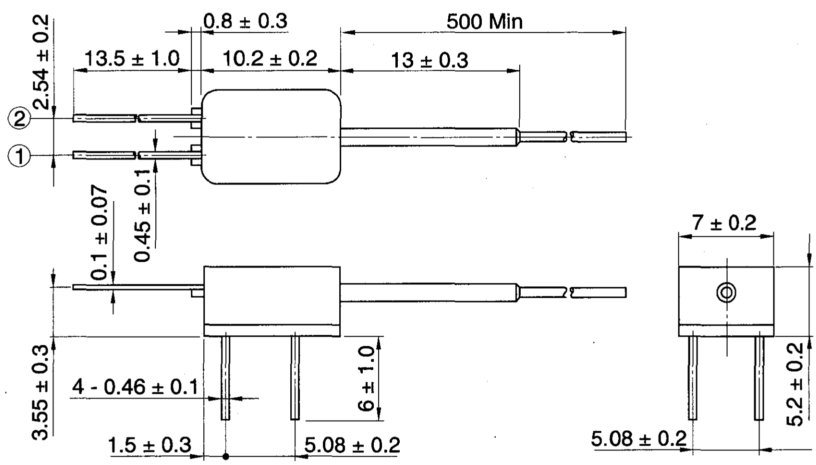
Photodiodes (cont.)

CR- Type

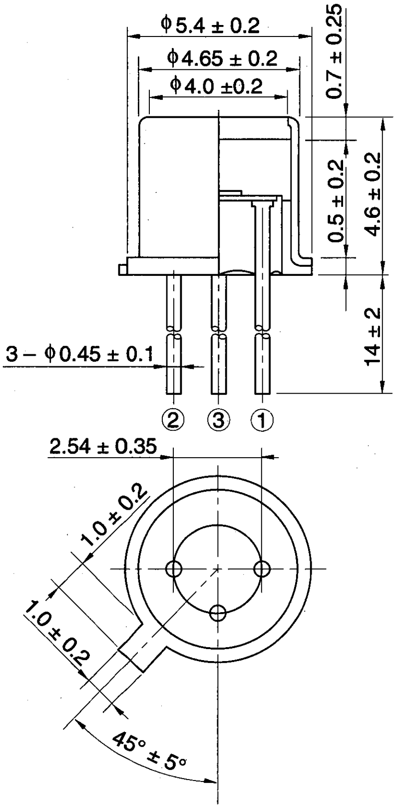


FR- Type

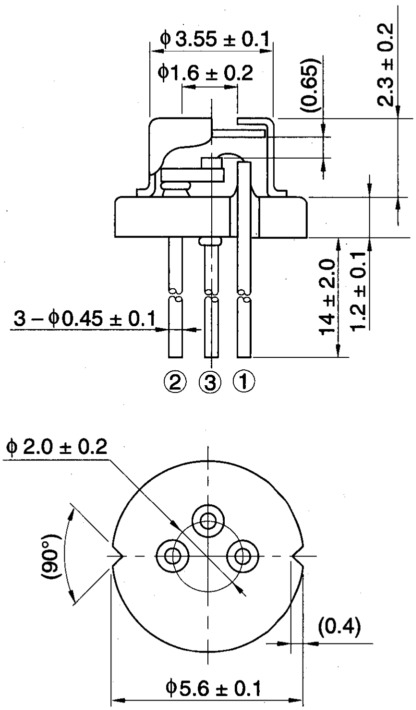


Photodiodes (cont.)

KG - Type

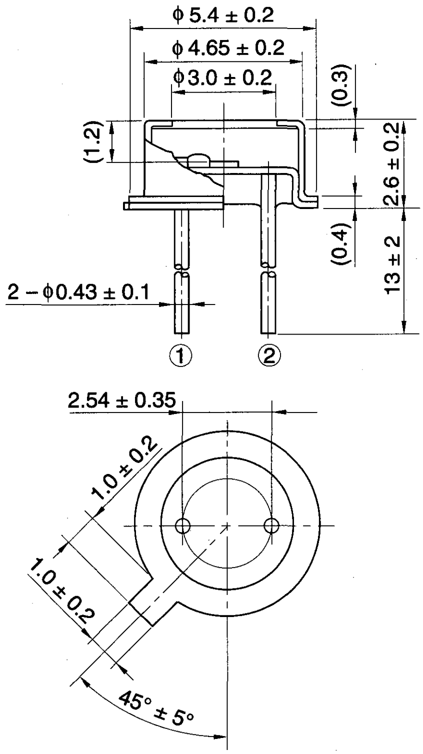


MH - Type

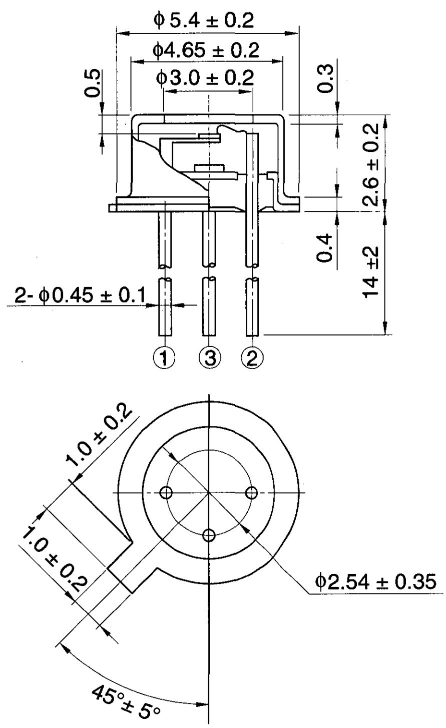


Photodiodes (cont.)

QG - Type

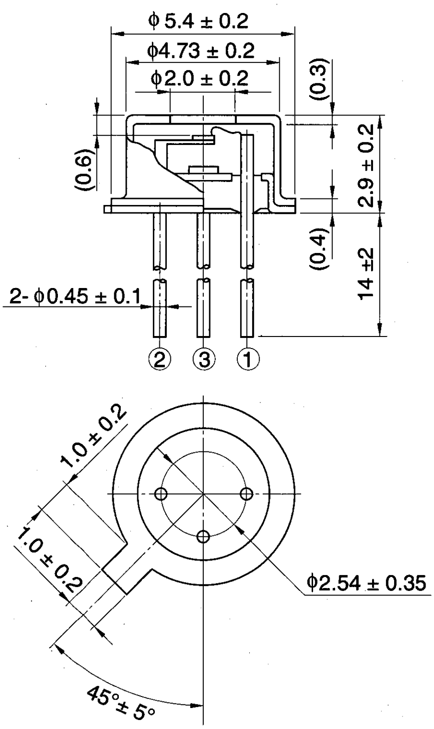


TG1- Type



Photodiodes (cont.)

TG2 - Type



1

Product Descriptions

1. Operating Principles
2. Chip Structures
3. Symbols and Definitions
4. Fundamental Characteristics
5. Handling Instructions
6. Reliability
7. Purchasing Hitachi Optodevices

§1. Operating Principles

1.1 Operating Principles of Laser Diodes (LDs), Infrared Emitting Diodes (IREDs) and Photodiodes (PDs)

1.1.1 Emitting Principles

Each electron in an atom or molecule has a specific discrete energy level, as shown in figure 1-1. The transition of electrons between different energy levels is sometimes accompanied by light absorption or emission with 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

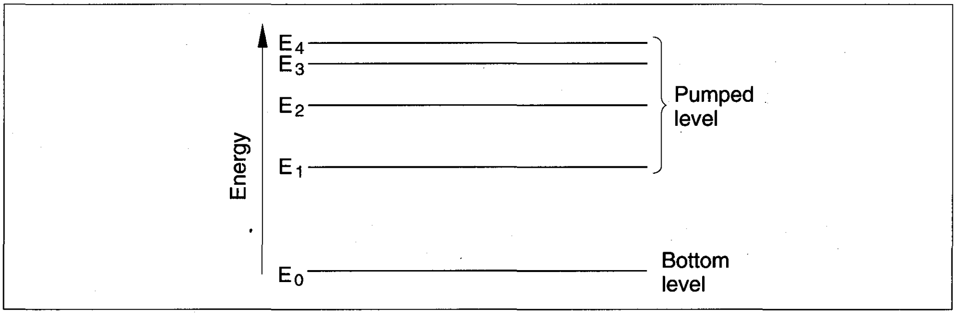


Figure 1-1: Energy Level

There are three types of electron transitions, as shown in figure 1-2.

The first type of transition, shown in figure 1-2 (a), is known as resonant absorption. An electron transits from the stable low energy level, E_0, to the higher energy level, E_1, by absorbing light.

Figure 1-2 (b) shows spontaneous emission. An electron transits from the high energy level, E_1, to a more stable low energy level, E_0. At the same time, the energy balance of $|E_1 - E_0|$ is released in the form of light. Since each electron at level, E_1, transits independently, light is emitted at random and out of phase. Such light is referred to as incoherent light and is one of the typical characteristics of spontaneous emission. The light from an IRED is an example of such spontaneous emission light.

Under thermal equilibrium, the probability of an electron to exist in the lower level, E_0, is higher than that in the higher energy level, E_1. Therefore, electron transition to a higher energy level ($E_0 - E_1$) by light absorption is more likely to occur than light emission as shown in figure 1-2 (a). To emit light, electrons must exist at E_1 with high probability, which is referred to as inversed population.

The third type of transition, shown in figure 1-2 (c) is 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 stimulated emission light is emitted resonant to the incident light. Such stimulated emission light is referred to as coherent light.

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

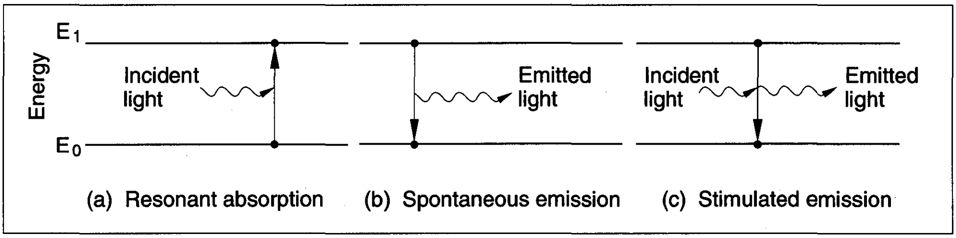


Figure 1-2: Transition Processes

Figure 1-3 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 figure 1-3, which uses clearing to make the reflection mirrors of both surfaces. Incident spontaneous emission light heading to the reflection mirror is amplified by stimulated emission and comes back to the initial position after reflection. This process is subject to losses resulting from light passing through or diffracting at the reflection mirrors and scattering or absorption within the cavity. When the loss is higher than the amplification gain, the light attenuates. Injected current strengthens amplification gain in an LD and when the gain and the loss are balanced, initial light intensity becomes equal to returned light intensity. This condition is referred to as threshold. A laser oscillates above the threshold when the gain is high enough.

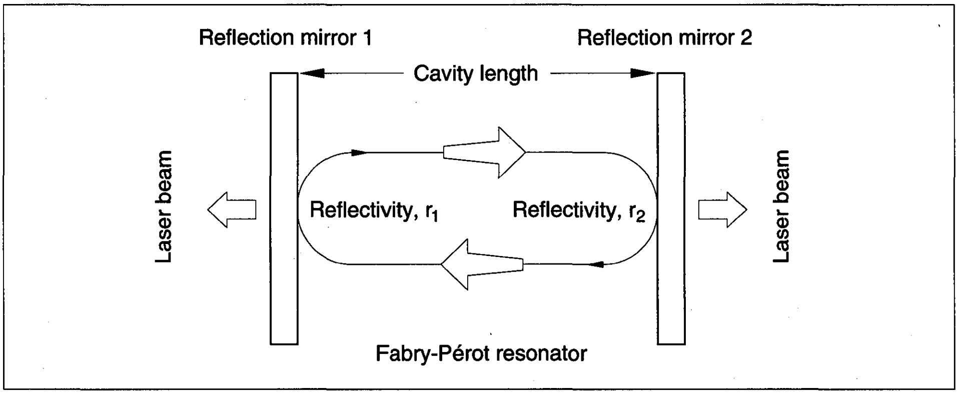


Figure 1-3: Fundamental Structure of Fabry-Pérot Resonator

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 within the cavity. Therefore, a laser can oscillate with a short resonant cavity of 300 μm and low reflectivity of 30%.

1.1.2 Photo-detection Principles

Photodiodes make use of a photovoltaic effect resulting from the application of voltage to both ends of a p-n junction at the time light exposes the junction. Under reverse-voltage conditions, a depletion region is generated to which an electric field has been applied (see figure 1-4). 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 caused by the electric field. Carriers generated in the diffusion region, however, move slowly under the influence of 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.

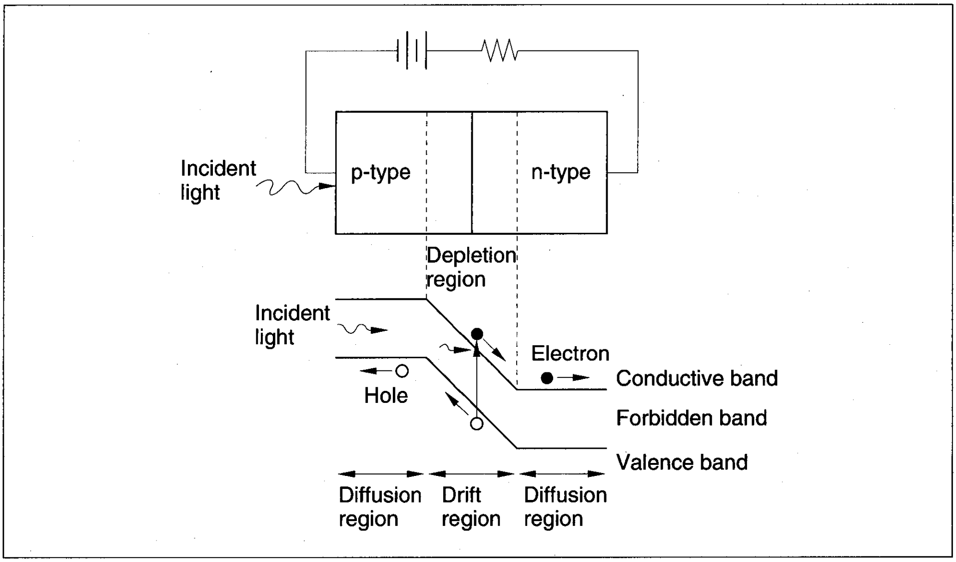


Figure 1-4: Photo-detection Principles

§2. Chip Structures

2.1 Laser Diodes Structures

2.1.1 GaAlAs LD Structure

The p-type active layer, in which stimulated emission enforces optical amplification (figure 2-1 (a)), is processed first. The p-n junction is made here for injecting 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 the p-n junction (heteroisolation junction), the injected carriers are mostly confined within the p-type active layer. This carrier confinement makes population inversion occur easily, increasing the light emission intensity.

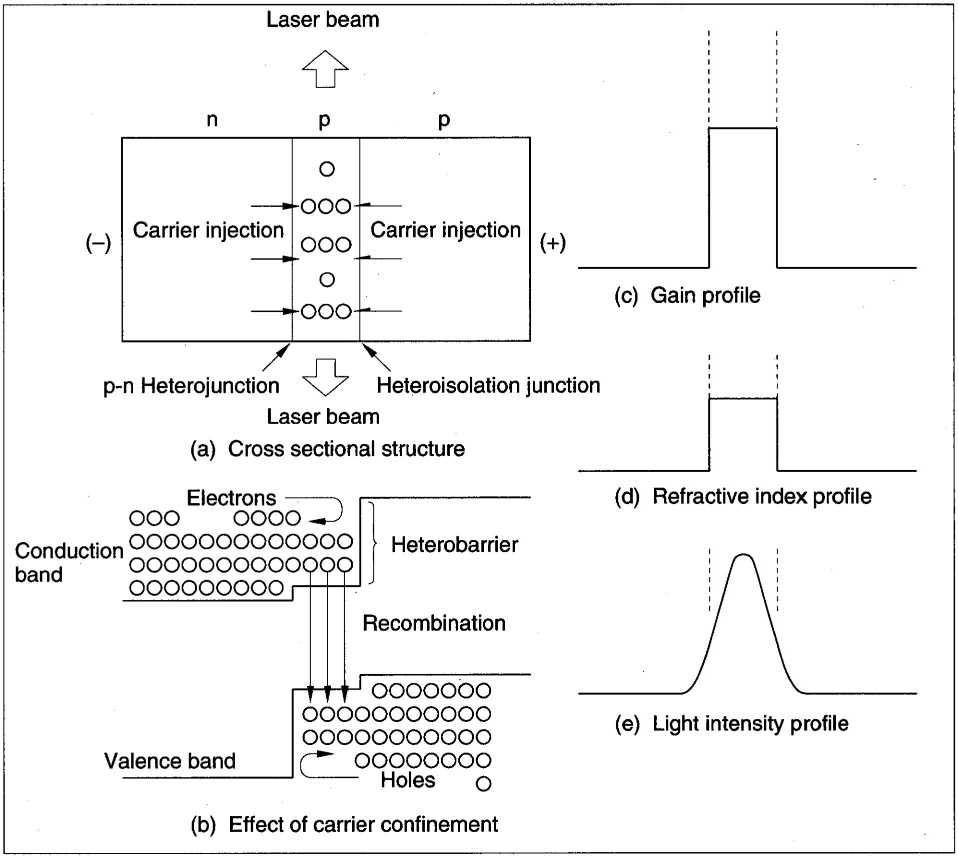


Figure 2-1: Operation Principles of Double-heterojunction LD

The active layer of the GaAlAs LD is made of GaAs or $Ga_{1-y}Al_yAs$ (figure 2-2). 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 a 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 percent than that of $Ga_{1-x}Al_xAs$, which confines the generated light within the GaAs active layer. The light penetrating into the Al_xAs layer is not absorbed because of its wide band gap. So laser oscillates effectively there (figure 2-1). The thinner GaAs layer can make do with less threshold current density to achieve laser oscillation. At present, a threshold current density of as low as 1 to 2 kA/cm^2 can be achieved, realizing a stable continuous oscillation (CW) at room temperature.

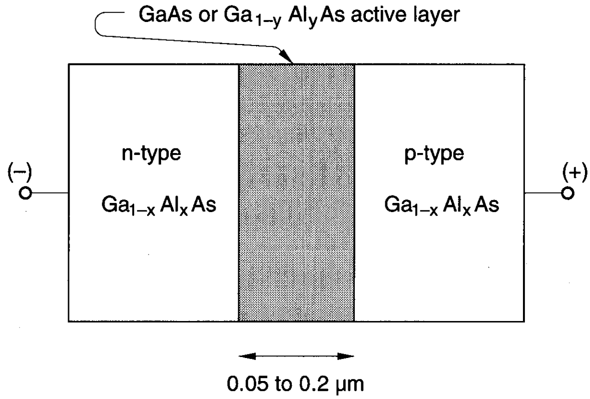


Figure 2-2 : GaAlAs DH Structure LD

2.1.2 Lasing Modes of GaAlAs LD

Under laser oscillation, a light standing wave is created with its wavefront parallel to the mirror facets while light is traveling back and forth within the laser cavity. This standing wave consists of a longitudinal mode and a transverse mode (figure 2-3). The longitudinal mode expresses the condition of the standing wave in the direction of cavity length (z direction). The transverse mode expresses the condition of the axis perpendicular to the cavity length direction. The transverse mode is divided into a perpendicular transverse mode which is perpendicular to the active layer, and a parallel transverse mode which is parallel to the layer.

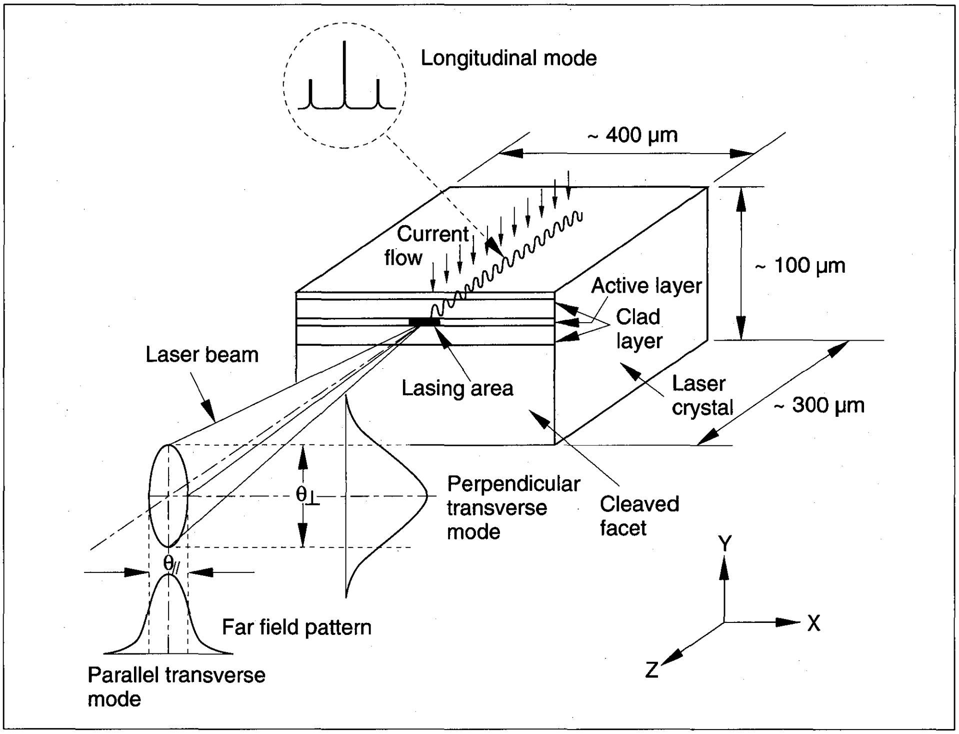


Figure 2-3: Lasing Mode of LD

Longitudinal mode

Figure 2-4 shows that a half-wavelength standing wave multiplied by an integer, q, forms in the direction of the laser cavity length (z direction). When the refractive index of the medium is n and the wavelength in a 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 above, 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 the mode number.

When the mode number, q, changes by 1, the wavelength change $\Delta \lambda$, is expressed as:

$| \Delta \lambda | = 0.34$ nm

Since a cavity length is incomparably longer than a wavelength, cavity resonance can take place at multiple wavelengths. The particular wavelength in which the cavity gain becomes maximum will then produce a stable standing wave.

In a semiconductor laser diode, when the temperature changes, the band gap energy changes causing the wavelength where the maximum gain is achieved to change. 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 $\Delta \lambda$ ($\approx$ 0.34 nm). The same phenomenon takes place because of temperature rise in the active layer when the injection current increases to achieve higher optical output power under continuous operation (CW).

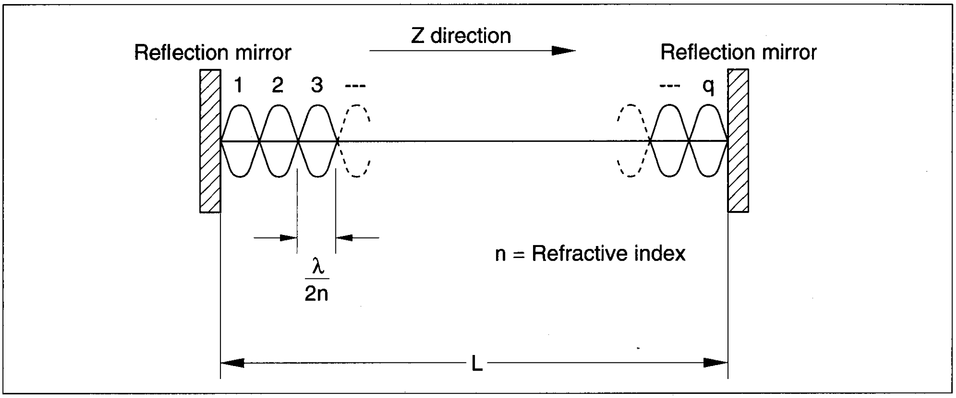


Figure 2-4: Longitudinal Mode of LD

Perpendicular transverse mode

In a GaAlAs laser diode, the active layer is sandwiched by heterojunctions (figure 2-5). Light is confined within the active layer because of the higher refractive index inside the layer than that of the outer GaAlAs layers. The amount of light confined within the active layer depends on its thickness. A thicker layer confines more light. Also, light penetrates into the outer layers when the active layer is too thin. The width of laser beam divergence depends on the thickness of the 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 faced becomes widest (figure 2-6). In general, in a semiconductor laser, the radiation angle of the 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 different from what occurs in a conventional gas laser or solid state laser.

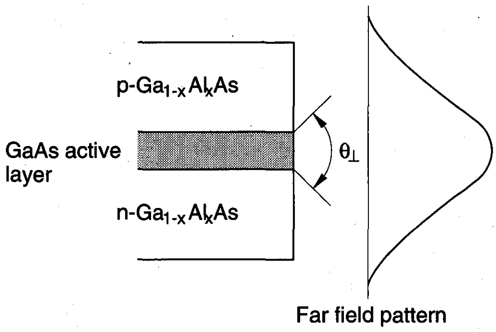


Figure 2-5: Perpendicular Transverse Mode

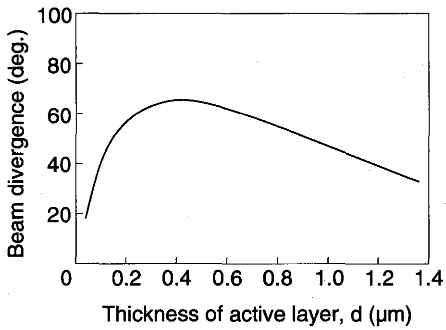


Figure 2-6: Thickness of Active Layer vs. Beam Divergence

Parallel transverse mode

A waveguide must be formed by some means because there is nothing to guide light in the active layer in a direction parallel to the junction. When current injection is limited to a narrow enough region with a full cavity length, laser oscillation can then take place in the region (figure 2-3). Figure 2-7 shows the basic stripe structure which can limit current pass only.

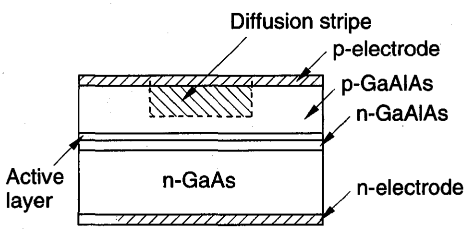


Figure 2-7: Basic Stripe LD

In order to control the transverse mode more effectively, the refractive index profile or the optical loss profile should also be built into the stripe structure. Figure 2-8 shows examples of this structure.

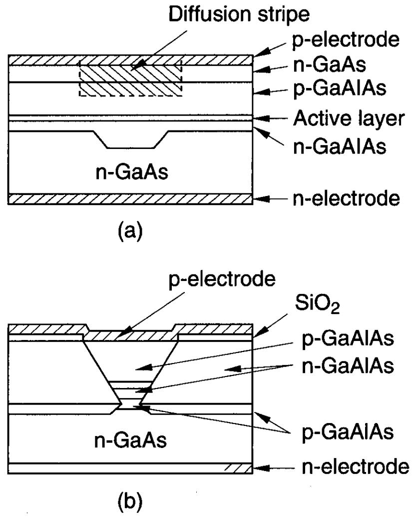


Figure 2-8: Stripe Lasers with Built-in Waveguide

Figure 2-8 (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 2-8 (b) describes a BH (buried heterostructure) laser. In both the perpendicular and parallel directions, the double-heterostructure is made.

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

The HL7801, HL7806, HL8311, HL8312, and HL8314 series employ the same basic material: GaAlAs. The HL1321 series employs InGaAsP in an active layer and InP in outer layers. The fundamental lasing principle and the lasing mode are the same. The structure a DFB (distributed feedback) LD takes to realize a dynamic single mode is shown in figure 2-9.

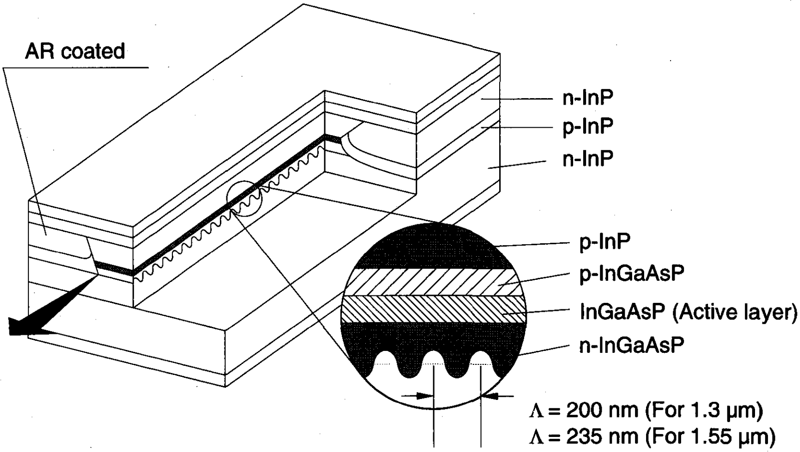


Figure 2-9: DFB-LD Structure

2.2 IRED Structures

2.2.1 Heterostructure

The p-n junction barrier of the diode confines the injected current to the active layer. The heterojunction (figure 2-10 (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 and high speed. Practically, $Ga_{1-x}Al_xAs$ is used the band gap energy is controlled by changing the mixture ratio, x.

Hitachi IREDs are divided into two structures: SH (Single Hetero) structure which has only one hetero-junction and DH (Double Hetero) structure which has two heterojunctions (figure 2-10 (b)) capable of realizing high-power output and high speed. Table 2-1 shows the structure of each type.

High efficiency of current-light conversion is achieved using GaAs crystal, which is a direct transition material. Hitachi shapes the chip surface hemispherically to best utilize the emitted light out of a chip (figure 2-11).

Table 2-1: Hitachi IRED Structures

Part No.	Structure
HLP series	SH
HE8807 series	SH
HE7601SG	DH
HE8404SG	DH
HE8812SG	DH
HE8811	DH
HE8813VG	DH
HE8815VG	DH
HE8403 series	DH
HE1303 series	DH

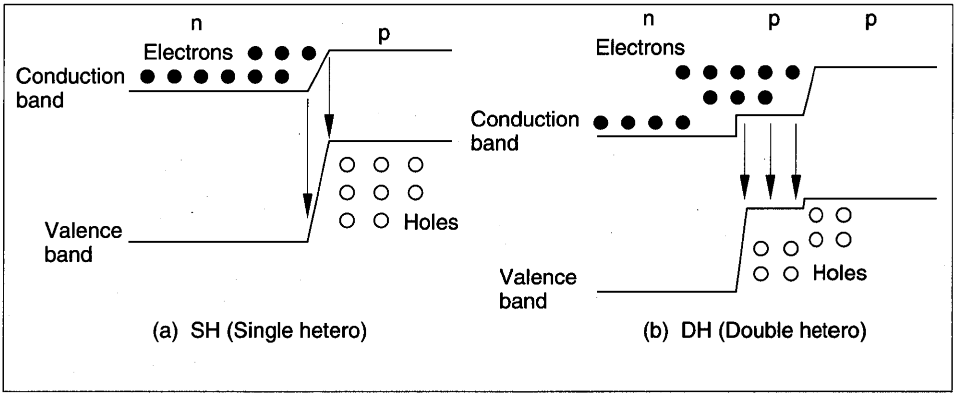


Figure 2-10: Junction Structure

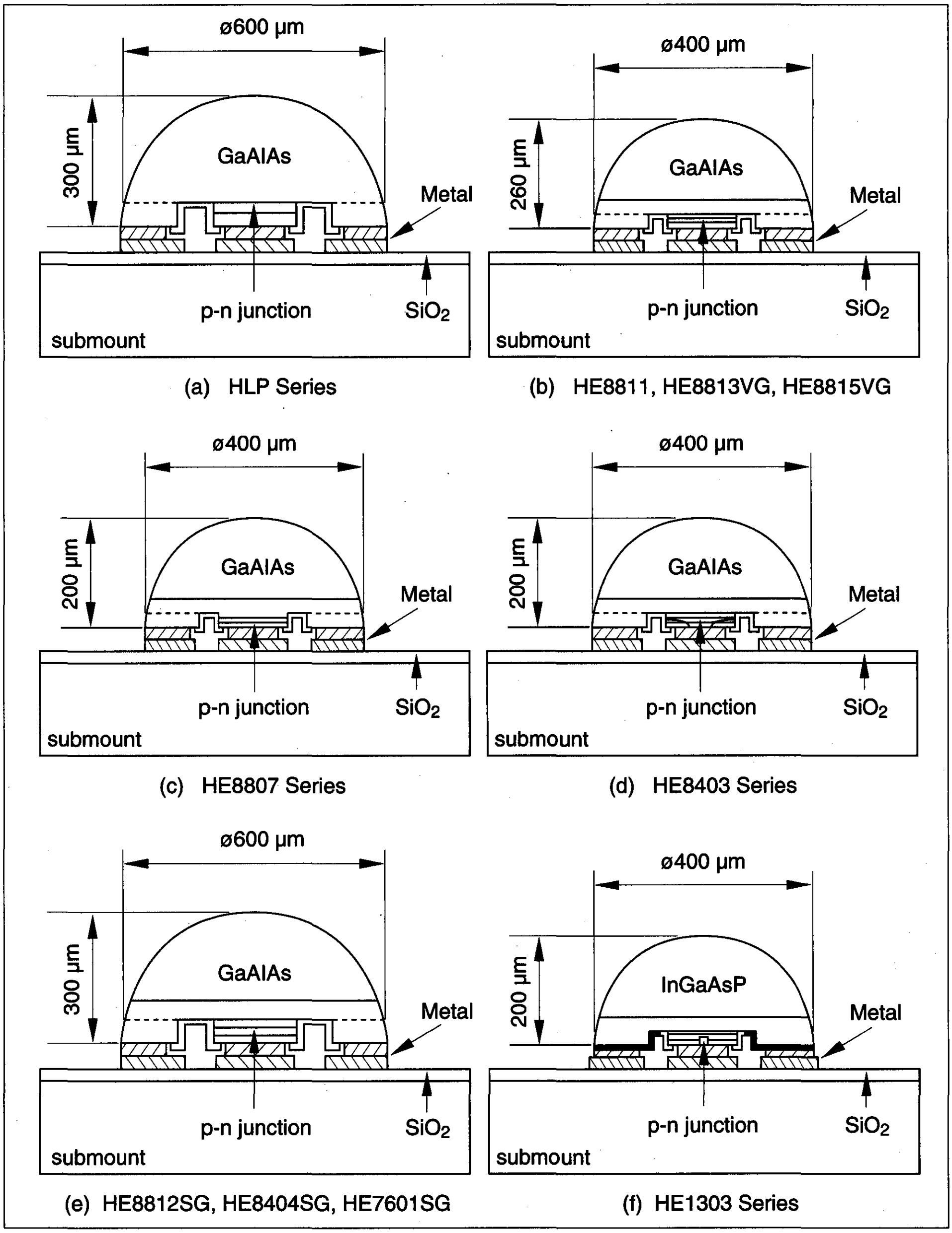


Figure 2-11: IRED Structures

2.2.2 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 flatshaped chip is unable to pass out at angles above 17 degrees and is reflected inside the chip, as shown in figure 2-12. 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 figure 2-13. 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 chips. As a result, light hitting around the dome periphery is refracted forward, increasing the amount of utilizable light.

Table 2-2: Dome Diameter and Junction Diameter of Each Part Number

Part No	Dome Dia. (μm)	Junction Dia. (μm)
HLP series	600	160
HE7601SG	600	160
HE8404SG	600	160
HE8812SG	600	160
HE8807 series	400	100
HE8811	400	100
HE8813VG	400	100
HE8815VG	400	100
HE8403 series	400	30
HE1303 series	400	30

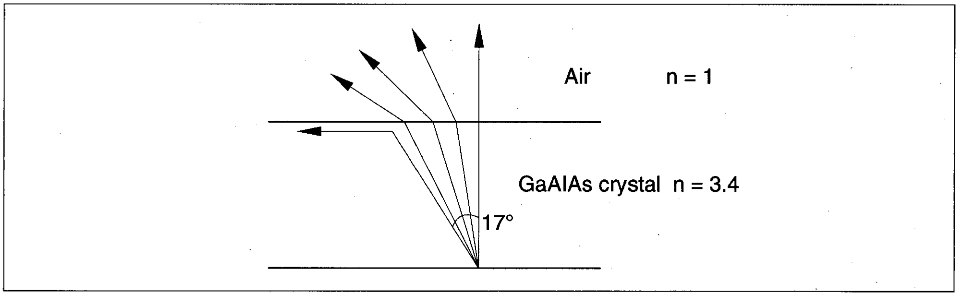


Figure 2-12: Light Refraction at Boundary Layer

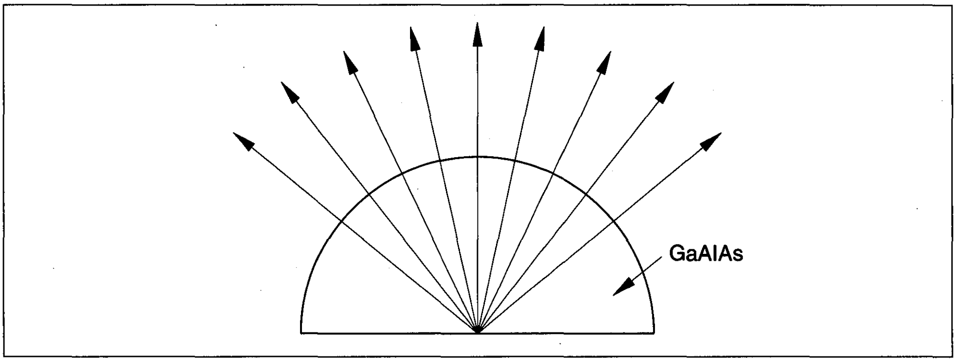


Figure 2-13: Hemispherical Shaped Light Radiation

2.3 Photodiode Structures

2.3.1 Si PIN Photodiodes

PIN photodiodes are characterized by high quantum efficiency and a high-speed response under low voltage. 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 by Hitachi's high-purity epitaxy processes. A cross-section of a Hitachi Si PIN photodiode is illustrated in figure 2-14.

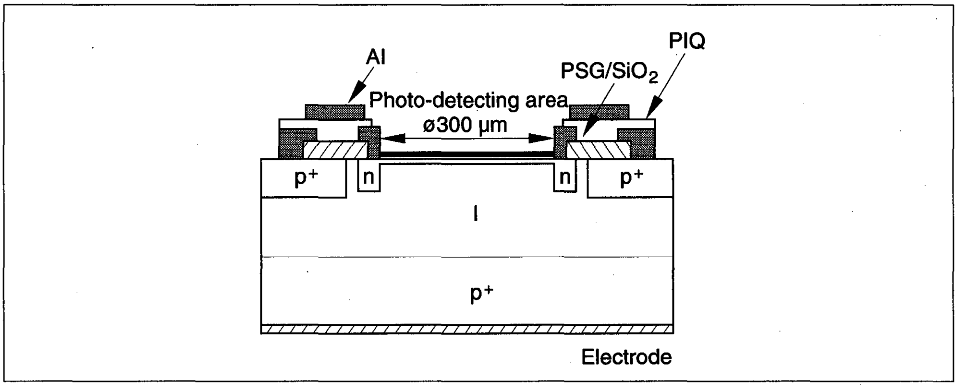


Figure 2-14: Si PIN Photodiode Structure

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 2-15 shows frequency response under conditions of 830 nm incident light, 50 Ω 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.

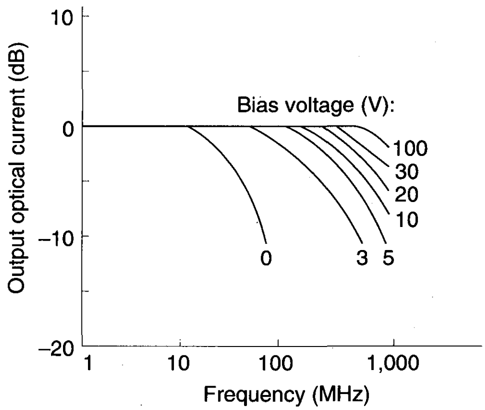


Figure 2-15: Frequency Response for Si PIN Photodiode

2.3.2 InGaAs/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 very large for light with energy greater than the band gap energy. Electron hole pairs also recombine and are annihilated easily when there are defects on the chip surface.

Hitachi InGaAs/InP photodiodes make use of a planar structure (figure 2-16). In this structure, incident light is absorbed into the InGaAs 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 InGaAs layer.

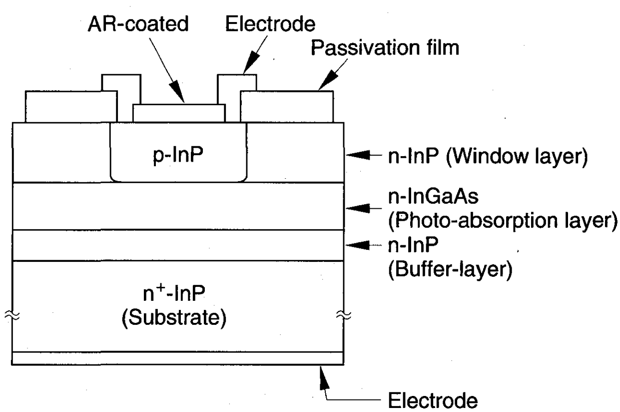


Figure 2-16: InGaAs/InP PIN Photodiode Structure

Quantum efficiency is about 80% at 1300 nm when the spectrally sensitive region is set at 1000 nm to 1650 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.

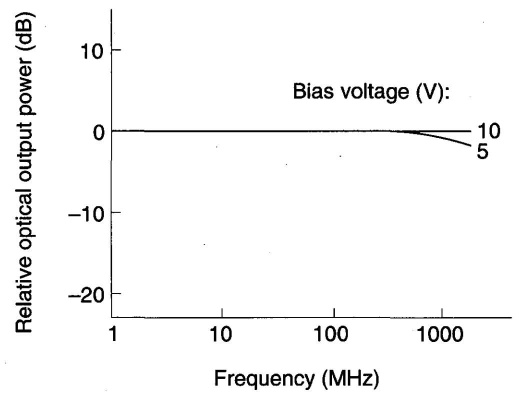


Figure 2-17: Frequency Response for InGaAs/InP PIN Photodiode

§3. Symbols and Definitions

3.1 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.

1

Table 3-1: Absolute Maximum Ratings

Items	Applicable Devices: LDs	IREDs	Photo-diodes	Definitions
Optical output power, P_O ,P_f	O			Maximum tolerable output power under continuous wave (CW) operation. The value with no kink phenomenon in light vs. current characteristics (figure 3-1). The power of device with a fiber pigtail is shown as fiber optical output power, P_f.
Forward current, I_F		O	O	Maximum tolerable current under CW operation.
Reverse current, I_R			O	Maximum permissable photocurrent when prescribed reverse voltage, V_R (but not exceeding breakdown voltage, V_B), and incident light are applied.
Reverse voltage, V_R	O	O	O	Maximum tolerable reverse bias applied to a device. For the LDs with a built-in photodiode, the reverse voltages of the photodiode, $V_{R\,(PD)}$, and of the 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).
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.

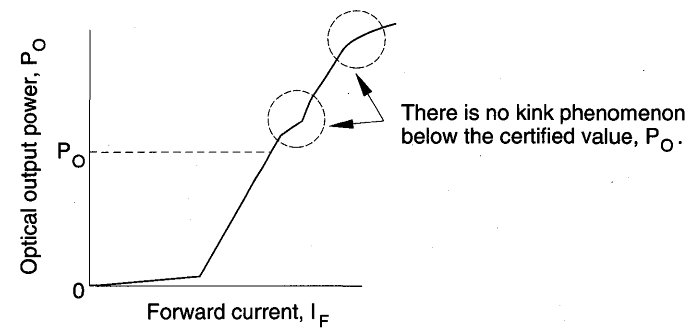


Figure 3-1: Light vs. Current Characteristics

3.2 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 the user's convenience for application to electrical circuits and optics.

The definitions of optical and electrical characteristics are listed below.

Table 3-2: LD Optical and Electrical Characteristics

Items	Definitions
Optical output power, P_O, P_f	Optical output power under the specified forward current, I_F or the value of the kink-free region. The power of device with a fiber pigtail is shown as the fiber optical output power, P_f.
Monitor power, P_m	Optical output power from the rear side of a chip 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 (figure 3-2). 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 (figure 3-3).
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 figure 3-4 (a). $\theta_{//}$ is the full angle at a half of the peak intensity in the parallel profile (figure 3-4 (b)). $\theta_{\perp}$ is the full angle at a half of the peak intensity in the perpendicular profile (figure 3-4 (c)).
Slope efficiency, η	Optical output power increment per unit drive current in lasing region (B region) of figure 3-2.
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 a built-in photodiode.

Table 3-2: LD Optical and Electrical Characteristics (cont.)

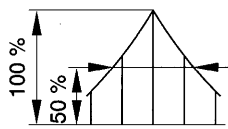
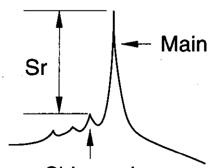
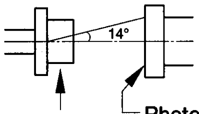
Items	Definitions
Dark current, I_{DARK}	Leakage current of photodiode when the specified reverse voltage is applied without any light input to the photodiode.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when drive 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. (Figure 3-5)
Spectral width, $\Delta\lambda$	Full width at half maximum when the spectrum pattern has been approximated to envelop. 
Capacitance ,C_t	Junction capacitance when specified reverse bias voltage is applied.
Side-mode suppression ratio, Sr	These are parameters for evaluating laser diode spectral shape. Particulary with regard to single longitudinal mode generation like the distributed feedback (DFB) laser, it indicates the ratio between the highest spectral intensity (called main mode) and the second highest spectral intensity (called side mode). 
Cooling capacity, ΔT Cooler current, I_C Cooler voltage, V_C Thermister resistance, R_{TM}	These are parameters used to evaluate the thermal characteristics of laser diode modules with built-in Peltier effect (cooling) elements. ΔT indicates, for cooler current, I_C, and cooler voltage, V_C, the cooling capacity as a temperature difference ($\Delta T = T_{LD} - T_C$). (Here T_{LD} is the temperature at the laser diode chip and T_C is the temperature of the module's case). R_{TM} indicates the resistance of the built in thermistor.

Table 3-3: 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 (figure 3-6). The power of device used in fiberoptic transmission is shown as fiber optical output power, P_f.
Forward optical output power, P_F	Indicates forward optical output power emitted from chip for prescribed forward current, I_f. This measurement is carried out with NA = 0.25, as shown in the figure below. 
Peak wavelength, λ_P Spectral width, $\Delta\lambda$	Maximum intensity wavelength in a spectral distribution (figure 3-7). Wavelength width at half the peak intensity of the peak wavelength (figure 3-7). 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 (figure 3-5).

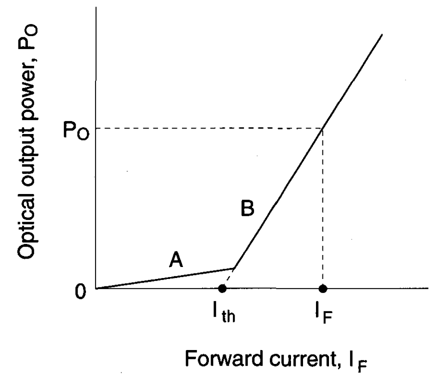


Figure 3-2: Light vs. Current Characteristics

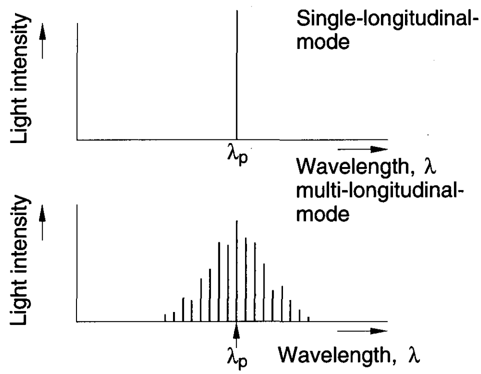


Figure 3-3: Lasing Spectrum

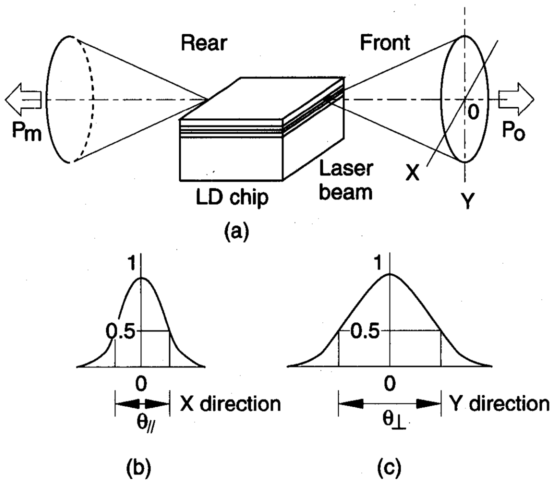


Figure 3-4: Beam Divergence

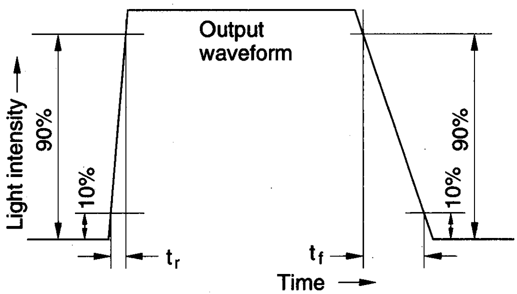


Figure 3-5: Definition of Rise & Fall Time

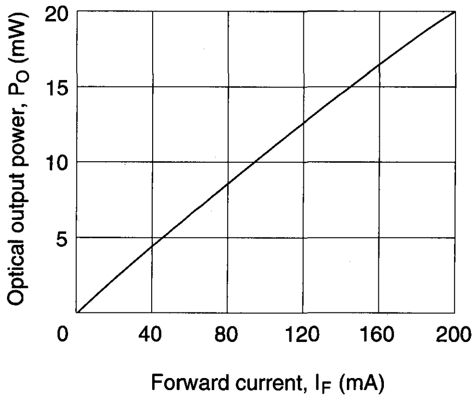


Figure 3-6: Light vs. Current Characteristics

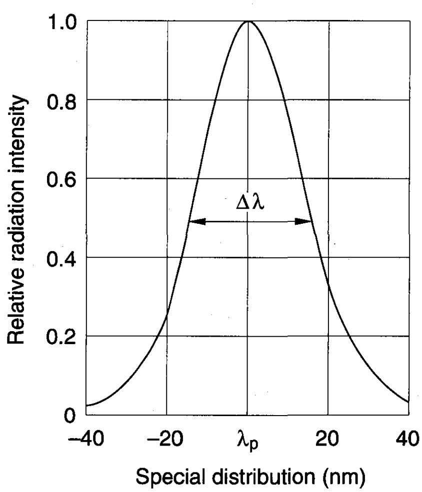
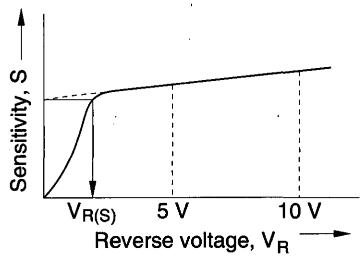


Figure 3-7: Spectral Characteristics for HLP30RG

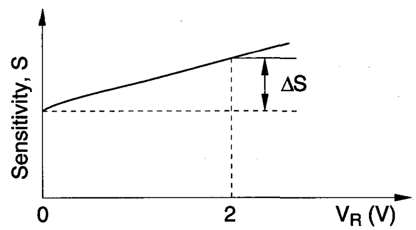
§3. Symbols and Definitions

Table 3-4: hotodiode 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 the photodiode.
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. (figure 3-5)
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



Amount of sensitivity change, ΔS	Amount of variation of photosensitivity with impressed reverse voltage V_R is defined below



$$\Delta S = \frac{S\,(V_R = 2V) - S\,(V_R = 0)}{S\,(V_R = 2V)} \times 100\%$$

This section applies to PDs, which have large sensitive area, for measurement use.

Table 3-5: PD Optical and Electrical Characteristics

Items	Definitions
Breakdown voltage, V_B	The reverse voltage when the specified leak current is applied without any light input to the photodiode.
Multiplication factor, M	Defined as ratio of the number of carriers which reach the electrode due to avalanche phenomenon to the number of carriers generated just by light input . V_R as V_I at the turning point of the I_{ph} curve (figure 3-8) $M = \frac{I_{ph} - I_{DARK}}{I_{ph1} - I_{DARK1}}$ thus M = 1 when $V_R = V_I$
Maximum multiplication factor, Mm	Maximum multiplication factor for V_R.
Multiplicated dark current, I_{DM}	Dark current for $V_R = V_I$ (M = 1).
Cut-off frequency, f_C	Frequency at which output power becomes –3 dB of output power at the standard frequency.
Excess noise factor, F, X	Multiplied shot noise parameter for avalanche photodiode. Excess noise factor F defined as $F = M^x$

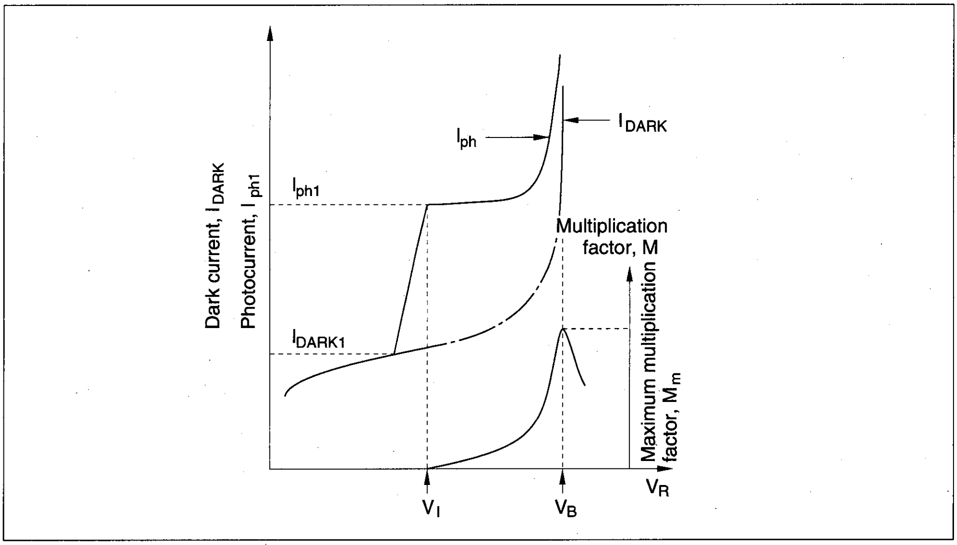


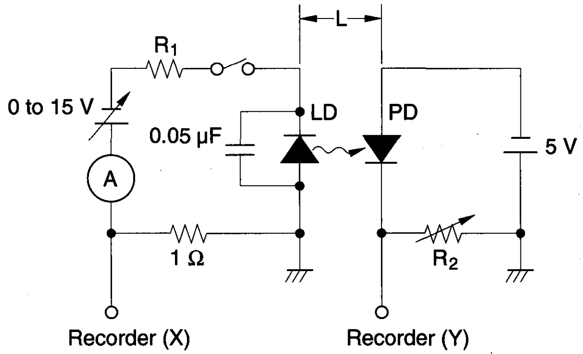
Figure 3-8: Definition of APD Symbols

§4. Fundamental Characteristics

4.1 LD Fundamental Characteristics

4.1.1 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 4-1 shows a measuring setup for light vs. current characteristic under CW operation.



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 4-1: Measuring Setup for Light vs. Current Characteristics under CW Operation

The photodetector with proper response and effective photosensitive area is first required for measuring the LD's optical characteristics. A photocell of more than 20 mm dia. is recommended providing enough photosensitive area to take-in the full light power without a lens. The suitable distance between the 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. The LD device must be mounted on a copper or aluminum heat radiator of about $30 \times 40 \times 2$ mm^3, especially for CW testing, because the heat generated by the chip degrades its characteristics and lifetime.

Light vs. current characteristics and dL/dI vs. I characteristics for the HL1322A are shown in figures 4-2 and 4-3 respectively.

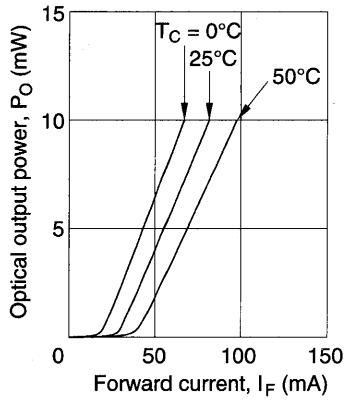


Figure 4-2: Light vs. Current Characteristics for HL1322A

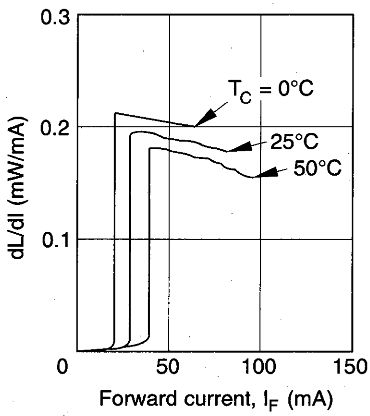


Figure 4-3: dL/dI vs. I Characteristics for HL1322A

§4. Fundamental Characteristics

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

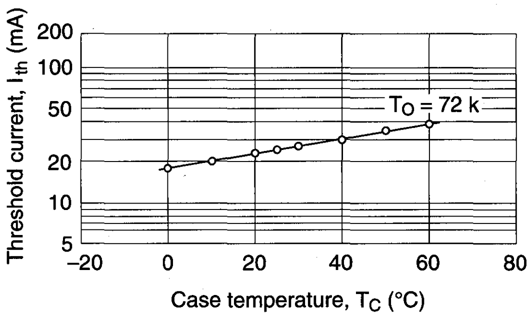


Figure 4-4: Temperature Dependency of Ith for HL1322A

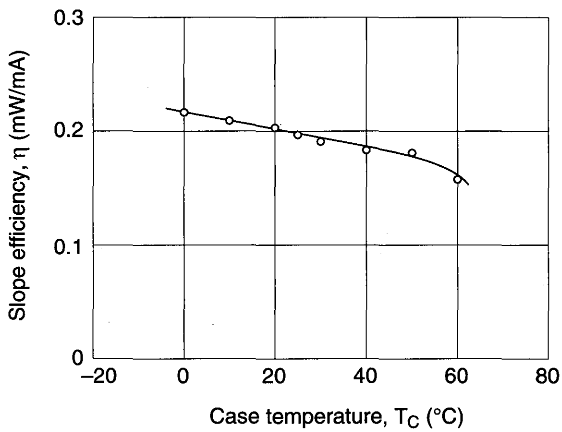


Figure 4-5: Temperature Dependency of h for HL1322A

4.1.2 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 figure 4-6, which employs a PIN photodiode as a photodetector. Sampling measurement of the photovoltaic current is made after it becomes stabilized.

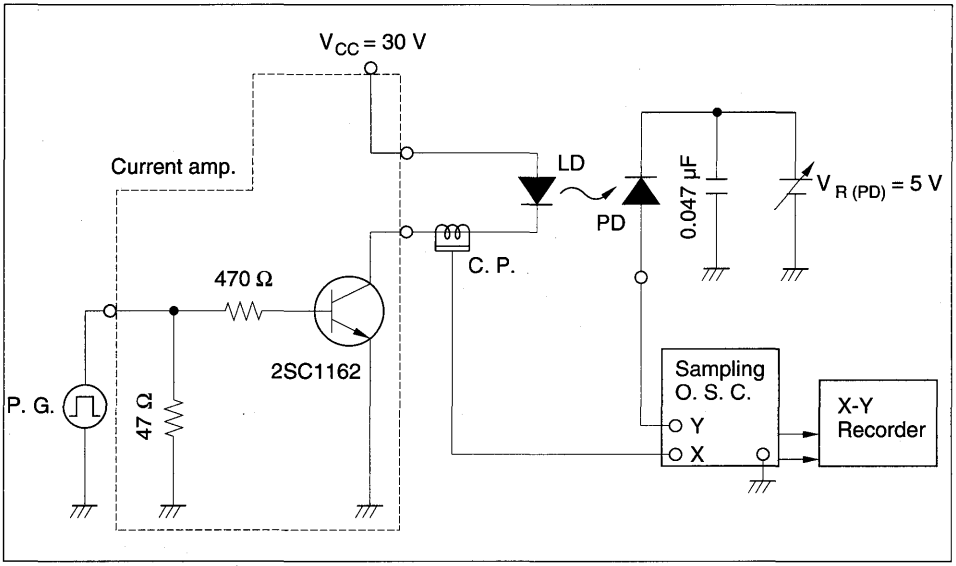


Figure 4-6: Measuring Setup for Light vs. Current Characteristics under Low-frequency Pulse Operation

Figure 4-7 shows pulse light vs. current characteristics for the HL1322A.

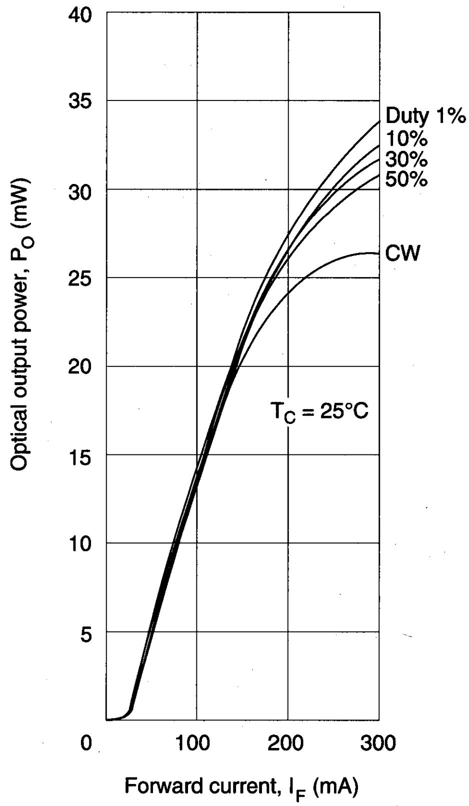


Figure 4-7: Pulse Light vs. Current Characteristics for HL1322A

4.1.3 Lasing Spectrum

The lasing spectrum (longitudinal mode) is a fundamental LD characteristic. The spectrum at modulation is an important factor for transmission use. Derivative characteristics such as the spectral width ($\Delta \lambda$) for Fabry-Pérot LDs and the side-mode suppression ratio for DFB (distributed feedback) LDs are particularly important for transmission applications. Temperature dependency and optical-output dependency of the spectrum should also be taken into consideration. A measuring setup for the spectrum at modulation is shown on figure 4-8.

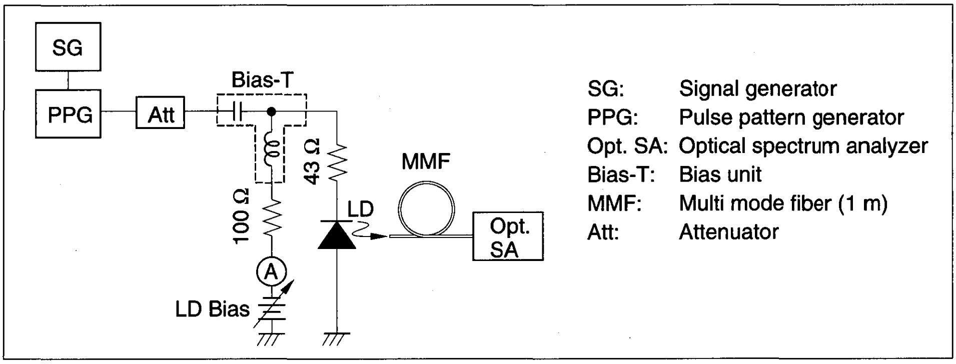


Figure 4-8: Measuring Setup for Spectrum under Modulation

For high frequency modulation, the same precautions for measurements described in "section 1.5 Pulse Response Characteristics" must be observed. Also, if the fiber pierces a portion of the human body, it can cause injury, so appropriate care must be exercised in its handling.

Figure 4-9 shows temperature dependency of lasing spectrum for the HL1322A, Fabry-Pérot LD. The temperature coefficient of the wavelength is about 0.3 nm/°C.

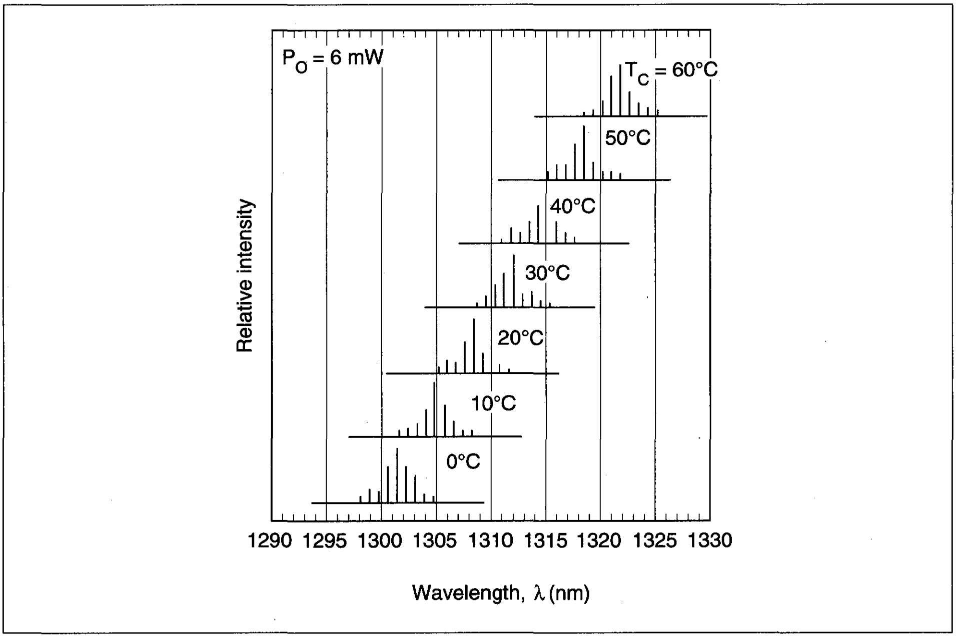


Figure 4-9: Temperature Dependency of Wavelength for HL1322A

Optical-output-power dependency of the lasing spectrum for the HL1322A is shown in figure 4-10.

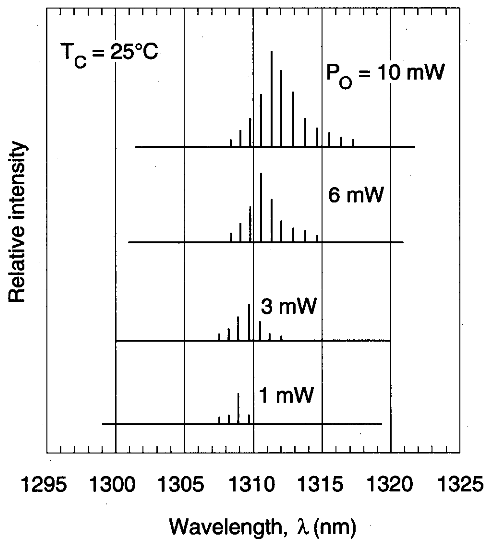


Figure 4-10: Optical-output-power Dependency of Wavelength for HL1322A

Figure 4-11 shows the modulation dependency of the spectral width, $\Delta\lambda$. The higher the bit rate, the larger $\Delta\lambda$ becomes.

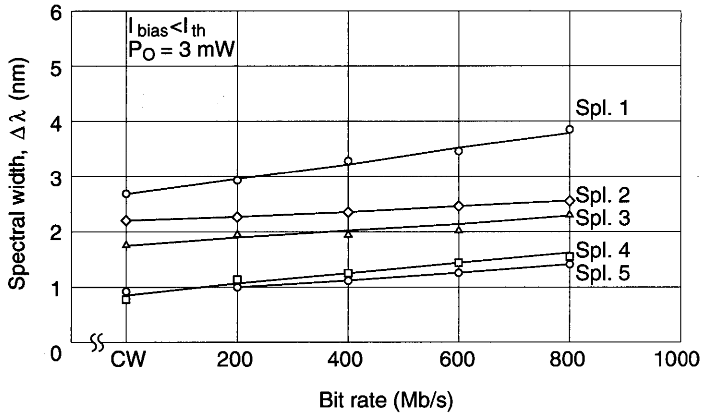


Figure 4-11: Spectral Width vs. Transmission Bit Rate for HL1322A

Figure 4-12 shows the dependency of the generated spectrum on temperature.

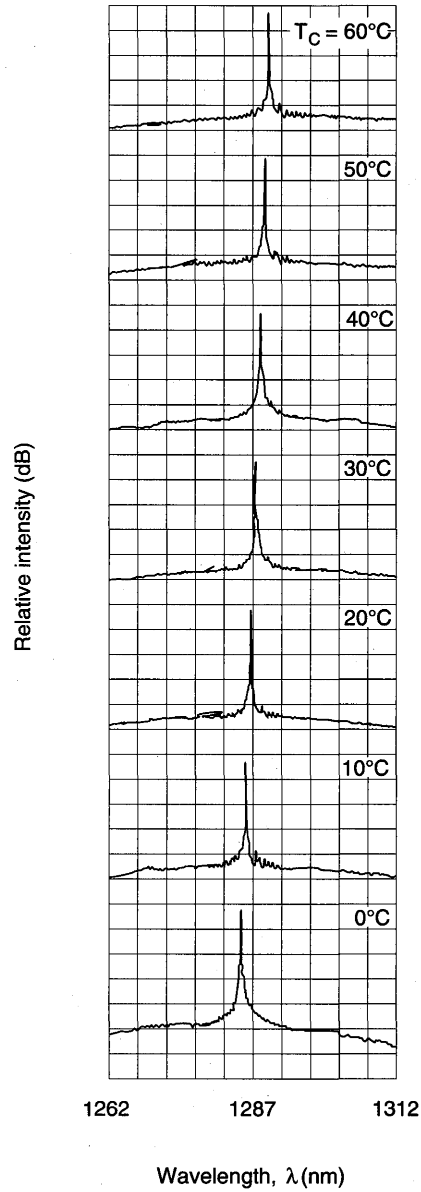


Figure 4-12: Temperature Dependence of Spectrum for HL1341A

The generated wavelength vs. temperature dependence of the DFB-LD, at 0.09 nm/°C, is small relative to that of the FP-LD.

Figure 4-13 shows the dependency of optical output power of the generated spectrum on temperature. At currents above the threshold current (I_{th}), a single mode is generated, but the generated wavelength exhibits almost no dependence upon optical output power.

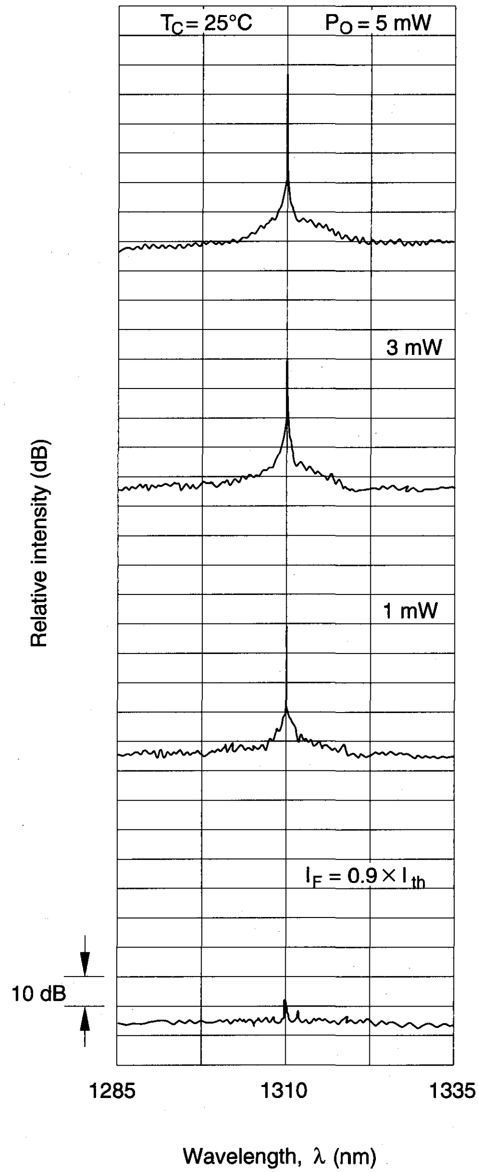


Figure 4-13: Optical Output Power Dependence of Spectrum for HL1341A

Figure 4-14 shows the generated spectrum for modulation. When modulating, the side mode suppression ratio Sr is stable even in comparison with CW operation, and it exhibits characteristics optimized for use in gigabit band transmission.

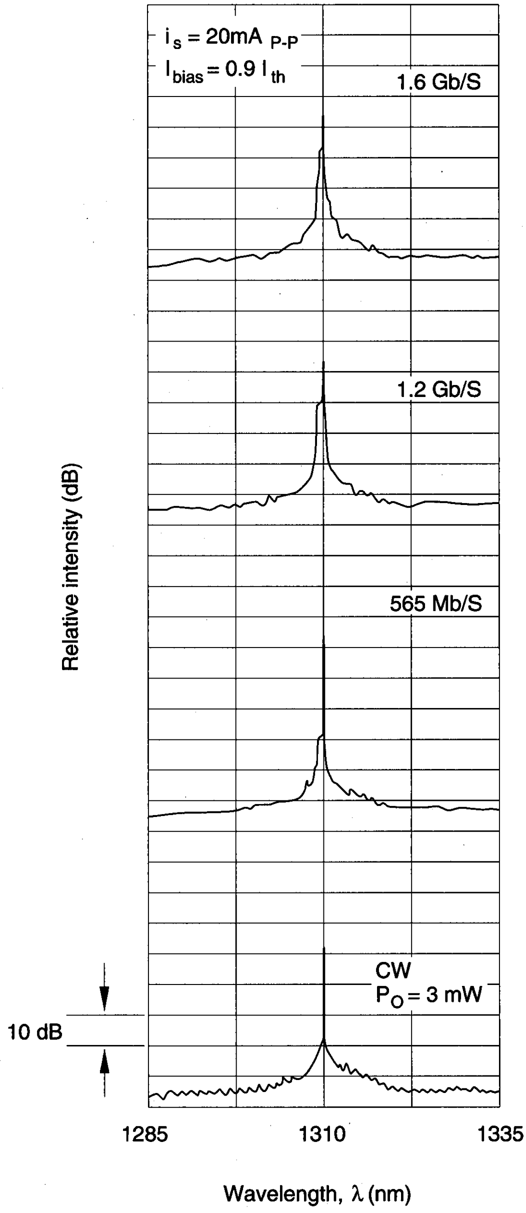


Figure 4-14: Frequency Dependence of Spectrum for HL1341A

4.1.4 Far Field Pattern (FFP)

The FFP is the light intensity profile measured in two directions as a function of angle: parallel and perpendicular to the device (the active layer of an LD and arbitrary for IRED). The measuring setup for the FFP, shown in figure 4-15, employs the same drive circuit as that for light vs. current characteristics measurement under CW operation. Use a PIN photodiode with a small photosensitive area or an avalanche photodiode (APD) as a photodetector. The distance between the detector and the LD is about 10 cm. Set the emitting point of the LD at the center of the turn table. Use a potentiometer to translate the rotation angle to voltage.

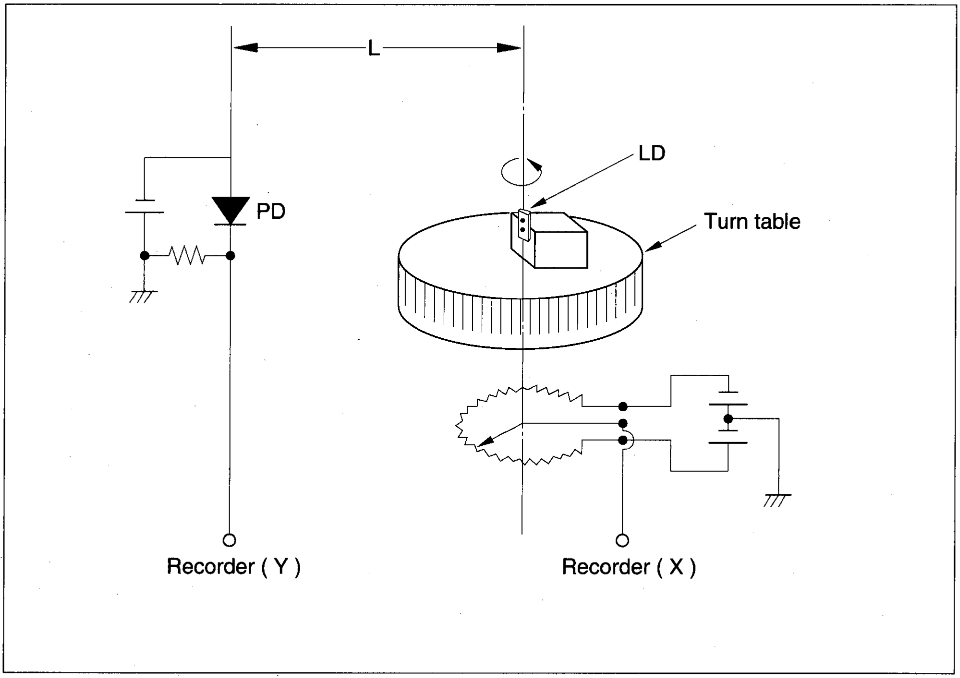


Figure 4-15: Measuring Setup for Far Field Pattern

The FFP of the HL7836 series is shown in figure 4-16 for various power outputs.

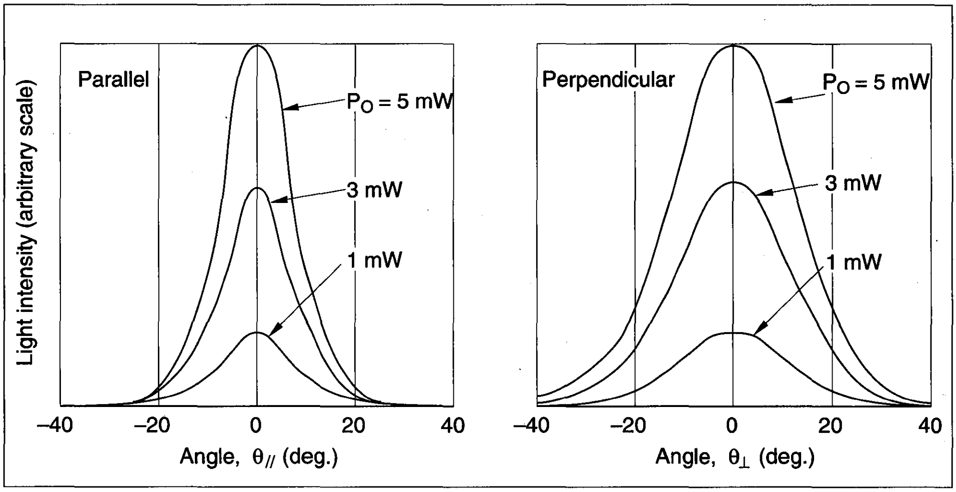
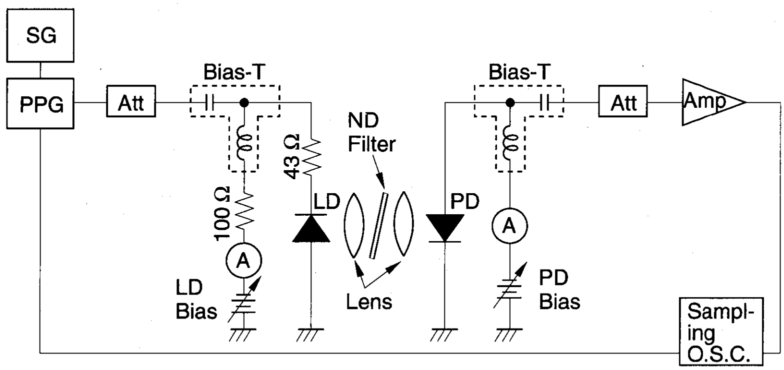


Figure 4-16: Optical-output-power Dependency of Far Field Pattern for HL7836 Series

The HL7836 series devices lase at a stable transverse fundamental mode with a single peak in the FFP approximating a gaussian curve. The FFP grows in height proportionally to the optical output power and has no peak point steering or no light distribution width change within the maximum ratings.

4.1.5 Pulse-response Characteristics

A measuring setup for pulse-response characteristics is shown in figure 4-17. Pulse signals are generated with a PPG (pulse signals generator). A fast-pulse-response PIN photodiode or APD (avalanche photodiode) is suitable for this setup.



SG: Signal generator
PPG: Pulse pattern generator
Bias-T: Bias unit
Amp: Amplifier
Att: Attenuator

Figure 4-17: Measuring Setup for Pulse-response Characteristics

When operating the LD in pulse mode, if the DC bias falls below the threshold current, a delay will develop between the drive current pulse and the optical output pulse. The exact value of the delay depends upon the bias point and the temperature. An example is given in figure 4-18.

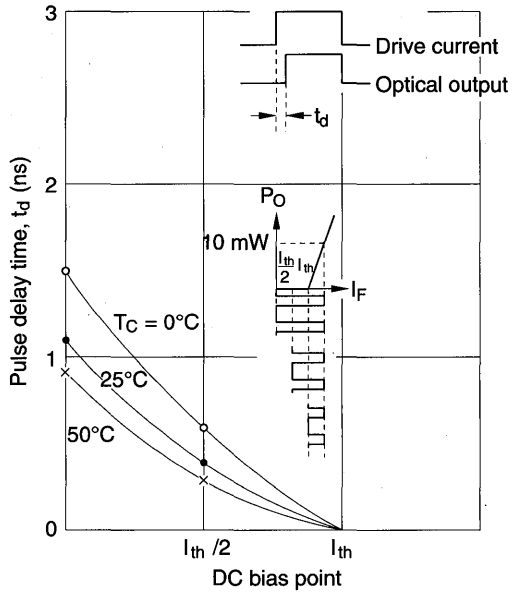


Figure 4-18 : Bias Point Dependency of Pulse Delay Time for HL7836 Series

Precautions when Making Measurements.

(1) Select a lens for light emitted from the LD with numerical aperture (NA) and magnification which concentrates adequate light on the active optical surface of the PD.

(2) Cut the lead of the LD as short as possible, and solder to a 50 Ω strip.

(3) For the LD impedance, because the LD gives rise to dispersion, select a ship resistance for which the LD impedance and chip resistance are 50 Ω (approx. 43 Ω is optimal).

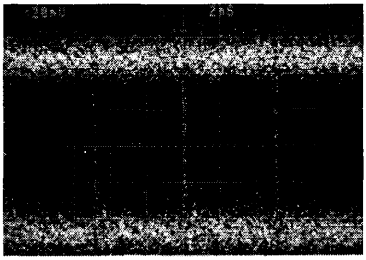
(4) Because this is a GHz order measurement, the cable must be kept as short as possible, and all connections should be verified for soundness.

To determine the pulse response characteristics, the rise and fall time and the eye pattern of the digital transmission must be evaluated.

Figure 4-19 shows an example of eye patterns for the HL1322A. As seen from this figure, the HL1322A responds up to 1.6 Gb/s.

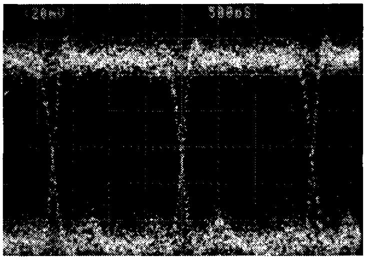
Transmission speed | **Eye patterns for HL1322A**

200 Mb/s



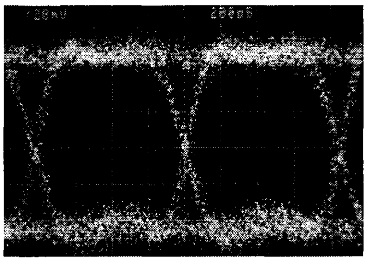
20 mV/div
2 ns/div

565 Mb/s



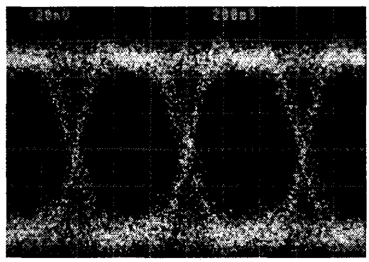
20 mV/div
500 ps/div

1200 Mb/s



20 mV/div
200 ps/div

1600 Mb/s

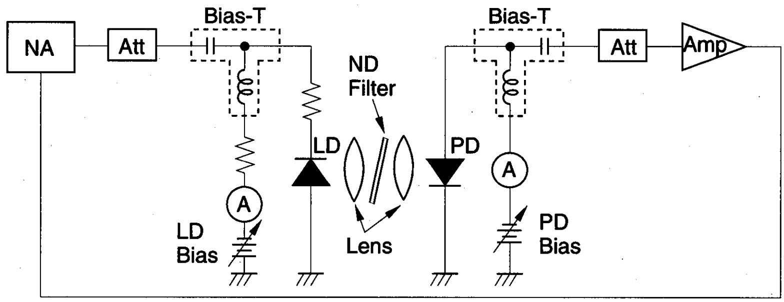


20 mV/div
200 ps/div

Figure 4-19: Eye-pattern Characteristics at Pulse Modulation for HL1322A

4.1.6 Frequency Characteristics

A measuring setup for frequency characteristics is shown in figure 4-20.



NA: Network analyzer
Bias-T: Bias unit
Amp: Amplifier
Att: Attenuator

Figure 4-20: Measuring Setup for Frequency-response Characteristics

A measurement example of frequency for the HL1322A is shown in figure 4-21.

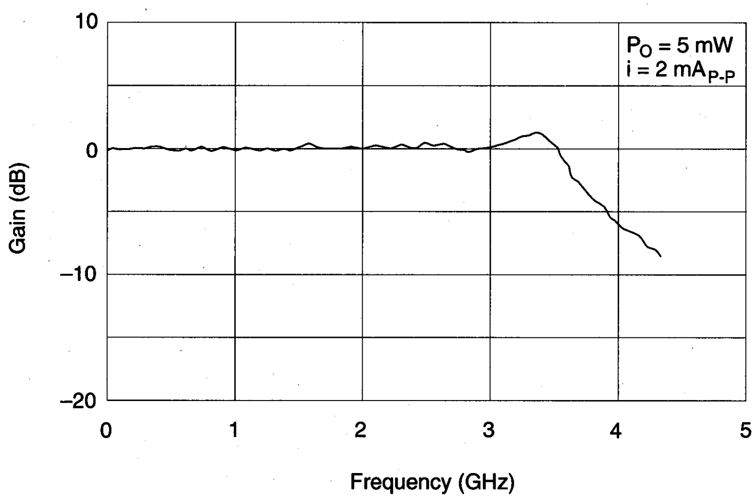


Figure 4-21: Frequency Characteristics for HL1322A

4.1.7 Mode Hopping Noise

A measuring setup for LD noise is shown in figure 4-22. Set the frequency range to be measured to a level suitable for the device application.

Measurement should be carried out after eliminating external noise. For measurement at temperatures below room temperature, take cake not to cut off the optical path due to condensation. Measurement in dry air or dry nitrogen is recommended.

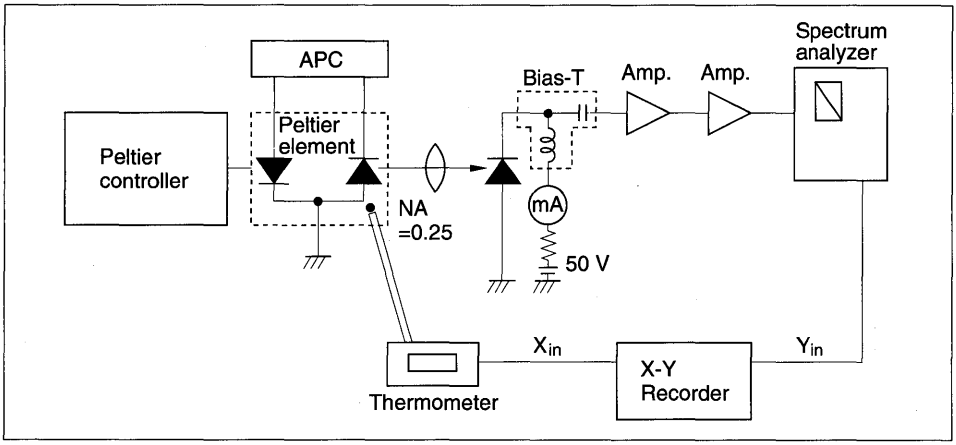


Figure 4-22: Measuring Setup for Noise

Figure 4-23 shows an example of noise vs. case temperature.

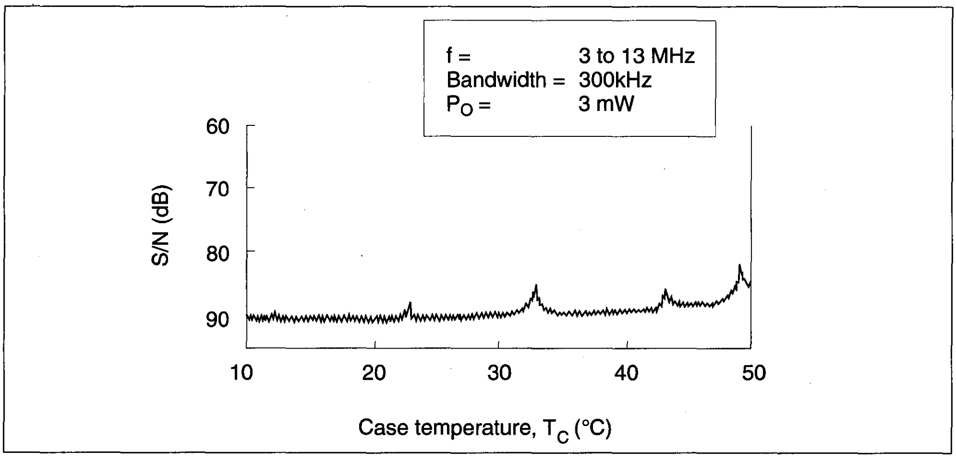


Figure 4-23: Noise Measurement Example

4.1.8 Polarization Ratio of LDs

The measuring setup for determining the polarization ratio is shown in figure 4-24. An objective lens collimates the light emitted from the LD to form parallel beam. In this case, use of an infrared phosphor plate is helpful in detecting light. Choose measuring equipment with appropriate aperture and photosensitive area so as not to disturb the parallel beam input. The polarization ratio is calculated with the maximum and minimum values of a power meter while turning a polarization prism.

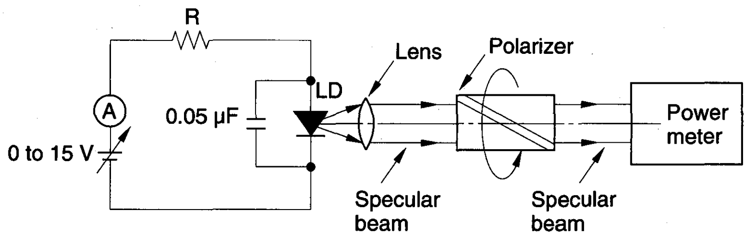


Figure 4-24: Measuring Setup for Polarization Ratio

The polarization phenomenon of an LD is illustrated in figure 4-25. The electric field oscillates parallel to the active layer, and the magnetic field oscillates perpendicular to the active layer.

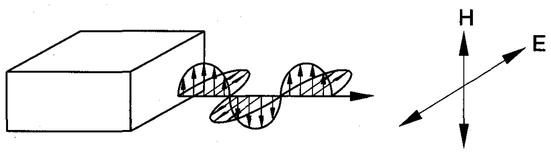


Figure 4-25: Polarization Ratio of LD

The polarization ratio depends on the optical output power and the numerical aperture. The polarization ratio vs. power output for the HL7806 series and HL8311 series are shown in figure 4-26 (a) and (b) respectively. The polarization ratio is larger when the optical output power is higher or NA (numerical aperture) of the objective lens is smaller.

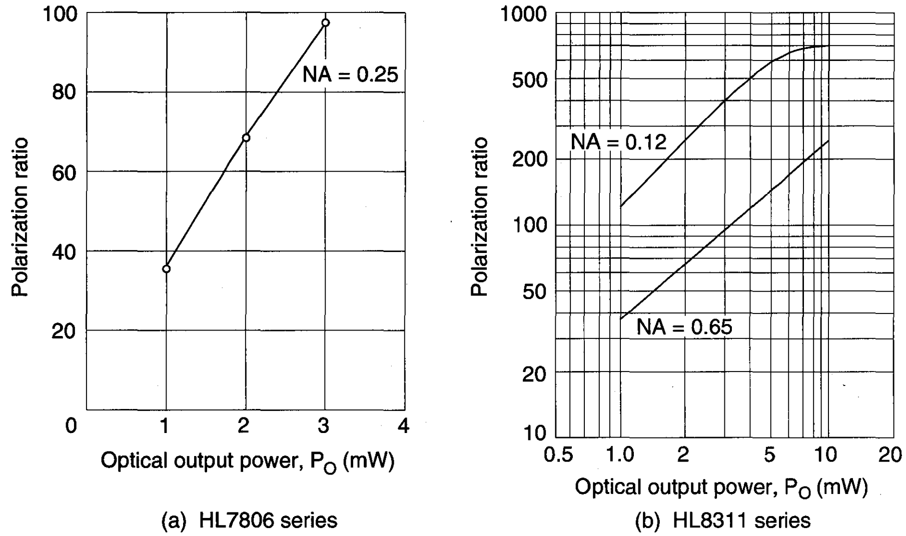


Figure 4-26: Optical-output-power Dependency of Polarization Ratio

4.2 IRED Fundamental Characteristics

4.2.1 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 figure 4-27). Photocells should be calibrated beforehand against a standard cell, since their photovoltaic current will vary from cell to cell. Under CW operation, optical output will fluctuate significantly during the measurement due to heat generated by the chip therefore, a copper or aluminum heat radiator larger than 30 × 40 × 2 mm^3 should be attached to the IRED before testing. An example of the optical output-power measuring setup is shown in figure 4-28.

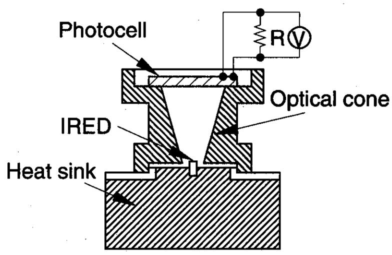


Figure 4-27: Optical Output-power Measuring Method under CW Operation

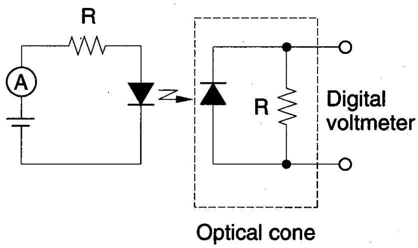


Figure 4-28: Measuring Setup for Optical Output Power under CW Operation

Optical output-power measuring method under pulse operation

An example of the measuring setup for optical output-power under low pulse operation (1-10 kHz range) is illustrated in figure 4-29. The light vs. current characteristics of the HLP30RGD are shown in figure 4-30.

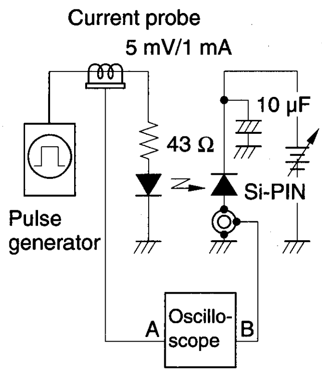


Figure 4-29: Measuring Setup for Light vs. Current Characteristics under Low Frequency Pulse Operation

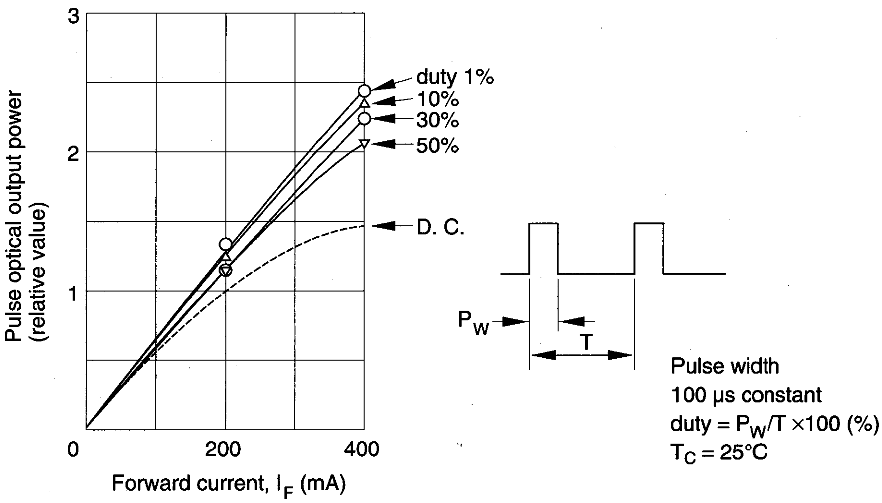


Figure 4-30: Light vs. Current Characteristics for HLP30RGD

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

A setup example for measuring the high-speed pulse response is given in figure 4-31. It is recommended that a high-speed PIN photodiode or avalanche photodiode able to respond to several GHz be used as the photodetector in this measurement. Figure 4-32 shows a measurement example of the high-speed response characteristics.

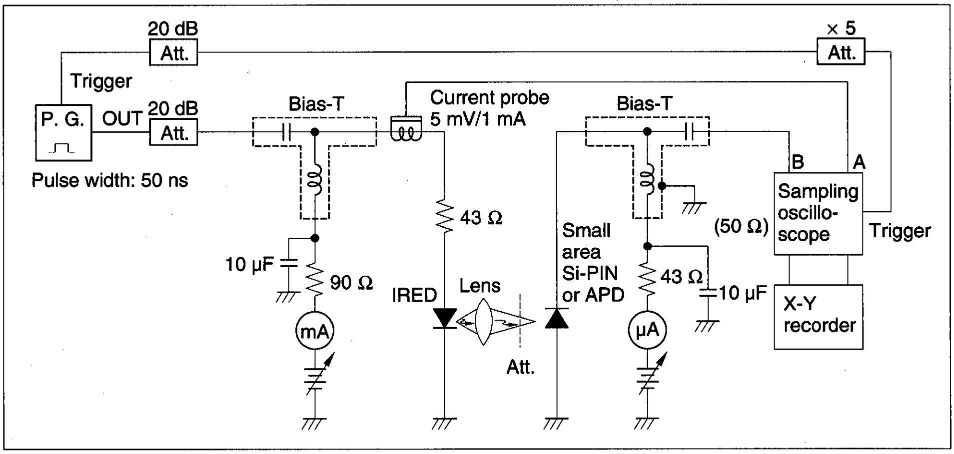


Figure 4-31: Measuring Setup for Fast Pulse Response Characteristics

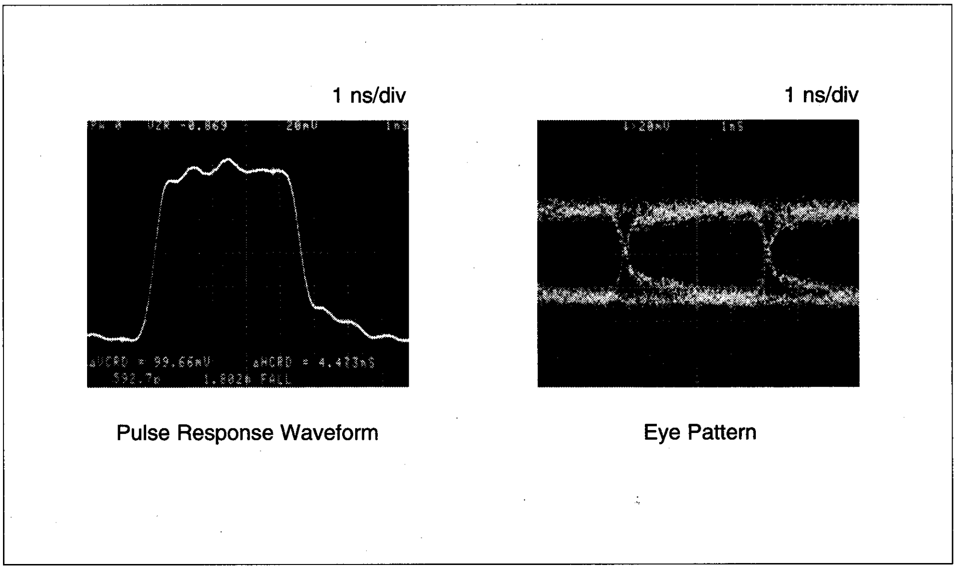


Figure 4-32: High-speed Response Example for HE1303ML

Optical output-power measuring method for fiber-ends

Figure 4-33 shows the measuring method for optical output-power at fiber-ends under CW operation.

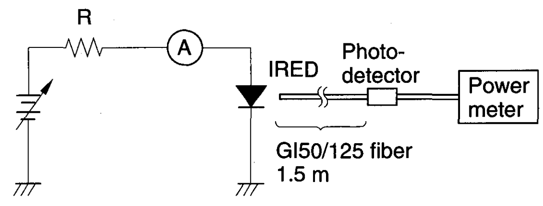


Figure 4-33: Measuring Setup for Optical Output-power at Fiber-ends

Figure 4-34 shows an example of the light vs. current characteristics for the HE1303ML.

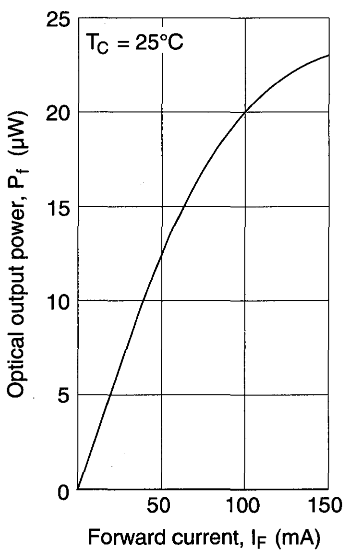


Figure 4-34: Light vs. Current Characteristics for HE1303ML

The main methods for coupling fiber to an IRED are the direct coupling method and the parabolic-rod-lens coupling method. 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 4-35 gives a measurement example of optical output fluctuation when IRED case temperature is varied. Temperature coefficients of optical output power are –0.8%/°C (typ.) for the HLP series, –0.5%/°C (typ.)

for the HE8811 and HE8403 series and –0.4%/°C (typ.) for the HE1303 series.

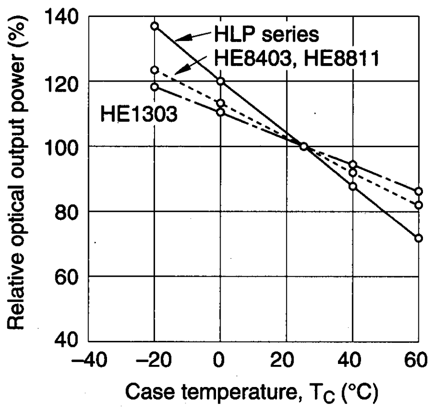


Figure 4-35: Temperature Dependency of Optical Output Power

4.2.2 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 4-36 shows the bundle fiber measuring method.

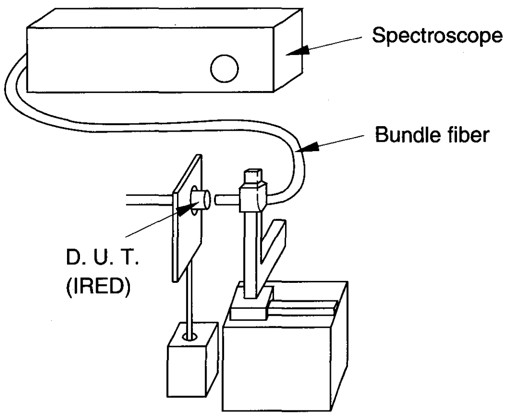


Figure 4-36: Spectral Distribution Measuring Method

Temperature dependency of wavelength

In the same way as with optical output power, temperature changes cause the wavelength distribution to fluctuate. Therefore, appropriate heat dissipation measures should be taken for the device. Figure 4-37 shows the temperature dependency of the wavelength for HE8807 series devices.

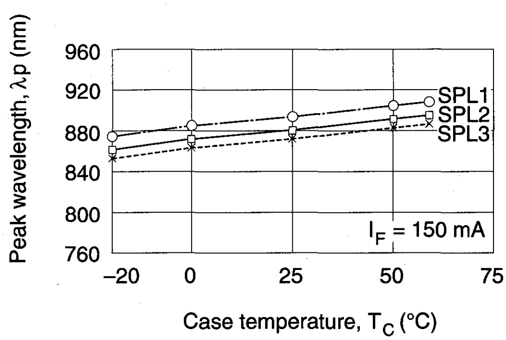


Figure 4-37: Temperature Dependency of Wavelength for HE8807 Series

As shown in figure 4-38, the peak wavelength becomes longer, spectral width wider, and optical output power lower when the temperature rises.

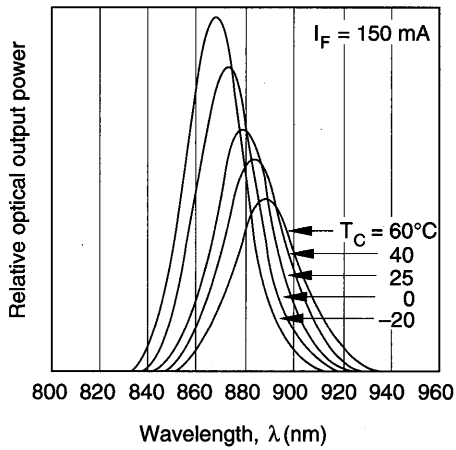


Figure 4-38: Temperature Dependency of Optical Output Power for HE8807 Series

4.2.3 Far Field Pattern (FFP)

A FFP is the light intensity profile used to obtain the relation between the angle and optical output when a photodetector is placed far enough away that the size of the IRED emitting area can be neglected. Figure 4-39 illustrates the FFP measuring method. This method employs the same driving circuit as is used with 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 to obtain the relationship between the light intensity and the turning angle.

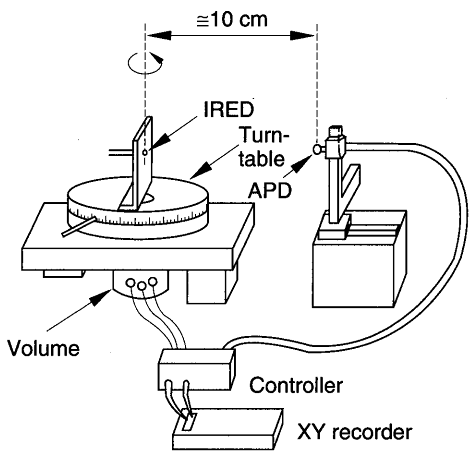


Figure 4-39: FFP Measuring Method

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 figure 4-40.

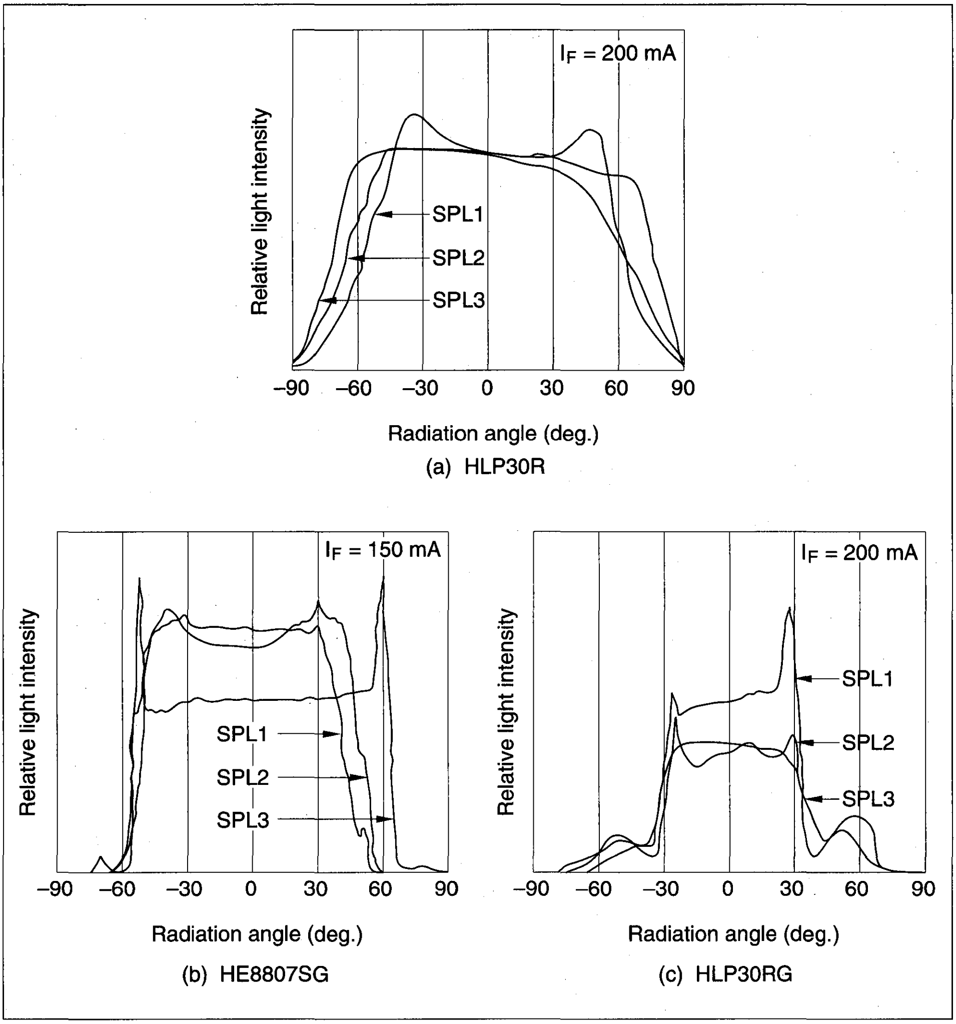


Figure 4-40: FFP Examples

4.2.4 Near Field Pattern (NFP)

A 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 figure 4-41). The amount of incident light into the infrared camera should be controlled with an optical attenuator, since too much incident light causes halation.

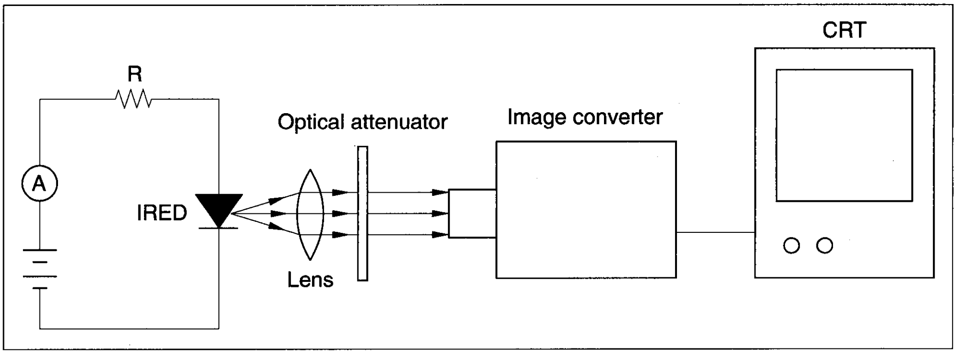


Figure 4-41: NFP Measuring Method

The emitting area is an enlarged area on the upper surface of the IRED chip and it appears larger than its actual size, due to the lens effect of the domeshaped 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 figure 4-42. The effective diameters are 520 μm (type) for the HLP series of 600 μm dome (chip) diameters and 360 μm (type) for the HE8807 and HE8811 of 400 μm dome diameters. Current confinement types such as the HE8403 and HE1303 series have effective diameters of 150 μm. Figure 4-43 shows an example measurement of effective diameters for the HE8807.

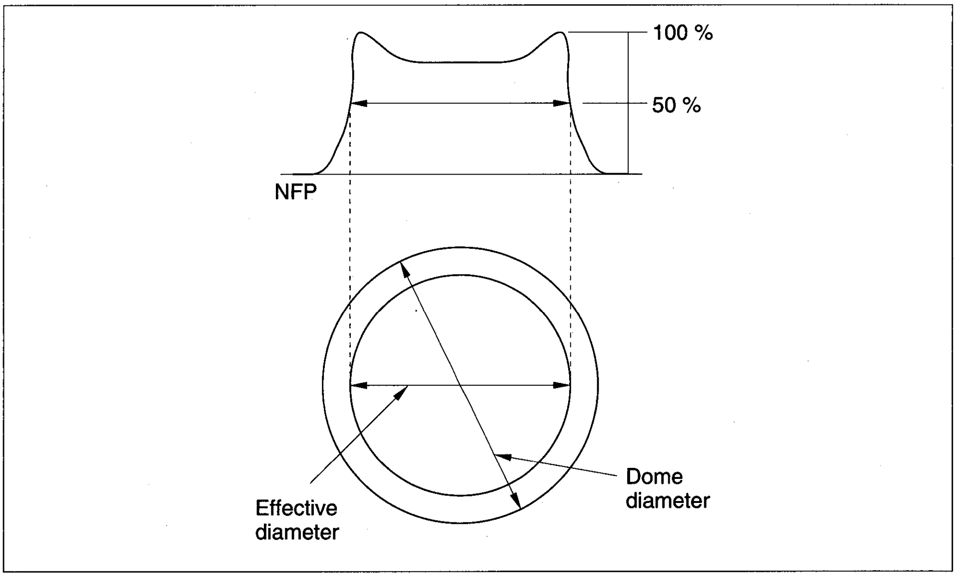


Figure 4-42: Effective Diameter and NFP

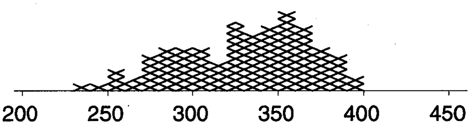


Figure 4-43: Effective Diameter Examples for HE8807

4.2.5 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 a IRED. Measurement values of destructive current are shown in figure 4-44. IREDs should be operated at value less than half this destruction current and in a region where the light-output-current characteristic is not saturated.

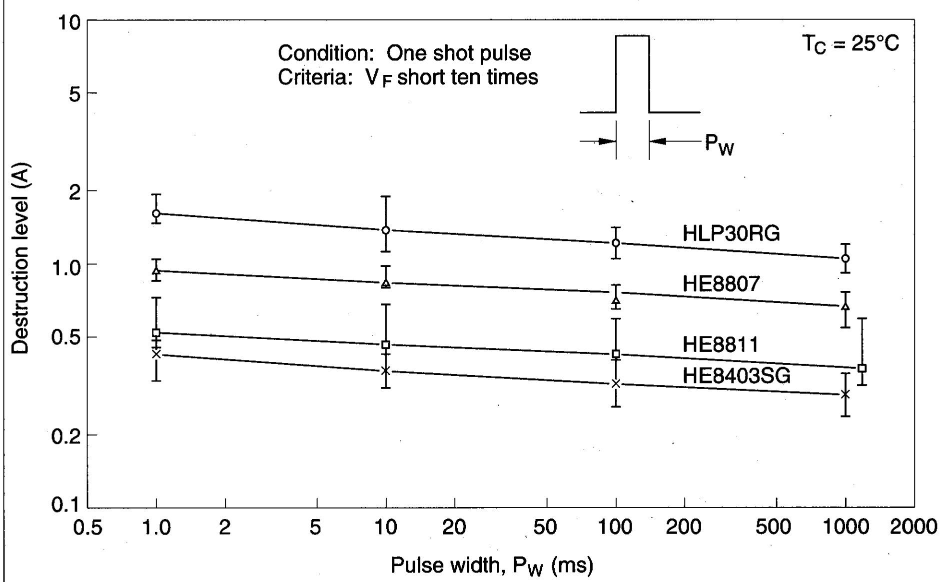
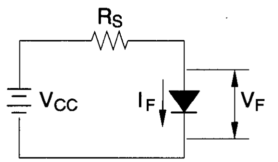


Figure 4-44: Destructive Current

A serial protection resistor, R_S, should be inserted in the drive circuit for CW operation to prevent excessive current flow (see figure 4-45). 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 limiter starts functioning after the power source is switched on.



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)

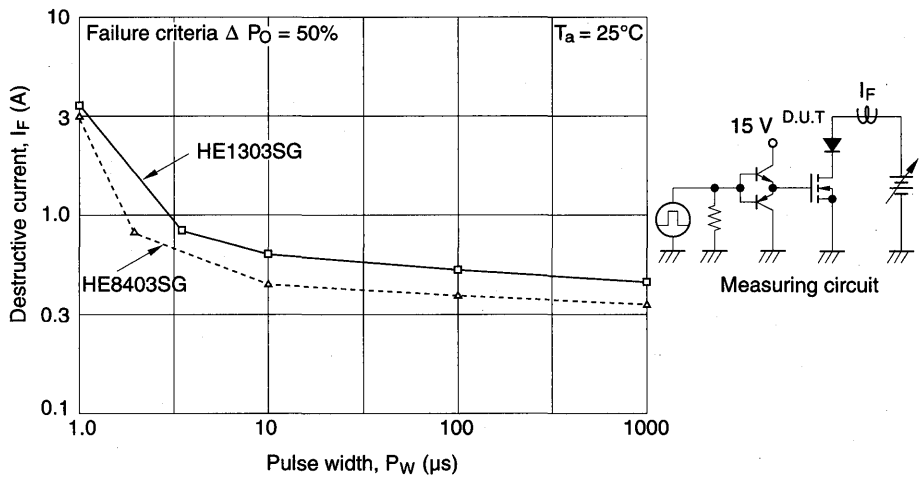
b) When using constant current supply

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

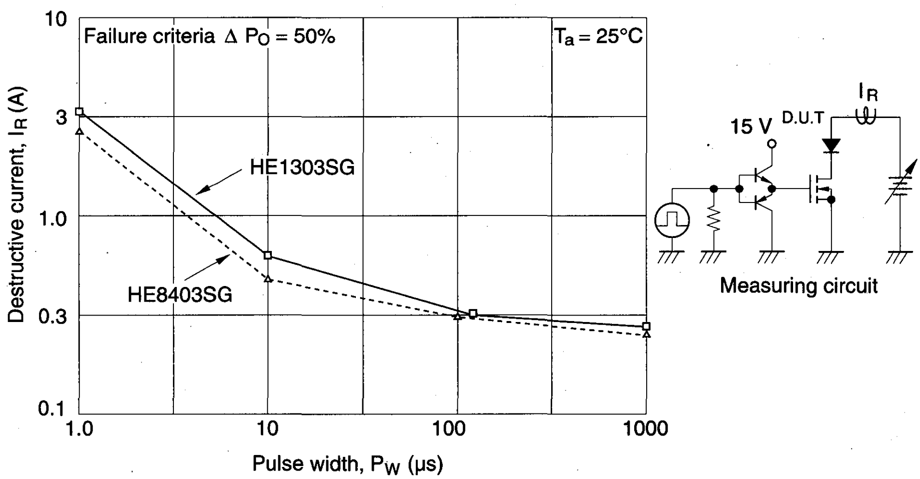
V_{CO}: Unloaded supply voltage (V)
V_F: Forward voltage (V)
I_F max: Forward current maximum rating (A)

Figure 4-45: Power Supply for CW Operation

Figure 4-46 shows a destructive-current example measurement when forward or reverse excessive current (surge current) is applied to the IRED.



(a) Forward current applied

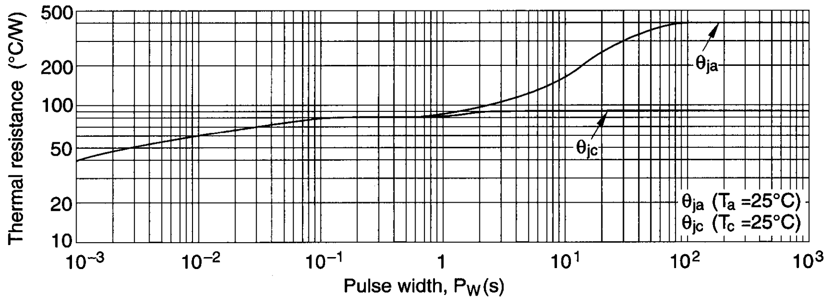


(b) Reverse current applied

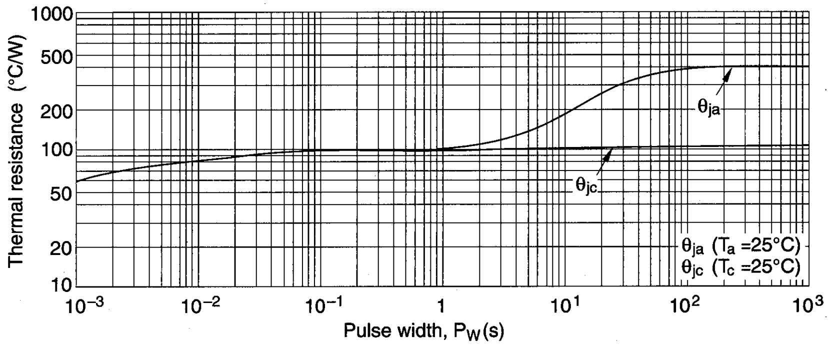
Figure 4-46: Durability against One-pulse Surge

4.2.6 Transient Thermal Resistance

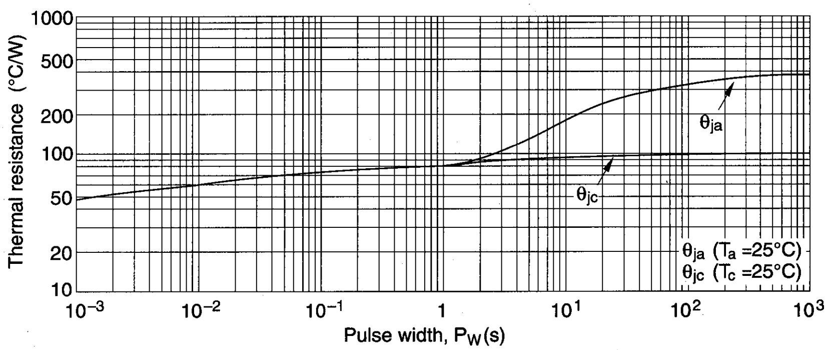
The lifetime of IREDs depends heavily on their junction temperature. Adequate heat release should be designed. Figure 4-47 shows examples of transient thermal resistance characteristics.



(a) HE8807SG



(b) HE8403SG



(c) HE1303SG

Figure 4-47: Transient Thermal Resistance Examples

4.2.7 Optical Fiber Coupling Efficiency

Figure 4-48 shows the coupling efficiency when connecting various types of optical fiber with IREDs. Figure 4-49 shows how the light input into an optical fiber changes when the distance from the chip surface to the fiber tip is varied. The reduction rate of optical fiber output is about 12 to 24%/100 µm at distance Z.

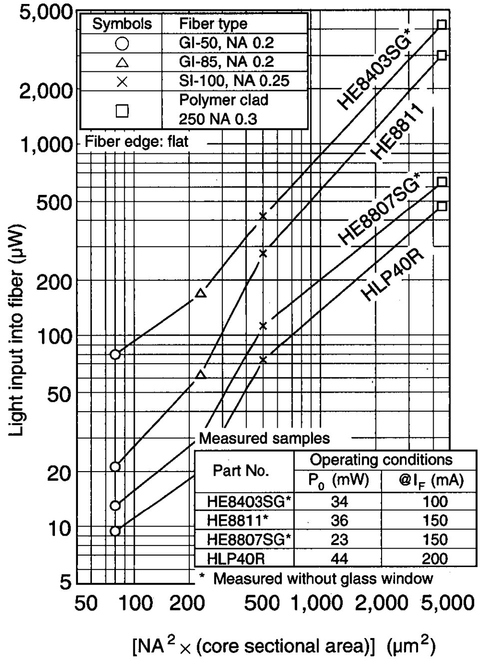


Figure 4-48: Optical Fiber Coupling Efficiency

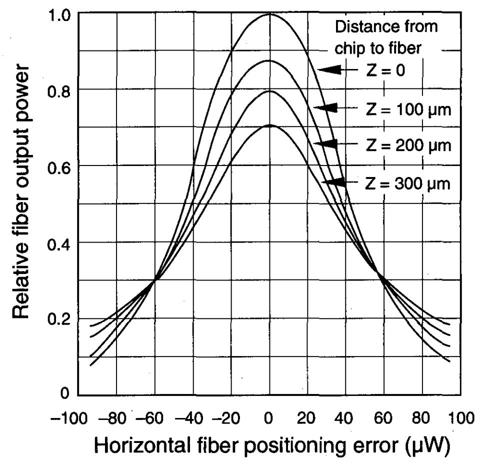


Figure 4-49: Fiber Output Deviation Due to Fiber Positioning Error with HE8403SG (measured without cap)

The fiber can either be processed or a lens used to obtain a 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 figure 4-50), almost the same fiber output can be obtained as with direct coupling method (figure 4-51) 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 devices without caps. Figure 4-52 shows the relation between the fiber output of IRED chips measured without caps through the direct coupling method and same IRED chips in capped SG packages measured through the parabolic-rod-lens coupling method.

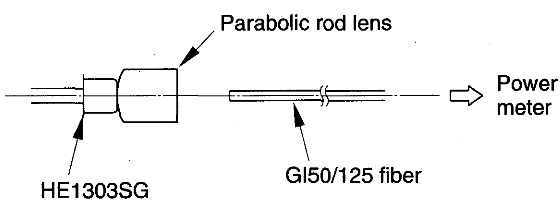


Figure 4-50: Parabolic Rod-lens Coupling Method

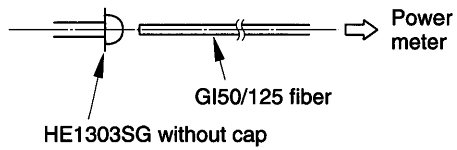


Figure 4-51: Direct Coupling Method

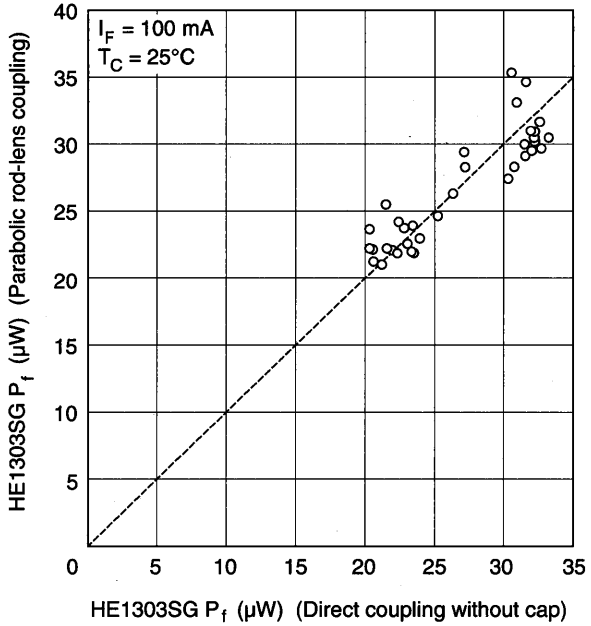


Figure 4-52: Fiber Output Comparison for HE1303SG with and without cap

4.2.8 Precision of Chip Position

In most practical applications, the optical output of an IRED is condensed by placing a lens over its face. When doing so, it is important to adjust the relative position of the light source and the center of the lens such that no offset problem arises. Figure 4-53 gives the amount of chip position off-set to the center of the stem, which is useful for designing optical systems. Figure 4-54 shows the distances between the glass window of the cap and the chip.

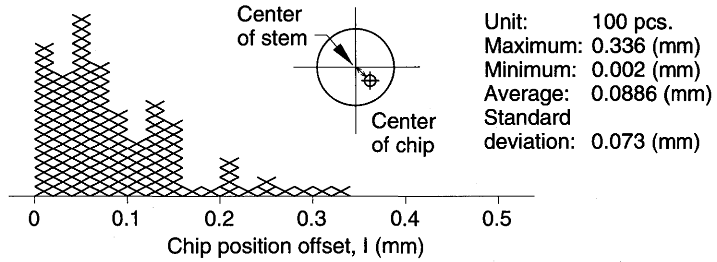


Figure 4-53: Chip Position Offset Examples

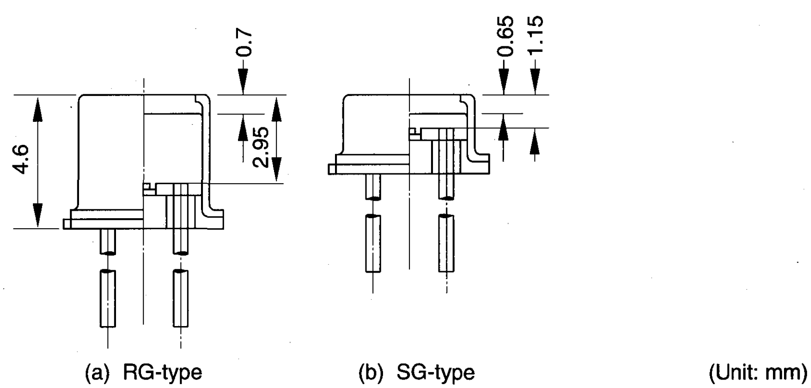


Figure 4-54: Distances between Glass Window of Cap and Chip

4.3 Photodiode Fundamental Characteristics

4.3.1 Photo-detection Sensitivity (S)

An example is given in figure 4-55 of a method for measuring photo-detection sensitivity. A laser beam of a 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 also necessary 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.

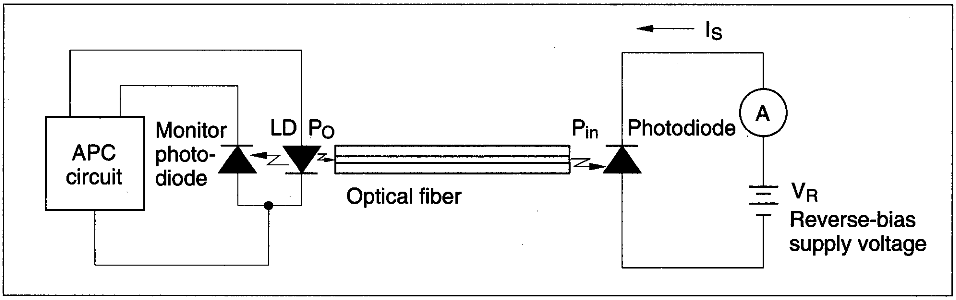


Figure 4-55: System for Measuring Photo-detecting Sensitivity

Figure 4-56 shows the relation between saturation current, I_S, and reverse voltage, V_R, for Si PIN and InGaAs/InP PIN photodiodes. Spectral sensitivity characteristics are listed in the individual product data sheets.

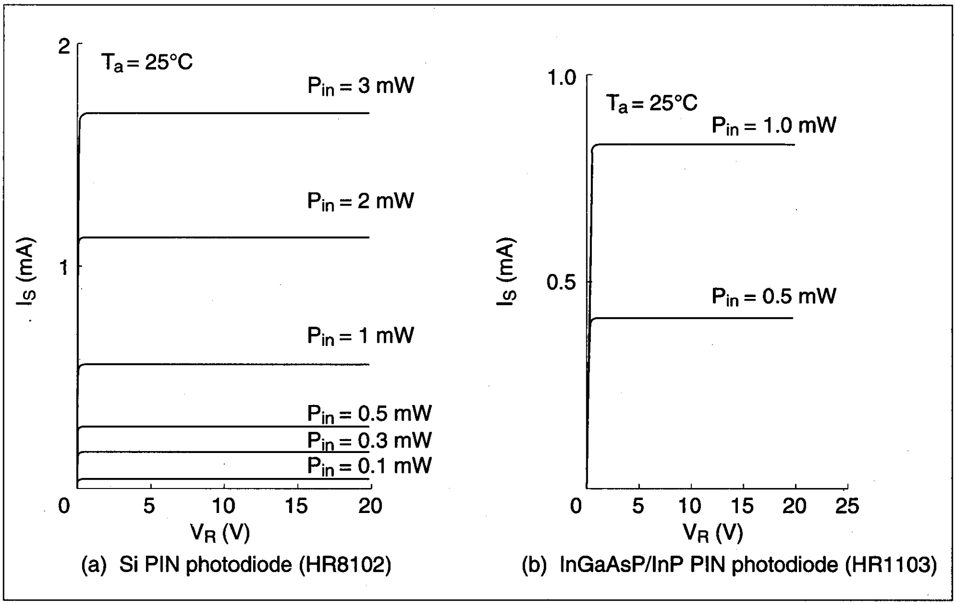


Figure 4-56: Relationship between Saturation Current and Voltage

4.3.2 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 (figure 4-57). A measurement setup example is for presented in figure 4-58. 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 focused using a lens, and the axis of the LD and the photodiode is adjusted so that the focused stop 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 figure 4-59.

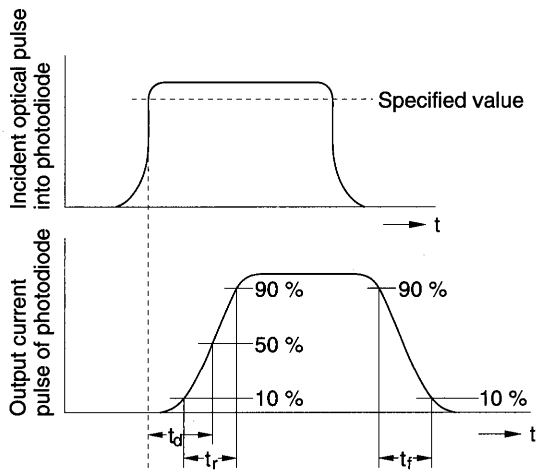


Figure 4-57: Definition of Photo-detection Response Time

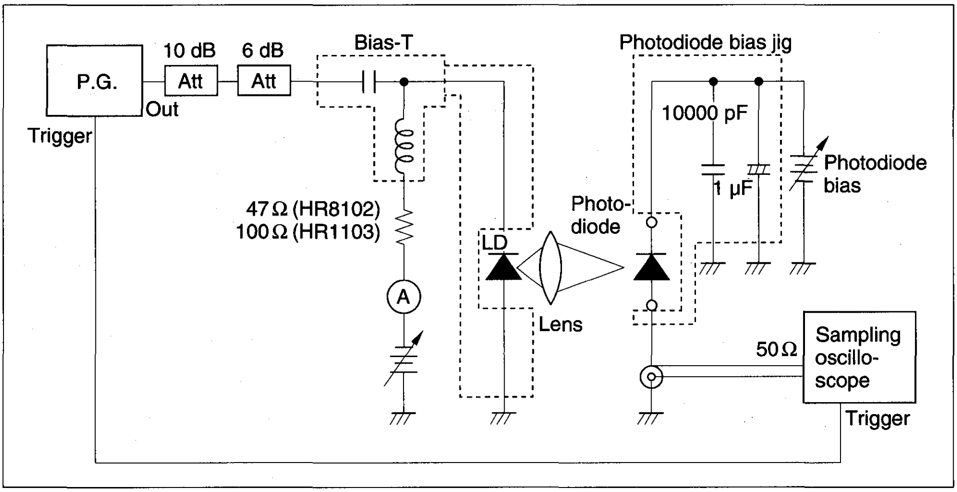


Figure 4-58: Measuring Setup for Photo-detection Response

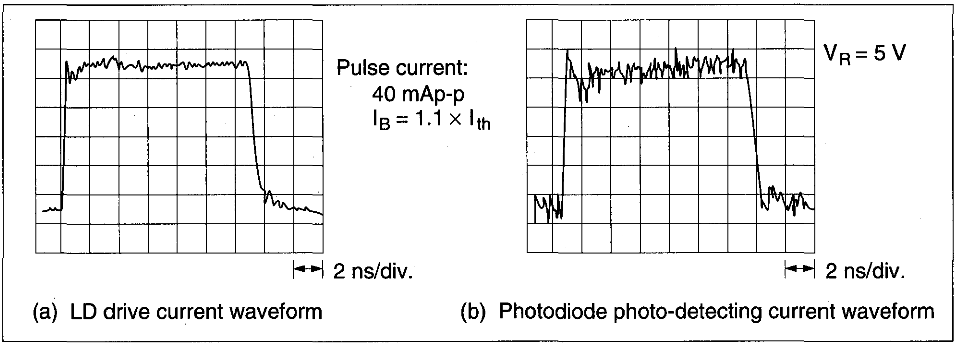


Figure 4-59: Photo-detecting Response Wave for InGaAs/InP PIN Photodiode (HR1103)

4.3.3 Frequency Response

Figure 4-60 shows the frequency response characteristics of Si PIN PD (HR8101, HR8102). These values were measured using a network analyzer with injected light at 830 nm and a 50 Ω load. Notice in particular that, even with a 5 V bias, the cutoff frequency is greater than 300 MHz.

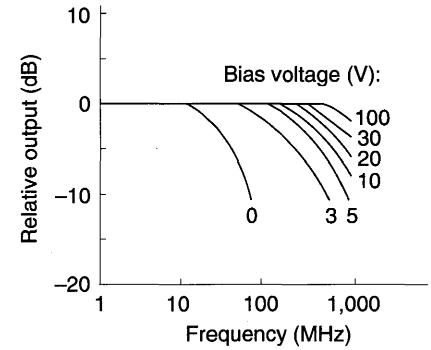


Figure 4-60: Frequency Response Characteristic of Si PIN PD

The frequency response characteristic of InGaAs PD (HR1103) with multi-layer heterozygous structure, is shown in figure 4-61. As is clear from the figure, the frequency response is flat up to the GHz region, making it ideally suited for a signal detector in a high speed optical fiber transmission system.

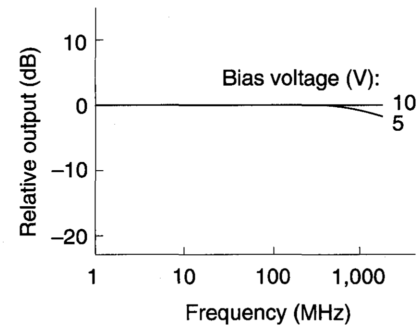


Figure 4-61: Frequency Response Characteristic of InGaAs /InP PIN PD

§5. 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.

5.1 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 below the maximum optical output power rating in order to prevent mirror facet damage and resultant loss in reliability.

5.2 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.

5.3 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.

5.4 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.

5.5 LD-package Handling

5.5.1 A- and AC-types

A-type package is designed for experimental use and AC-type package for module assembly. A LD chip is mounted on a submount which is mounted on a heat sink; 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 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, or reliability.

(3) The cleanest atmosphere is strongly desired when handling a device to keep mirror facets free from dust and scratches, because the light emitting area is extremely small. This precaution prevents degradation of optical output power and far field patterns.

(4) Hold the copper heat sink when 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 for the mounting of the device. The temperature of a LD chip rises highly owing to the high current density unless a good heat sinking is provided. This precaution prevents lower optical output power and device deterioration. Observe the following cautions when using a thermal radiator.

(i) Never use silicone grease because it 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 the thermal radiator surface to provide good thermal conductivity with the device heat sink. Finish the radiator surface to keep bumps, twists, or bends 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 the screwing action or allow 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 the process within 30 seconds, because a low melting point solder is used for chip mounting.

(ii) Use a fine tipped soldering iron commercially available or a common soldering iron with copper coil around the tip. When soldering, earth the tip of the iron. A battery operated type is the best kind to use.

(iii) Do not allow the solder to flow into the pad of the bonding wire.

(iv) Do not allow the scattered flux to adhere to the mirror facets.

(v) Do not wash out flux after soldering, because that would contaminates the mirror facets.

(8) Hermetic seal

Hermetically seal a device to extend its life time.

These packages should be hermetically sealed when mounting on systems.

5.5.2 BF-, DL-, DM-, CF- and CN-types

These packages are designed for fiberoptic communications. DL- and BF-types contain a PD for power monitoring as well as a TE cooler. The DM-, CF- and CN-types contain a PD. Both are provided with a single mode fiber. The LD, PD, and TE cooler are all hermetically sealed. Pay attention to the following precautions in handling these devices.

(1) Excessive force applied to an optical fiber disconnects the fiber rapidly an or deforms it partially. Do not pull, crook, or twist the fiber because it deteriorates fiber characteristics. Do not bend the optical fiber within a 30 mm radius.

(2) Do not apply excessive stress between the package and the optical fiber, to prevent a fiber from breaking or falling out and reducing optical output power. Lift both the package and the optical fiber at the same time to avoid bending the fiber bottom.

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

(4) Do not process or deform a package.

(5) 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 an 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 (figure 5-1). Be careful when processing a fiber; the extremely thin core of the fiber may easily pierce human skin.

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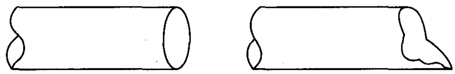


Figure 5-1: Processed Fiber-tip Examples

(6) Mounting a device on a thermal radiator

Use a LD with a thermal radiator.

(i) When screw mounting a device on a radiator, torque should be 1 to 2 kg·cm. Too small a torque may result in excessive thermal resistance and too excessive torque may damage the diode.

(ii) Use a screw of 2 mm diameter

Use a spring washer and apply lock paint to tapping holes or nuts to prevent turning or relaxation of the screw.

(iii) For other considerations, follow the instructions described in the previous section 5.1 (6).

(7) Soldering

Follow the instructions described in the previous section 5.5.1 (7).

5.5.3 E-, G-, MF- and MG-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 following items when mounting diodes on thermal radiators.

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

(ii) To provide 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 and 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.

When the cap-side of the stem-surface of an E-package is to be mounted on a heat sink, pay careful attention to the following points in order to reduce stress on the glass cap. An example is shown in figure 5-2.

- The mounting surface must be finished to a flatness of better than 0.01 mm over the area where contact is made.
- To prevent flexing of the stem, furnish a recess of 7 mm center width and at least 0.3 mm depth.
- Make certain that no burrs or external matter are present on the mounting surface.

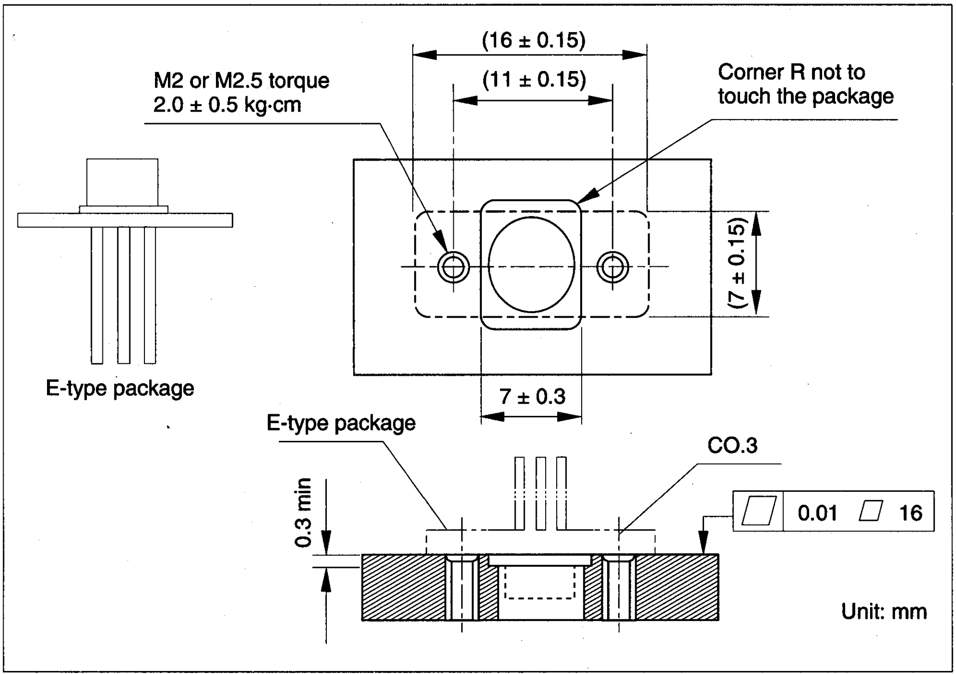


Figure 5-2: E-package Face Down Mounting Example

(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, to prevent the window glass from becoming contaminated or cracked.

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

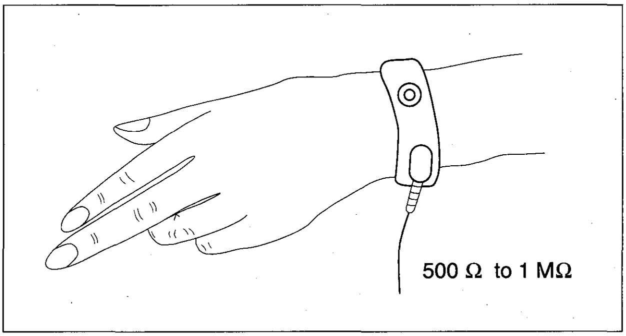
5.6 Advice for Beginners

(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 5-1 when handling diodes and designing application circuits.

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

(ii) Ground the operator's body by wearing a wrist band, 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 ($50 \times 50 \times 2$ 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 figure 5-3, set the output level to the minimum. Also, before disconnecting a laser diode from the power supply, set the output voltage to the minimum. After disconnecting, turn off the main switch.

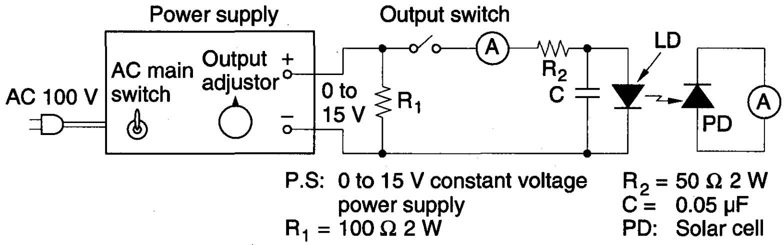


Figure 5-3: Simple Drive Circuit

(3) LD drive circuit

The optical output power from an LD is affected easily by the fluctuations in ambient temperature. A APC (automatic power control) function is generally recommended for a drive circuit to achieve stable operation. A function which monitors the beam and feeds it back to the drive current is useful to achieve constant optical output power against temperature change.

Table 5-1: 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 the APC circuit or relay switch on and off as much as possible.	

Table 5-1: Ways to Prevent Surge Destruction of LDs (Examples) (cont.)

Items	Check Points	Specification Examples
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.

5.7 IRED-package Handling

5.7.1 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 when it is bare.

(2) Never apply mechanical stress to an IRED chip; it may peel off the chip from the diode base causing deterioration and reducing reliability. Also do not contaminate the chip surface, because it deteriorates optical properties and reduces output power.

(3) Do not process or deform a diode or diode base.

(4) Mounting a device on a thermal radiator.

An IRED must be mounted on a thermal radiator to reduce its temperature rise because it is usually driven at a 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 plate greater than $20 \times 30 \times 2$ mm^3 of copper or aluminum is usually recommended.

(ii) Polish the thermal radiator surface to provide good thermal conductivity with the device heat sink. Finish the radiator surface to keep bumps, twists, or bends below 0.05 mm.

(iii) Use of silicone grease is absolutely prohibited as described in the previous section 5.5.1 (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 or 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.

5.7.2 RG-, SG-, VG-, CL-, FL-, SL- and ML-types (Hermetically sealed)

These packages are moisture-proof and easy to handle because of the hermetic seal. Pay attention to the following precautions in handling these 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, as this will crack the glass area and deteriorate 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 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 5.7.1 (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.

5.8 Photodiode Package Handling

5.8.1 KG-, MH-, QG-, TG-, MR-, CR- and FR-types (Hermetically sealed)

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

(1) Keep the glass surface of KG, MH, 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 5.7.2 (4).

5.8.2 CX-type (Chip-carrier)

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 5-2 are meant to assure maximum product quality.

Table 5-2: 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

(ii) Use storage containers which are not subject to the buildup 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 5-3 should be maintained if optical and electrical characteristics and reliability are not to degrade.

Table 5-3: Recommended Soldering Conditions

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

(iv) This device should be hermetically sealed when it is in its final mounting. 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.

§6. Reliability

This section covers points which particularly affect the operating life light emitting devices, and provides some examples which should be studied before proceeding with your system design.

6.1 Characteristic Drift

When optical emission devices such as the LD or IRED are operated in the forward mode, crystal defects (point defects and dislocations) propagate in the active region of the crystal.

These crystal defects cause optical emission characteristics (optical output power, threshold current, etc.) to drift, and ultimately lead to the end of the device's useful operating life.
Figure 6-1 shows an example of drift in the optical output power vs current characteristic of a LD. From t_1 to t_4, the threshold current increases and the slope efficiency declines. The end of useful operating life is defined as the point where the operating current becomes 1.5 times of its initial value.

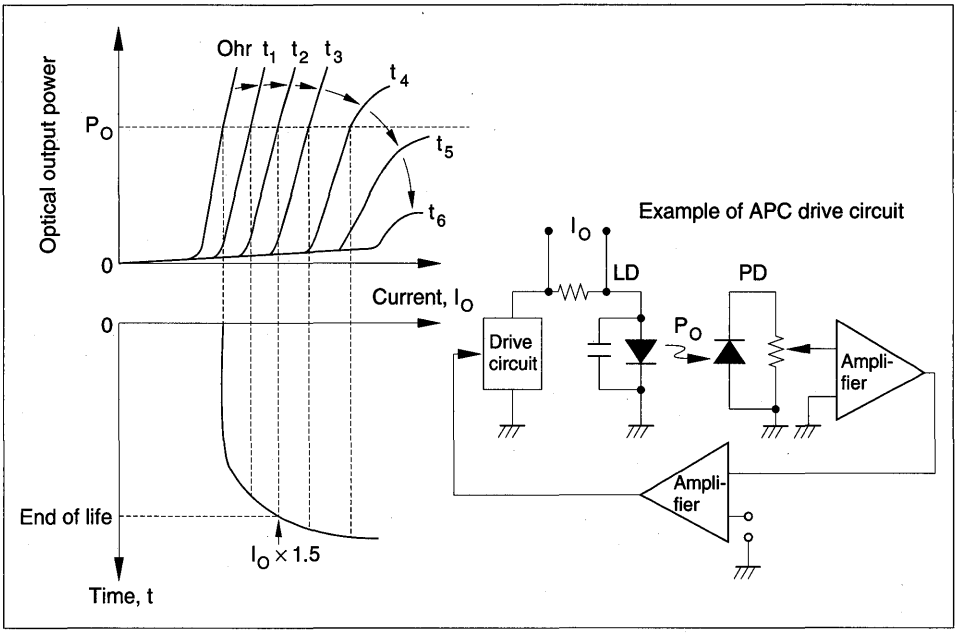


Figure 6-1: Example of Drift in LD Optical Output Power vs. Current Characteristic

6.2 Derating

LDs and IREDs have a strong temperature dependence of lifetime. Thus, the expected operating life shows an exponential decrease with operating temperature. Derating should be employed to keep the rise of junction temperature as small as possible. (See figure 6-2, and 6-3). Figure 6-4 shows the dependence of operating life on optical output power. Please note that this decrease in operating life occurs even at threshold current bias.

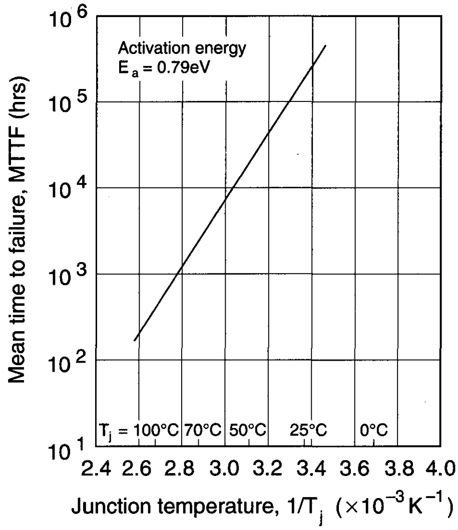


Figure 6-2: LD Mean Time to Failure vs. Junction Temperature (Example)

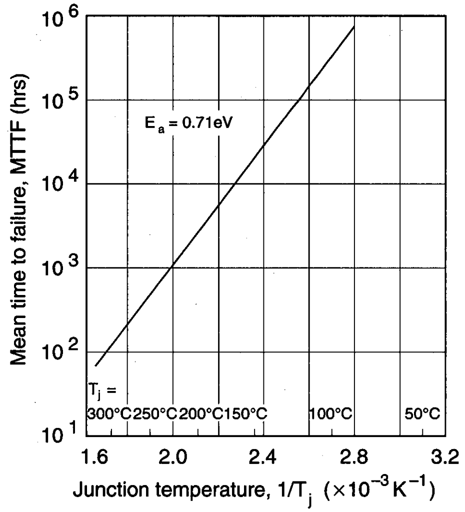


Figure 6-3: IRED Mean Time to Failure vs. Junction Temperature (Example)

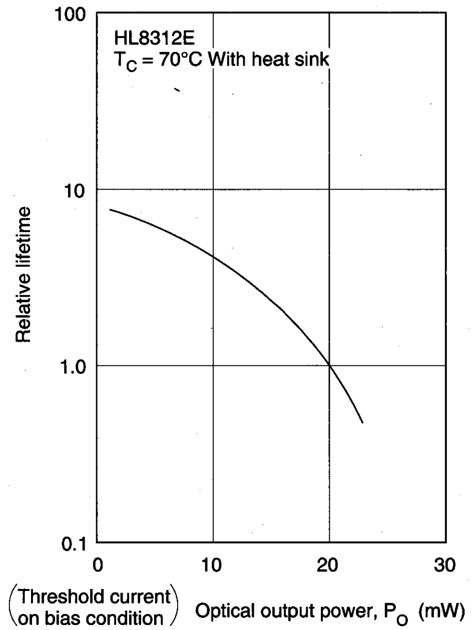


Figure 6-4: LD Operating Life vs. Optical Output Power (Example)

Figure 6-5 shows operating current dependence of IRED lifetime. In particular, when operated in open air at high current, the operating life is drastically affected by the rise in junction temperature due to heat generated by the device. Careful attention must be paid to carrying away excess heat.

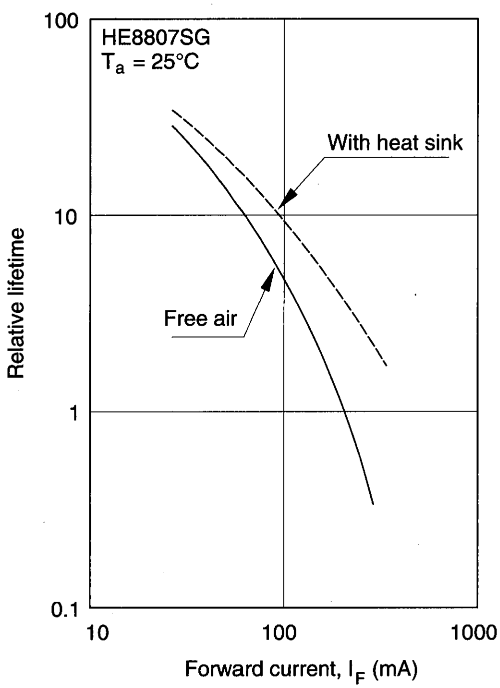


Figure 6-5: IRED Operating Life vs. Forward Current (Example)

6.3 Estimation for Useful Operating Life

The operating life of light emitting devices exhibits the typical wear failure distribution, and thus is generally approximated by the lognormal distribution. Figure 6-6 shows an example distribution for LD operating life. When the temperature derating and optical output power derating discussed in the previous section are also considered, the actual expected operating life under given operating conditions can be estimated.

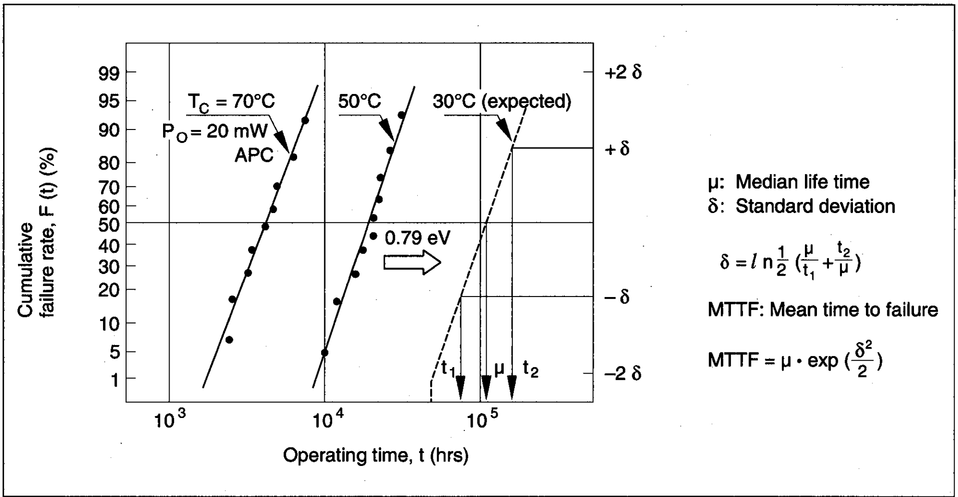


Figure 6-6: Distribution of Expected LD Life (Example)

6.4 Standard Devices Graded by Expected Life

Hitachi classifies IREDs of standard-specifications by life levels and applications as shown in table 6-1. For special requests or further details, please see your Hitachi representative.

Table 6-1: Lifetime and Application for Standard-specification IREDs

Applications	Expected Life Time	Operating Conditions	Criteria	Applicable Products
Auto-focusing still camera	10 hrs.	I_F = 200 mA	F(t) = 0.1%, $\Delta P_O \leq 30\%$	HE8815VG HE8813VG
Auto-focusing VTR camera	200 hrs.	I_F = 250 mA f = 10 kHz, duty 25%	F(t) = 0.1%, $\Delta P_O \leq 30\%$	HE8815VG
Measurement or general use	1000 hrs.	$T_j \leq P_O$ 100°C	F(t) = 0.1%, $\Delta P_O \leq 30\%$	HLP series, HE8811, HE8812SG, HE8404SG, HE7601SG
Industrial use	10000 hrs.	$T_j \leq$ 100°C	F(t) = 1%, $\Delta P_O \leq 50\%$	HE8807 series
Communications use	24000 hrs.	$T_j \leq$ 100°C	F(t) = 1%, $\Delta P_O \leq 50\%$	HE8403 series, HE1303 series

§7. Purchasing Hitachi Optodevice

7.1 Accompanying Data

If measurement data for ordered parts is desired, please mention this to your Hitachi representative.

7.2 Price and Delivery

For information on price and delivery, please check with your Hitachi representative.

1

Data Sheets

Laser Diodes

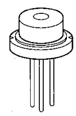
Description

HL6312G is a 0.63 µm AlGaInP laser diode with a multi-quantum well (MQW) structure. Wavelength is equal to He-Ne Gas laser. It is suitable as a light source for bar code readers, laser levelers and various other types of optical equipments.
Hermetic sealing of the package achieves high reliability.

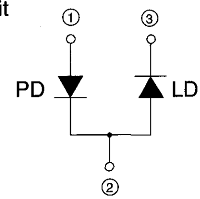
Features

- Visible light output: λ_p = 633 nm Typ. (equal to He-Ne Gas Laser)
- Optical power output: 5 mW CW
- Low Operating voltage: 2.7 V Max.
- Single longitudinal mode.
- Built-in photodiode for monitoring laser output.

Package Type
- HL6312G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

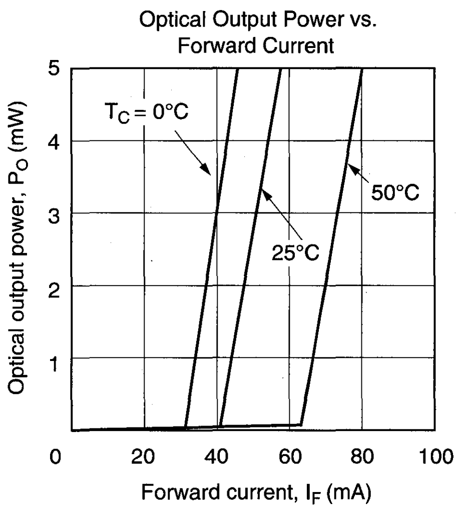
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

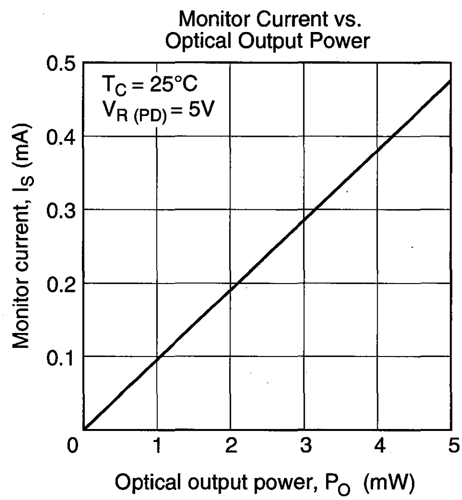
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

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

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	20	45	70	mA	
Optical ouput power	P_O	5	—	—	mW	Kink free
Operating current	I_{op}	—	55	85	mA	$P_O = 5$ mW
Operating voltage	V_{op}	—	—	2.7	V	$P_O = 5$ mW
Lasing wavelength	λ_p	625	633	640	nm	$P_O = 5$ mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	$P_O = 5$ mW
Beam divergence (perpendicular)	$\theta_{\perp}$	25	31	37	deg.	$P_O = 5$ mW
Monitor current	I_S	0.2	0.4	0.8	mA	$P_O = 5$ mW, $V_{R\,(PD)} = 5$ V

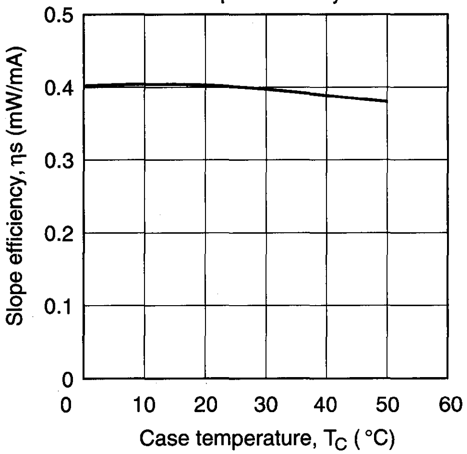
Typical Characteristic Curves



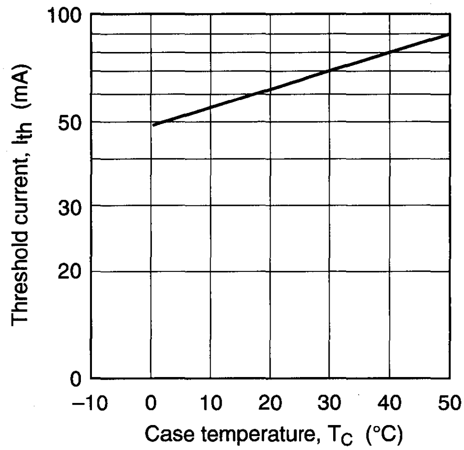


Typical Characteristic Curves (cont.)

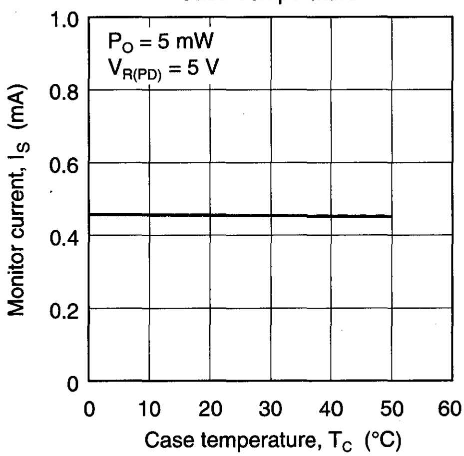
Temperature Dependence of
Slope Efficiency



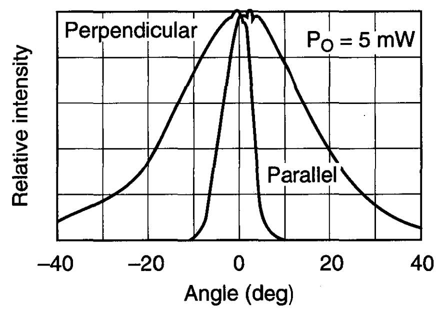
Temperature Dependence of
Threshold Current



Monitor Current vs.
Case Temperature

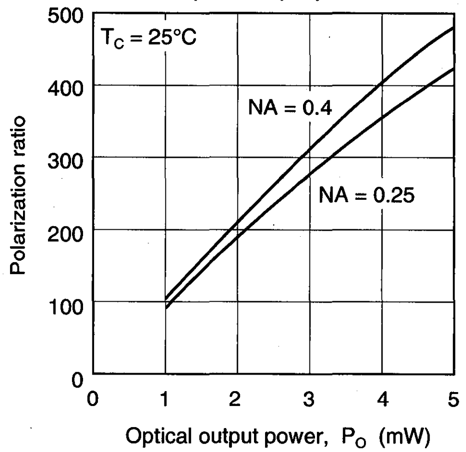


Far Field Pattern

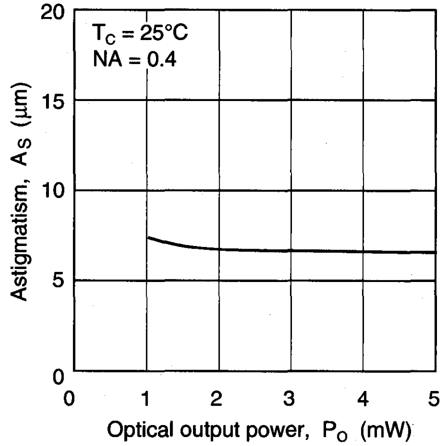


Typical Characteristic Curves (cont.)

Polarization Ratio vs.
Optical output power



Astigmatism vs.
Optical output power



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HL6313G (Preliminary) — AlGaInP LD

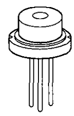
Description

HL6313G is a 0.63 μm AlGaInP laser diode with a multi-quantum well (MQW) structure. Wavelength is equal to He-Ne Gas laser. It is suitable as a light source for bar code readers, laser levelers and various other types of optical equipments.
Hermetic sealing of the package achieves high reliability.

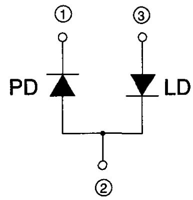
Features

- Visible light output: λ_p = 633 nm Typ. (equal to He-Ne Gas Laser)
- Optical power output: 5 mW CW
- Low Operating voltage: 2.7 V Max.
- Single longitudinal mode.
- Built-in photodiode for monitoring laser output.

Package Type
- HL6313G: G2



Internal Circuit



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Absolute Maximum Ratings (T_C = 25°C)

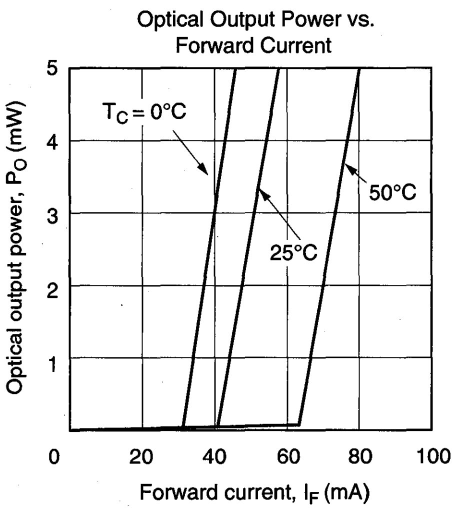
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

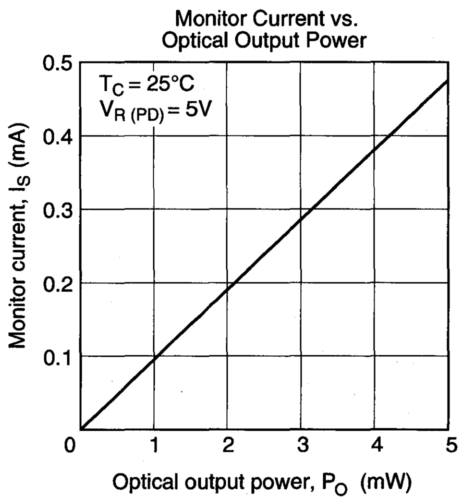
Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

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

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	20	45	70	mA	
Optical ouput power	P_O	5	—	—	mW	Kink free
Operating current	I_{op}	—	55	85	mA	P_O = 5 mW
Operating voltage	V_{op}	—	—	2.7	V	P_O = 5 mW
Lasing wavelength	λ_p	625	633	640	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	P_O = 5 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	25	31	37	deg.	P_O = 5 mW
Monitor current	I_S	0.2	0.4	0.8	mA	P_O = 5 mW, $V_{R\,(PD)}$ = 5 V

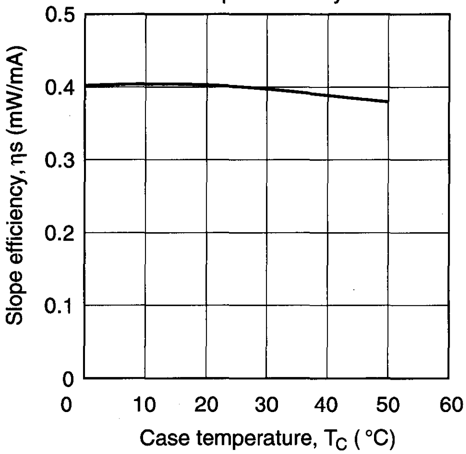
Typical Characteristic Curves



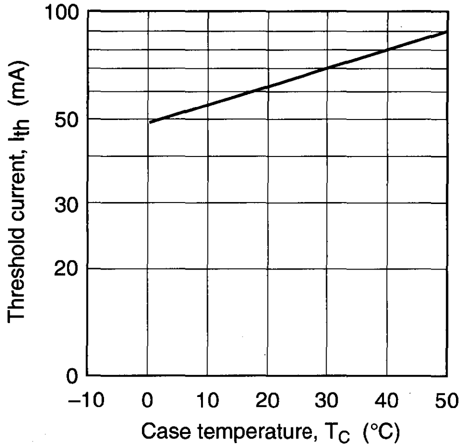


Typical Characteristic Curves (cont.)

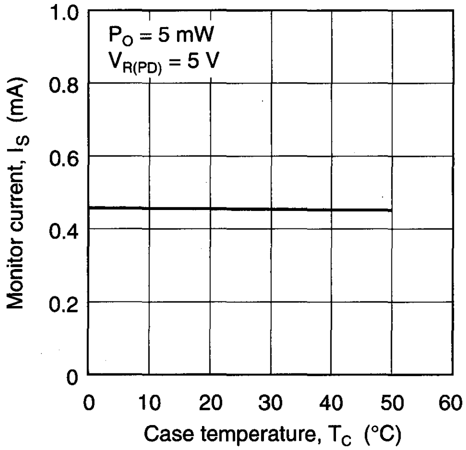
Temperature Dependence of Slope Efficiency



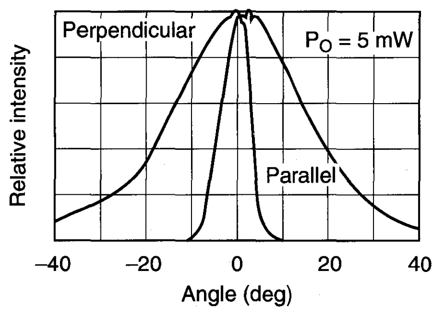
Temperature Dependence of Threshold Current



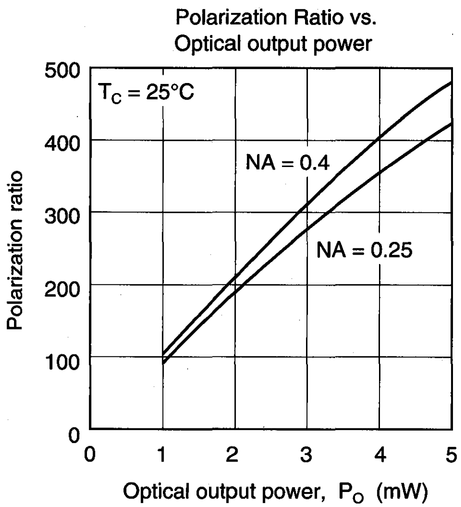
Monitor Current vs. Case Temperature

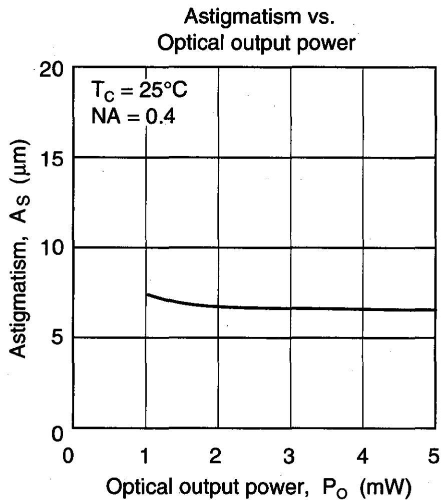


Far Field Pattern



Typical Characteristic Curves (cont.)





HL6314MG — AlGaInP LD

Description

The HL6314MG is a 0.63 µm band AlGaInP laser diode with a multi-quantum well (MQW) structure.
It is suitable as a light source for laser pointers and optical equipment for amusement. Hermetic sealing of the package assures high reliability.

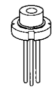
Application

- Laser pointer

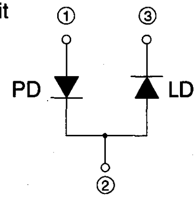
Features

- Visible light output at wavelengths up to 640 nm. (nearly equal to He-Ne gas laser)
- Optical output power: 3 mW CW
- Low operating current: 30 mA Typ.
- Low operating voltage: 2.7 V Max.
- Built-in monitor photodiode

Package Type
- HL6314MG: MG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

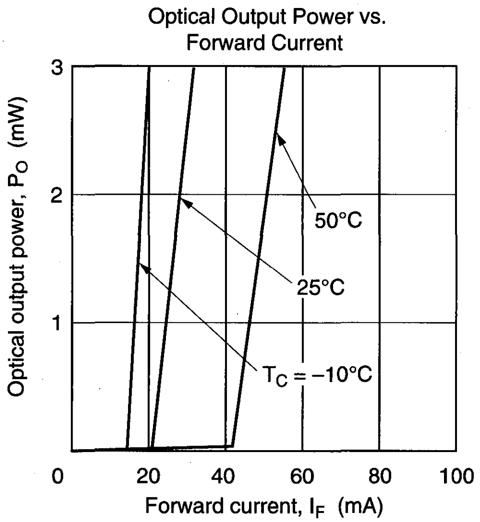
Item	Symbol	Rated Value	Unit
Optical output power	P_O	3	mW
Pulsed optical output power	$P_{O\,(pulse)}$	5*1	mW
LD reverse voltage	$V_{R\,(LD)}$	2	V
PD reverse voltage	$V_{R\,(PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

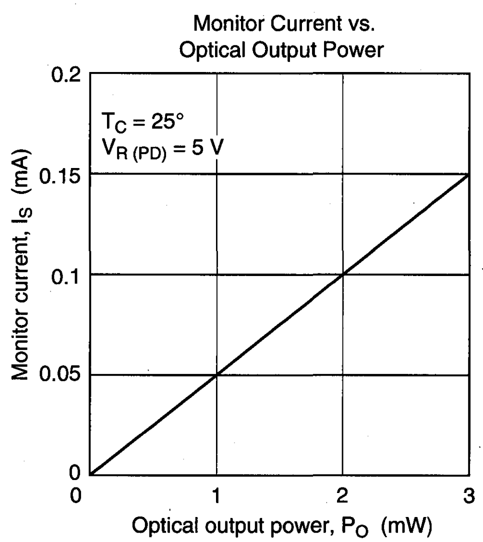
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

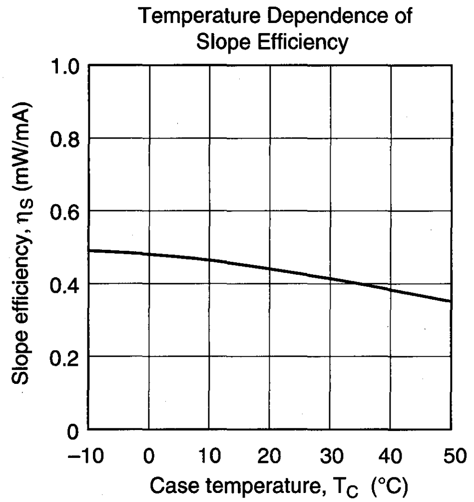
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	25	—	mA	
Optical output power	P_O	3	—	—	mW	Kink free
Operating voltage	V_{op}	—	—	2.7	V	P_O = 3 mW
Operating current	I_{op}	—	30	—	mA	P_O = 3 mW
Lasing wavelength	λ_p	630	635	640	nm	P_O = 3 mW
Beam divergence (parallel)	$\theta_{//}$	6	8	10	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	23	30	39	deg.	P_O = 3 mW, FWHM
Monitor current	I_S	—	0.15	—	mA	P_O = 3 mW, $V_{R(PD)}$ = 5 V

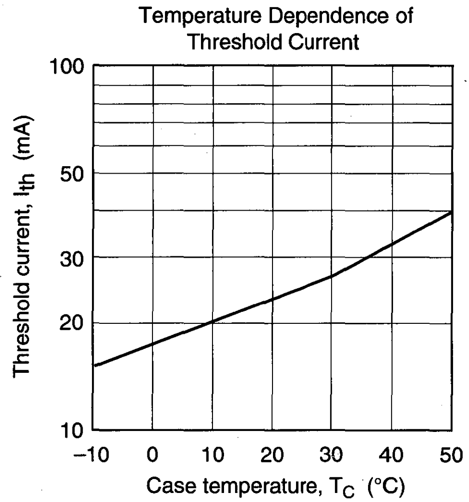
Typical Characteristic Curves

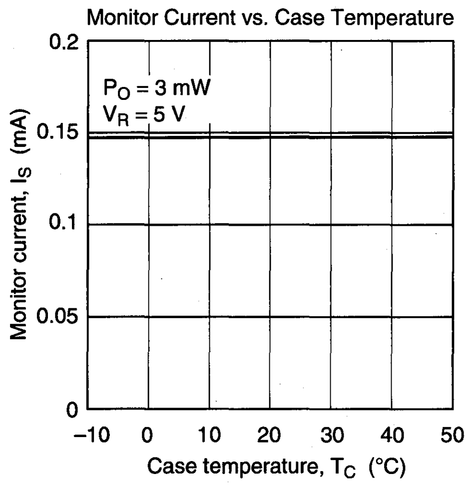


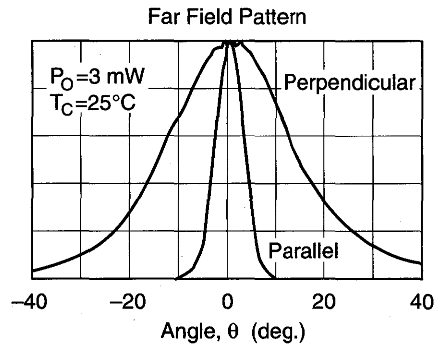


Typical Characteristic Curves (cont.)

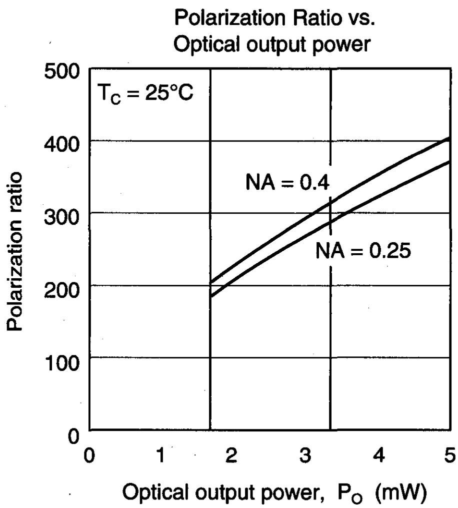


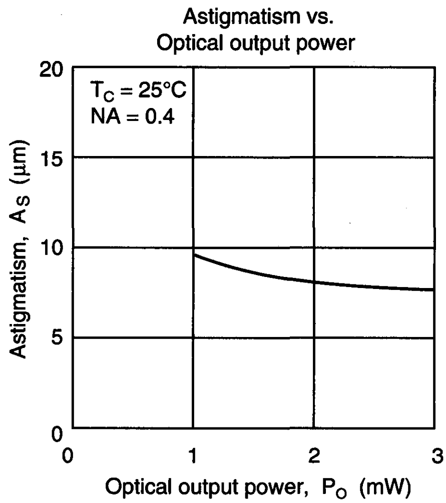






Typical Characteristic Curves (cont.)





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HL6315G (Preliminary)

AlGaInP LD

Description

The HL6315G is a 0.63 μm band AlGaInP laser diode with a multi-quantum well (MQW) structure.
It is suitable as a light source for laser pointers and optical equipment for amusement. Hermetic sealing of the package assures high reliability.

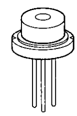
Application

- Laser pointer

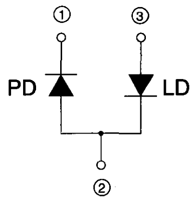
Features

- Visible light output at wavelengths up to 640 nm. (nearly equal to He-Ne gas laser)
- Optical output power: 3 mW CW
- Low operating current: 30 mA Typ.
- Low operating voltage: 2.7 V Max.
- Built-in monitor photodiode

Package Type
- HL6315G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

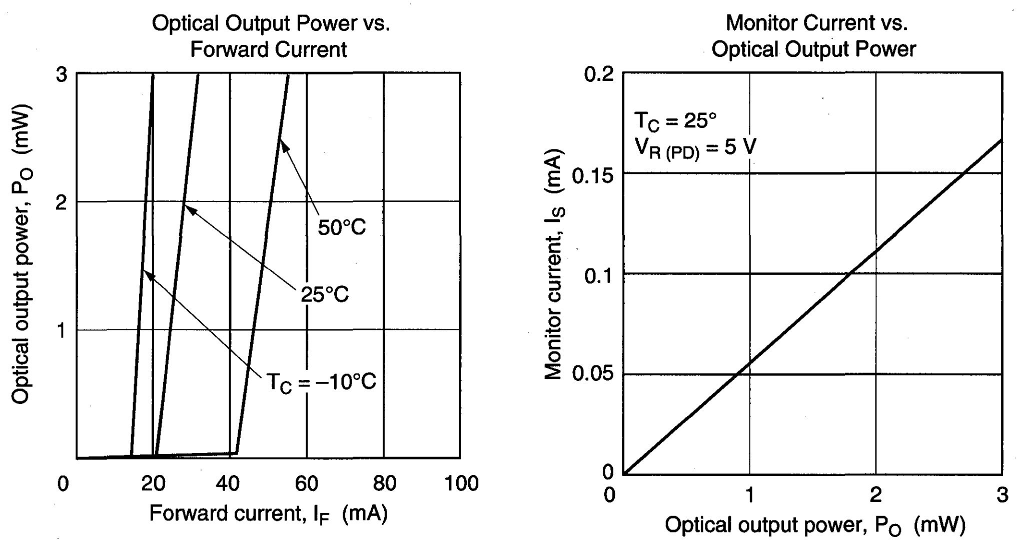
Item	Symbol	Rated Value	Unit
Optical output power	P_O	3	mW
Pulsed optical output power	$P_{O\ (pulse)}$	5*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	25	—	mA	
Optical output power	P_O	3	—	—	mW	Kink free
Operating voltage	V_{op}	—	—	2.7	V	P_O = 3 mW
Operating current	I_{op}	—	30	—	mA	P_O = 3 mW
Lasing wavelength	λ_p	630	635	640	nm	P_O = 3 mW
Beam divergence (parallel)	$\theta_{//}$	6	8	10	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	23	30	39	deg.	P_O = 3 mW, FWHM
Monitor current	I_S	—	0.16	—	mA	P_O = 3 mW, $V_{R(PD)}$ = 5 V

Typical Characteristic Curves



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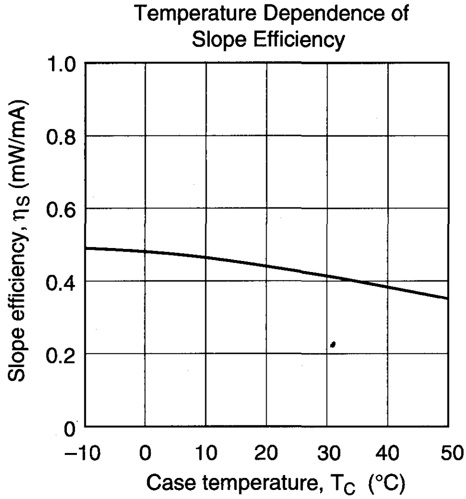
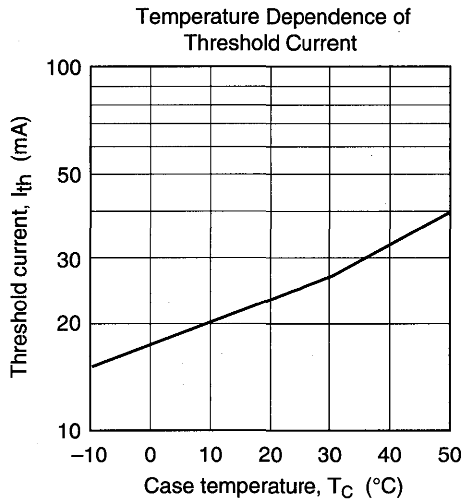
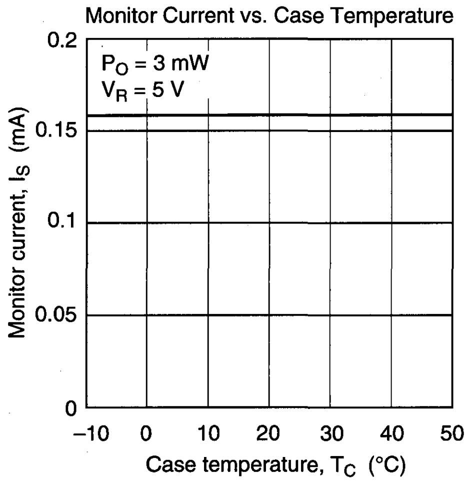
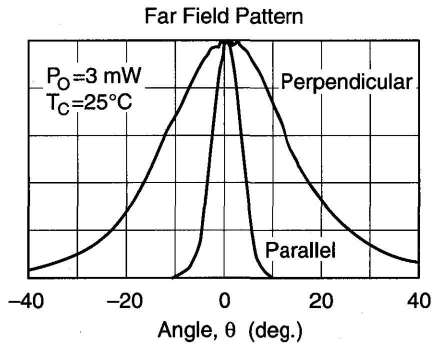
Typical Characteristic Curves (cont.)

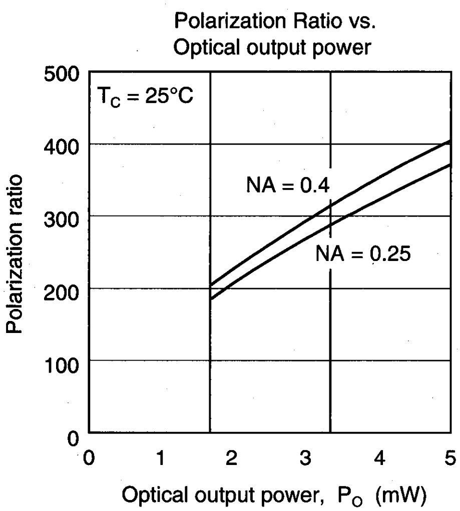


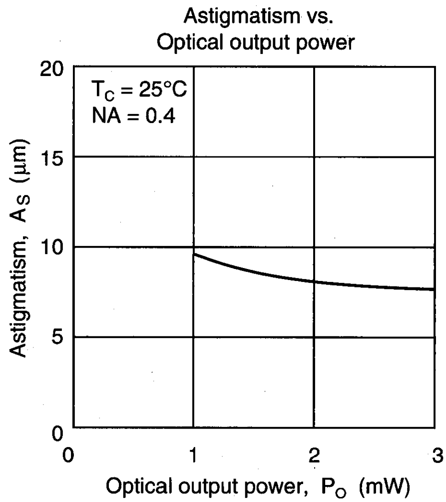






Typical Characteristic Curves (cont.)





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HL6316G AlGaInP LD

Description

The HL6316G is a 0.63 μm band AlGaInP laser diode with a multi-quantum well (MQW) structure.
It is suitable as a light source for laser pointers and optical equipment for amusement. Hermetic sealing of the package assures high reliability.

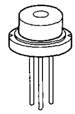
Application

- Laser pointer

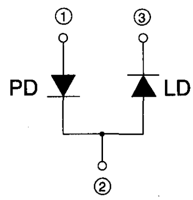
Features

- Visible light output at wavelengths up to 640 nm. (nearly equal to He-Ne gas laser)
- Optical output power: 3 mW CW
- Low operating current: 30 mA Typ.
- Low operating voltage: 2.7 V Max.
- Built-in monitor photodiode

Package Type
- HL6316G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

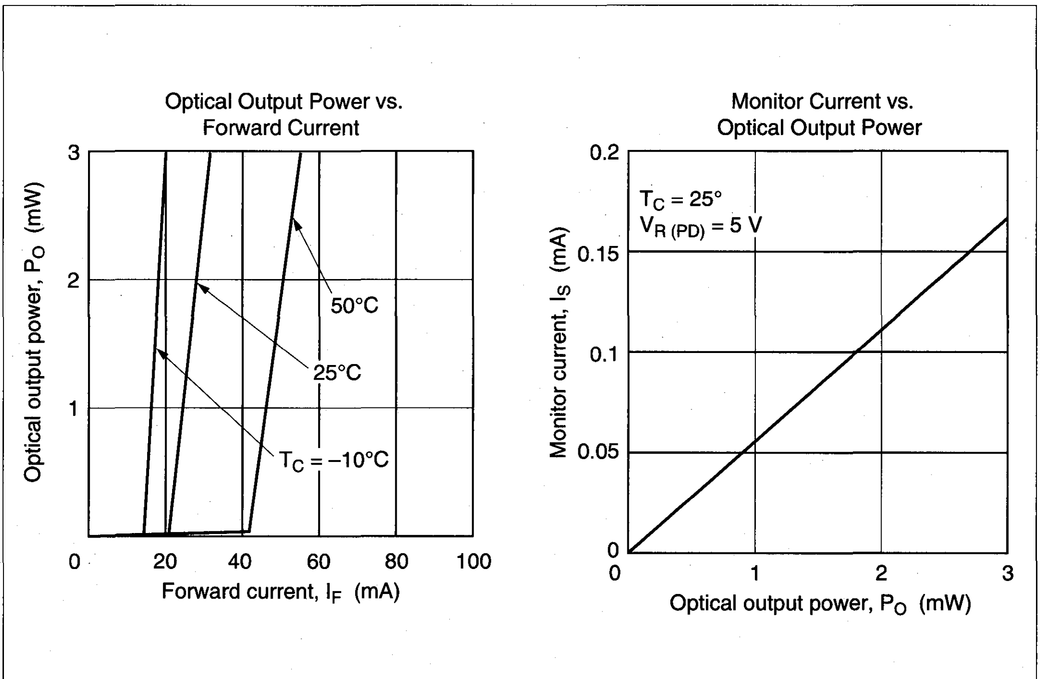
Item	Symbol	Rated Value	Unit
Optical output power	P_O	3	mW
Pulsed optical output power	$P_{O\ (pulse)}$	5*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	25	—	mA	
Optical output power	P_O	3	—	—	mW	Kink free
Operating voltage	V_{op}	—	—	2.7	V	P_O = 3 mW
Operating current	I_{op}	—	30	—	mA	P_O = 3 mW
Lasing wavelength	λ_p	630	635	640	nm	P_O = 3 mW
Beam divergence (parallel)	$\theta_{//}$	6	8	10	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	23	30	39	deg.	P_O = 3 mW, FWHM
Monitor current	I_S	—	0.16	—	mA	P_O = 3 mW, $V_{R(PD)}$ = 5 V

Typical Characteristic Curves



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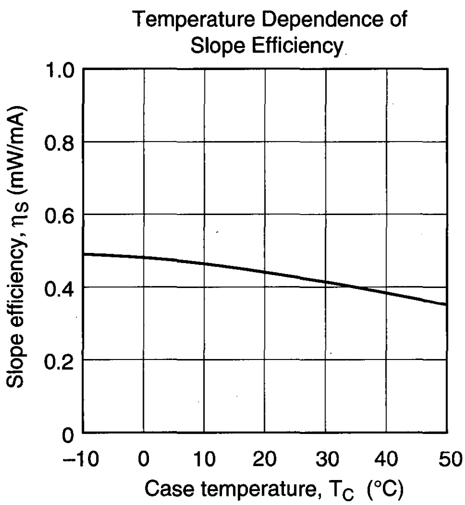
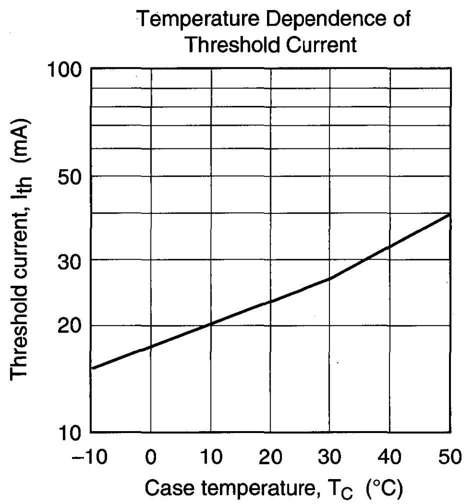
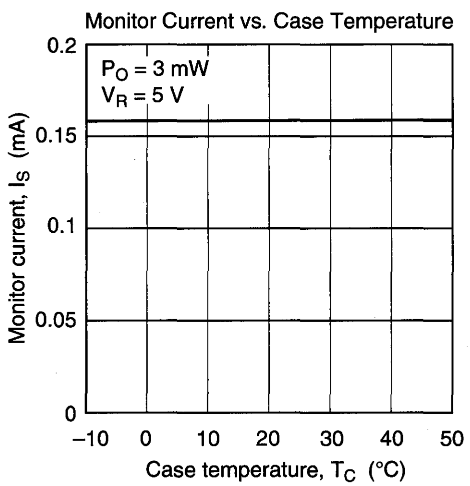
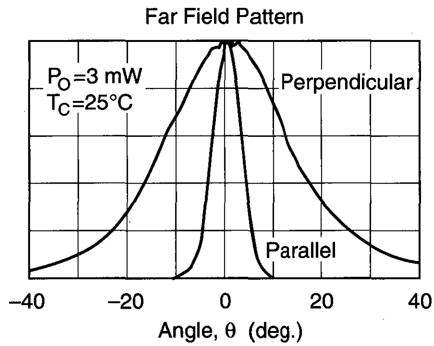
Typical Characteristic Curves (cont.)

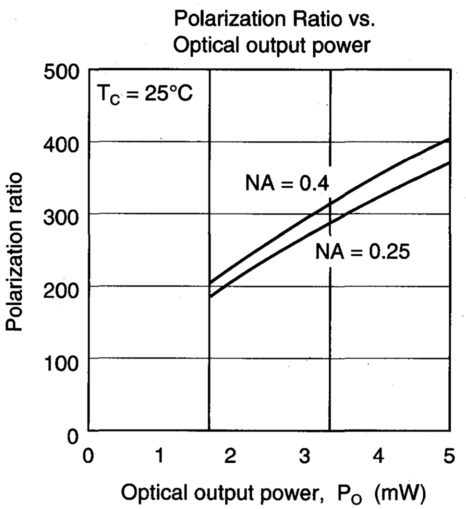


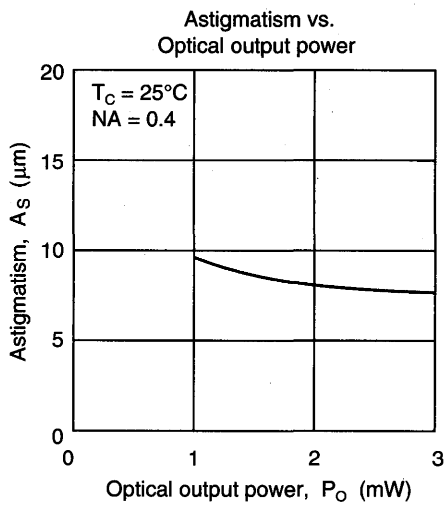






Typical Characteristic Curves (cont.)





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HL6712G/MG

AlGaInP LD

Description

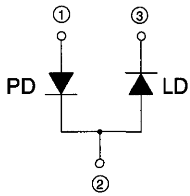
The HL6712G/MG are 0.67 µm band AlGaInP index-guided laser diodes with a double heterostructure. They are suitable as light sources for barcode readers, levelers, laser printers, and various other types of optical equipment.
Hermetic sealing of the packages assure high reliability.

Features

- Visible light output at wavelengths up to 680 nm
- Single longitudinal mode
- Low threshold current: 40 mA Typ.
- Low astigmatism: 10 µm Typ.
- Operates at temperatures up to 50°C
- Built-in monitor photodiode

Package Type
- HL6712G: G1
- HL6712MG: MG

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

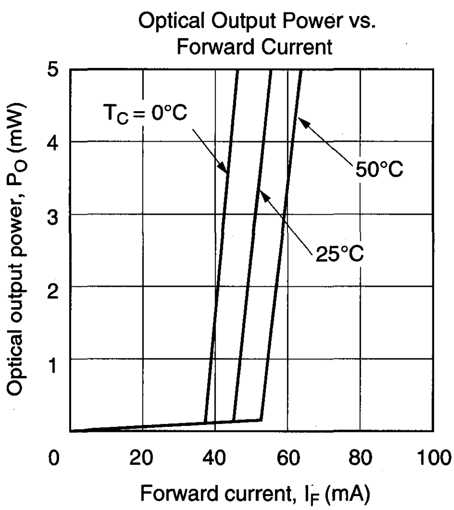
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

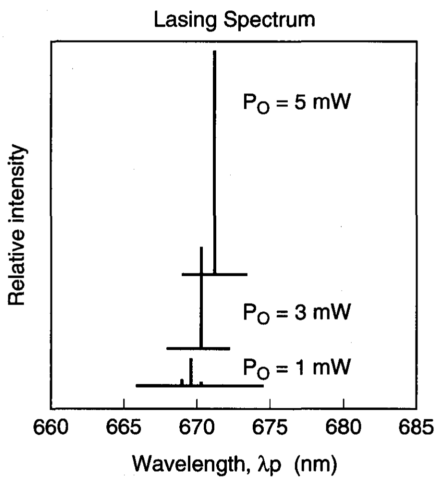
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current		I_{th}	—	40	65	mA	
Optical ouput power		P_O	5	—	—	mW	Kink free
Slope efficiency		η	0.3	0.55	0.7	mW/mA	3 mW / ($I_{(4\ mW)}-I_{(1\ mW)}$)
Lasing wavelength		λ_p	—	675	680	nm	P_O = 5 mW
Beam divergence (parallel)		$\theta_{//}$	5	8	11	deg.	P_O = 5 mW, FWHM
Beam divergence (perpendicular)		$\theta_{\perp}$	22	27	37	deg.	P_O = 5 mW, FWHM
Monitor current	HL6712G	I_S	0.25	0.6	1.25	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5V
	HL6712MG		0.2	0.75	1.3		
Astigmatism		A_S	—	10	—	μm	P_O = 5 mW, NA = 0.4

Typical Characteristic Curves





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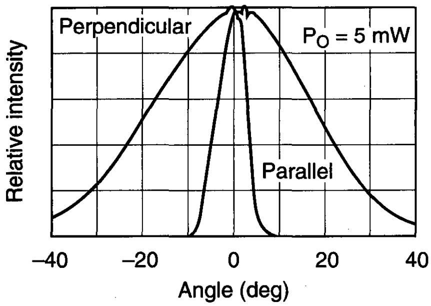
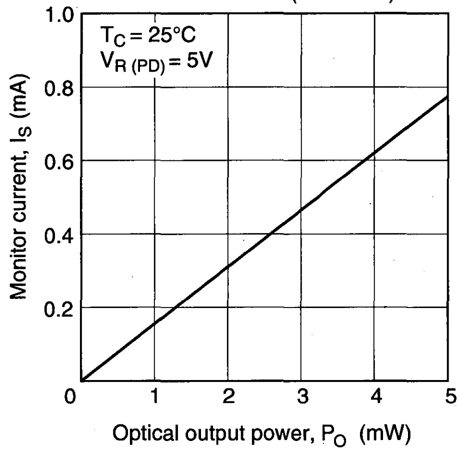
Typical Characteristic Curves (cont.)

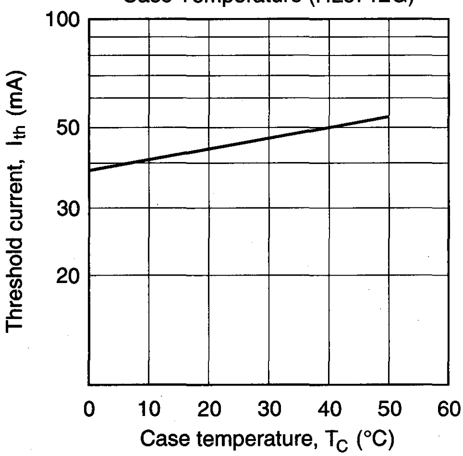
Far Field Pattern



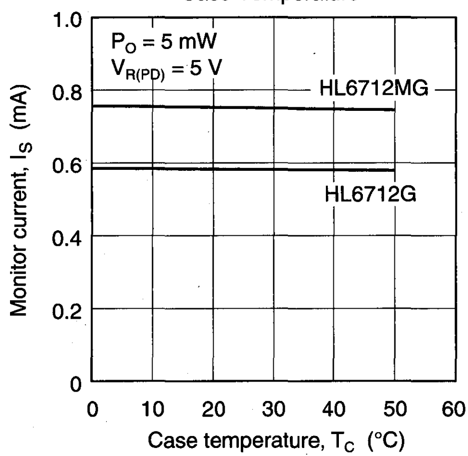
Optical Output Power vs. Monitor Current (HL6712G)



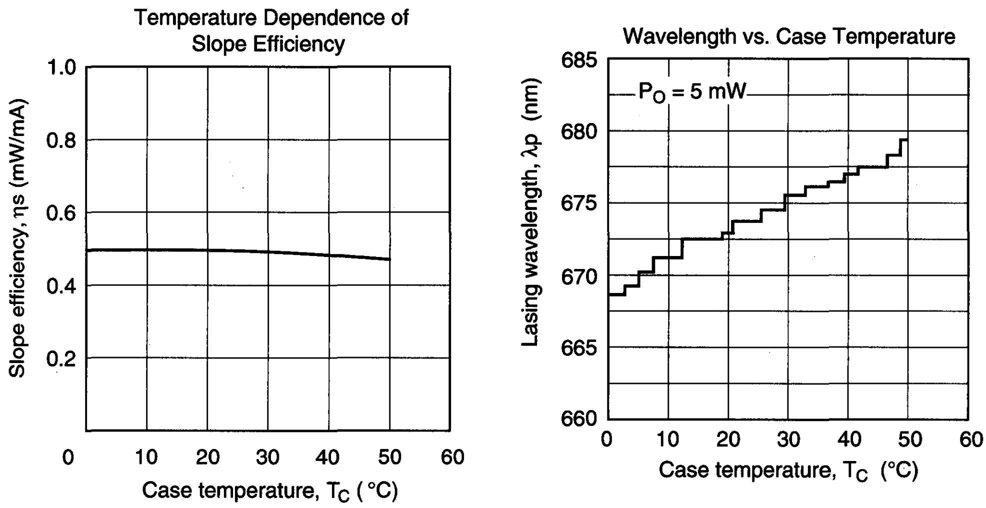
Threshold Current vs. Case Temperature (HL6712G)



Monitor Current vs. Case Temperature



Typical Characteristic Curves (cont.)



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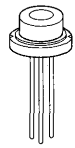
Description

The HL6713G is a 0.67 μm band AlGaInP index-guided laser diode with a double heterostructure. It is suitable as a light source for laser beam printers, levelers and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

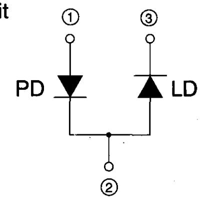
Features

- Visible light output at wavelengths up to 680 nm.
- Single longitudinal mode
- Low astigmatism: 10 μm Typ.
- Small droop under pulse operation: 10% max
- Built-in monitor photodiode

Package Type
- HL6713G: G1



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

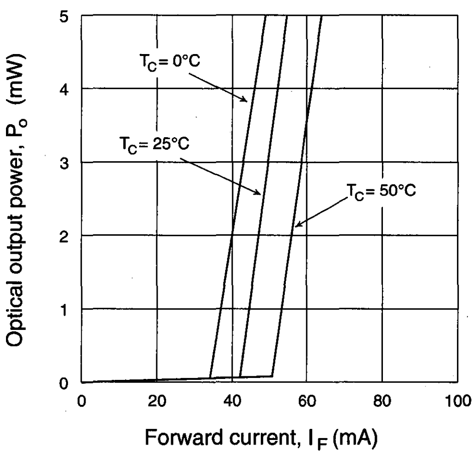
Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

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

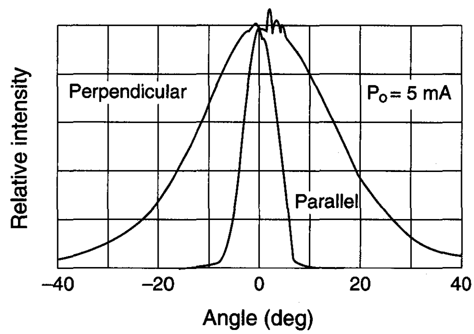
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	20	—	50	mA	
Optical output power	P_O	5	—	—	mW	Kink free
LD Operating Voltage	V_{op}	—	2.3	2.7	V	$P_O = 5$ mW
Slope efficiency	η	0.16	—	0.45	mW/mA	3 (mW) / ($I_{(4\ mW)}-I_{(1\ mW)}$)
Lasing wavelength	λ_p	—	670	680	nm	$P_O = 5$ mW
Beam divergence (parallel)	$\theta_{//}$	7	9	11	deg.	$P_O = 5$ mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	25	30	38	deg.	$P_O = 5$ mW, FWHM
Monitor current	I_S	1.0	2.0	3.0	mA	$P_O = 5$ mW, $V_{R\ (PD)} = 5$ V
Astigmatism	A_S	—	10	—	mm	$P_O = 3$ mW, NA = 0.4
Droop	$-R_{th}$	—	—	10	%	$P_O = 3$ mW, f = 600 Hz

Typical Characteristic Curves

Optical Output Power vs. Forward Current

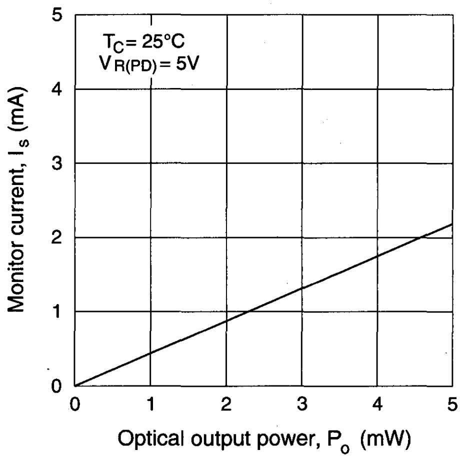


Far Field Pattern

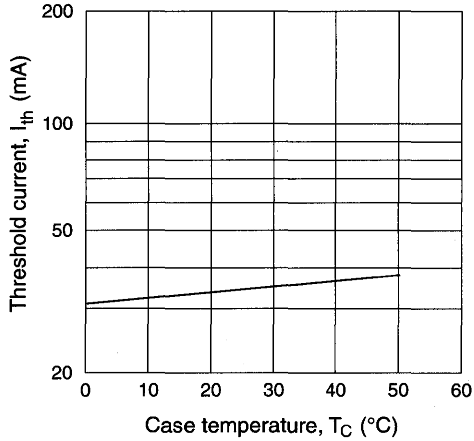


Typical Characteristic Curves (cont.)

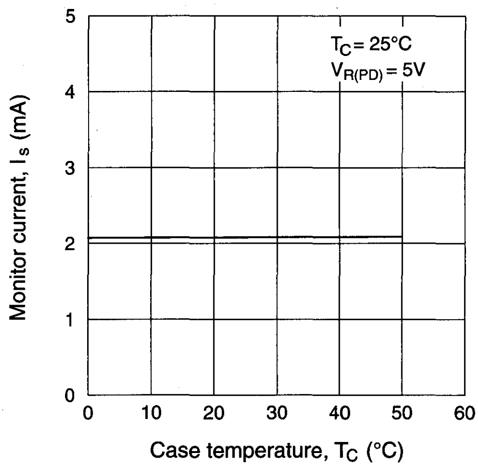
Monitor Current vs. Optical Output Power



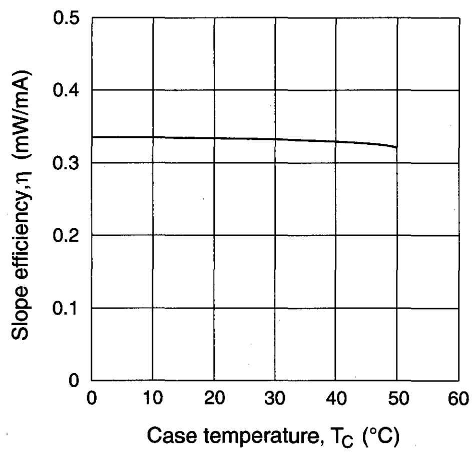
Temperature Dependence of Threshold Current



Temperature Dependence of Monitor Current



Temperature Dependence of Slope Efficiency



HL6714G AlGaInP LD

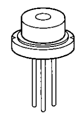
Description

The HL6714G is a 0.67 µm band AlGaInP index-guided laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for laser beam printers, levelers and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

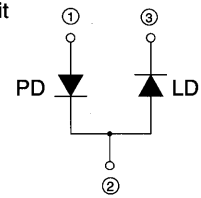
Features

- Visible light output at wavelengths up to 680 nm.
- Single longitudinal mode
- Low astigmatism: 10 µm Typ.
- High output power: 10 mW (CW)
- Built-in monitor photodiode

Package Type
- HL6714G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

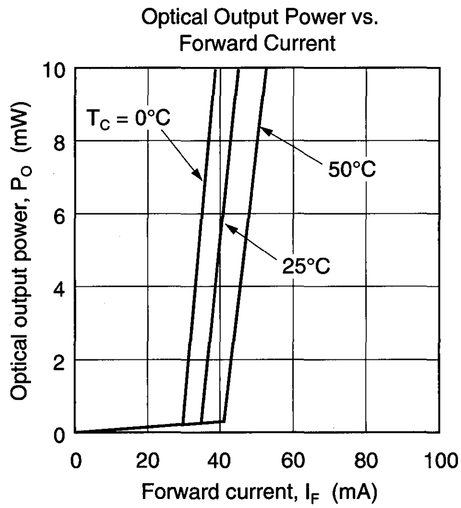
Item	Symbol	Rated Value	Unit
Optical output power	P_O	10	mW
Pulsed optical output power	$P_{O\ (pulse)}$	12[*1]	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

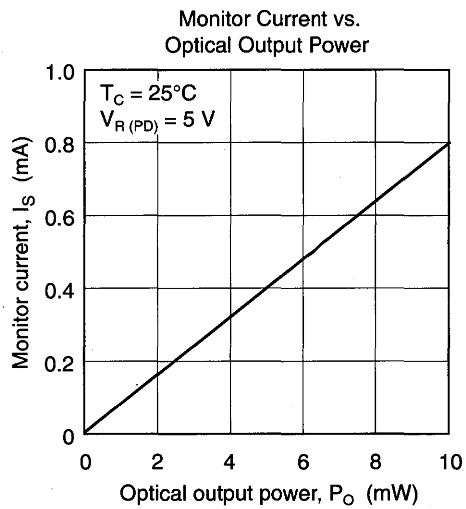
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

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

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	20	35	60	mA	
Optical output power	P_O	10	—	—	mW	Kink free
LD Operating Voltage	V_{op}	—	—	2.7	V	P_O = 10 mW
Slope efficiency	η	0.3	0.5	0.8	mW/mA	6 (mW) / ($I_{(8 mW)}-I_{(2 mW)}$)
Lasing wavelength	λ_p	660	670	680	nm	P_O = 10 mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	P_O = 10 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	18	22	30	deg.	P_O = 10 mW, FWHM
Monitor current	I_S	0.3	0.8	1.5	mA	P_O = 10 mW, $V_{R (PD)}$ = 5 V
Astigmatism	A_S	—	10	—	mm	P_O = 10 mW, NA = 0.4

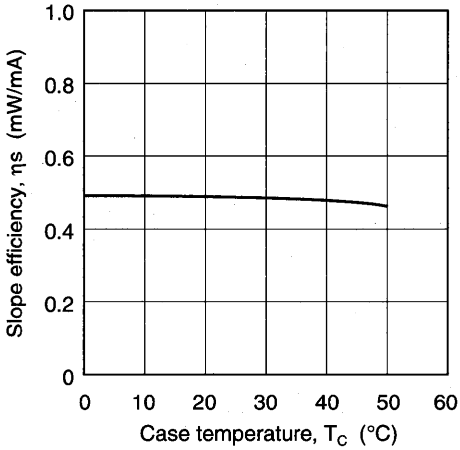
Typical Characteristics Curves



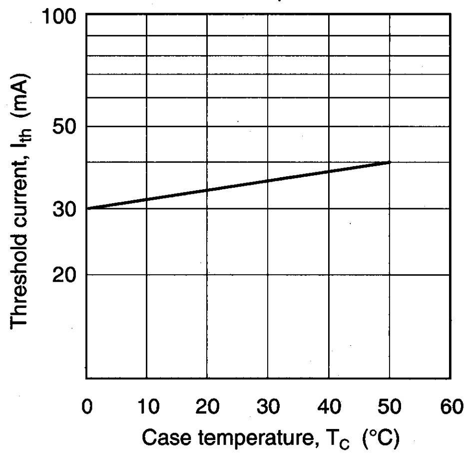


Typical Characteristics Curves (cont.)

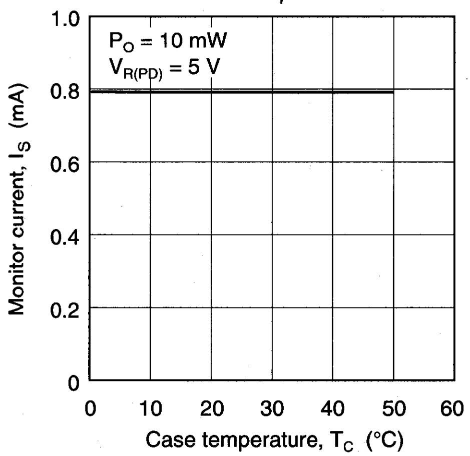
Temperature Dependence of
Slope Efficiency



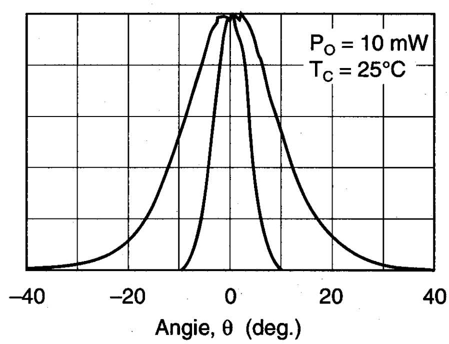
Threshold Current vs.
Case Temperature



Monitor Current vs.
Case Temperature



Far Field Pattern



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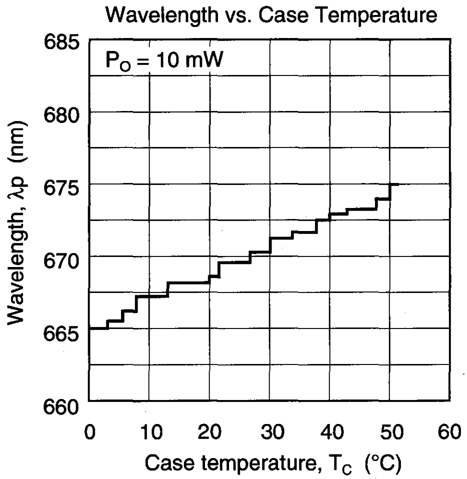
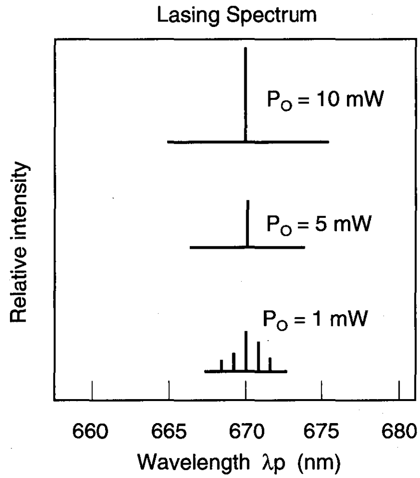
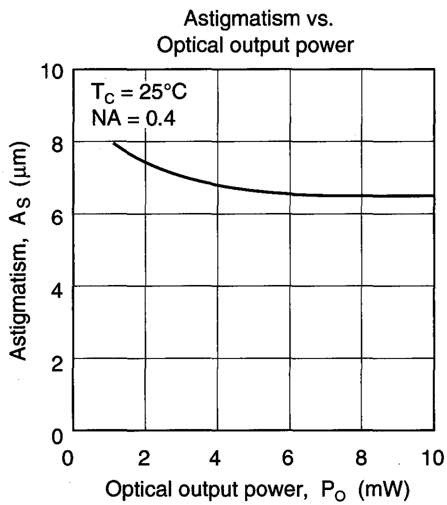
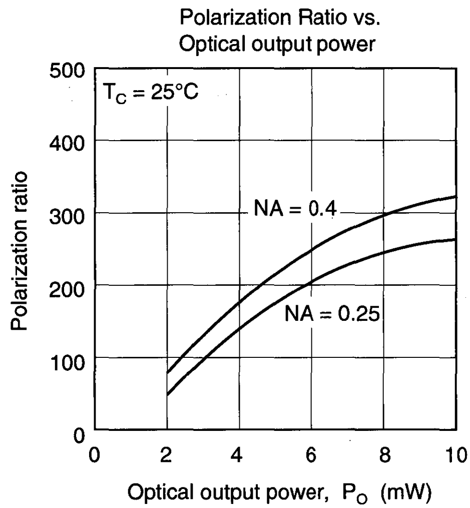
Typical Characteristics Curves (cont.)









HL6720G

AlGaInP LD

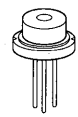
Description

The HL6720G is a 0.67 µm band AlGaInP index-guided laser diode with a double heterostructure.
It is suitable as a light source for pointers, and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

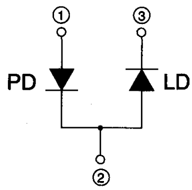
Features

- Visible light output at wavelengths up to 680 nm
- Continuous operating output: 5 mW CW
- Low voltage operation: 2.7 V Max
- Single longitudinal mode
- Built-in monitor photodiode

Package Type
- HL6720G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

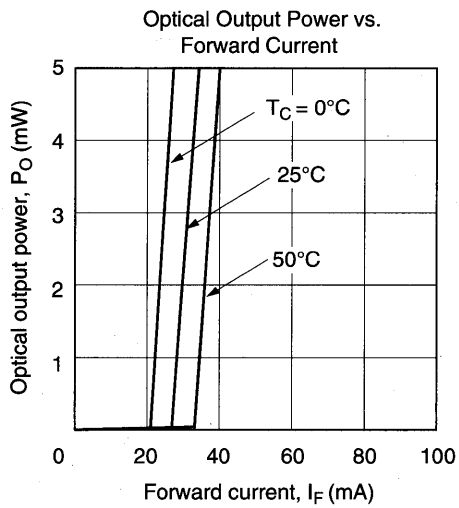
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

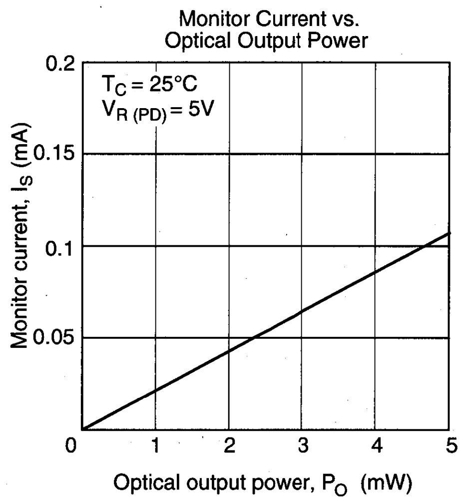
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

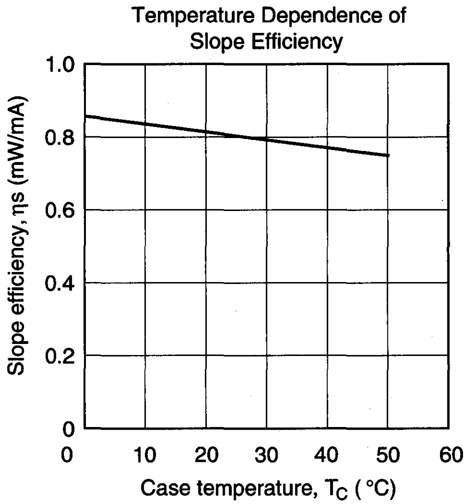
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	30	60	mA	
Optical output power	P_O	5	—	—	mW	Kink free
LD operating current	I_{op}	—	35	70	mA	P_O = 5 mW
LD operating voltage	V_{op}	—	—	2.7	V	P_O = 5 mW
Slope efficiency	η	0.4	—	1.0	mW/mA	3 mW / ($I_{(4\ mW)}-I_{(1\ mW)}$)
Lasing wavelength	λ_p	660	670	680	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	6	9	12	deg.	P_O = 5 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	20	30	40	deg.	P_O = 5 mW
Monitor current	I_S	0.03	—	0.2	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V

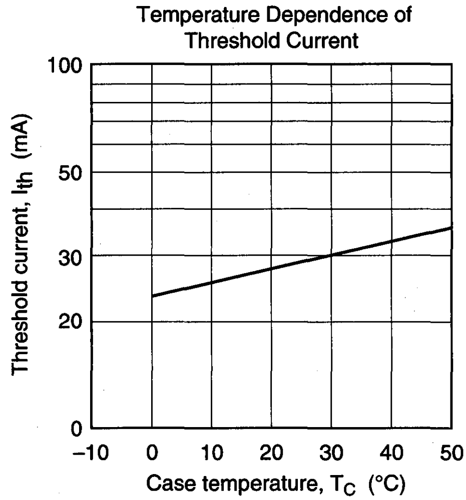
Typical Characteristic Curves

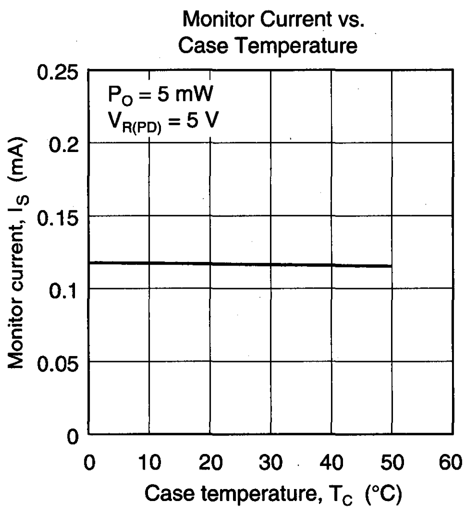


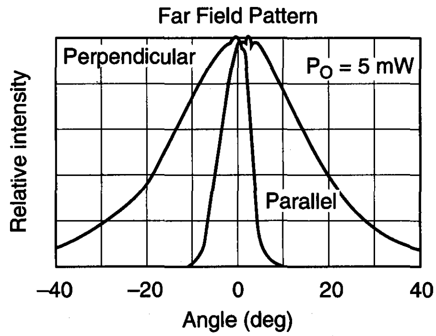


Typical Characteristic Curves (cont.)

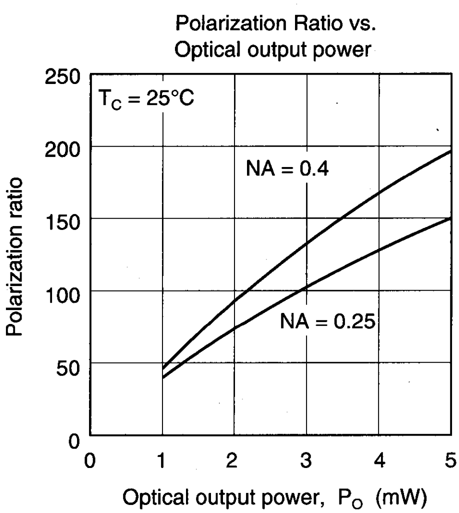


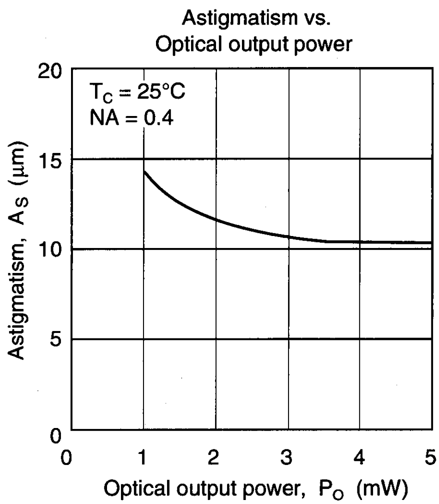






Typical Characteristic Curves (cont.)





Description

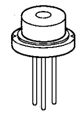
The HL6722G is a 0.67 μm band AlGaInP index-guided laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for pointers, and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

Features

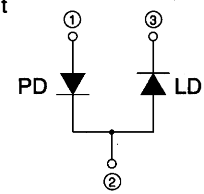
- Visible light output at wavelengths up to 680 nm
- Continuous operating output: 5 mW CW
- Low voltage operation: 2.7 V Max
- Low threshold current: 32 mA Typ.
- Single longitudinal mode
- Built-in monitor photodiode

Package Type

- HL6722G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

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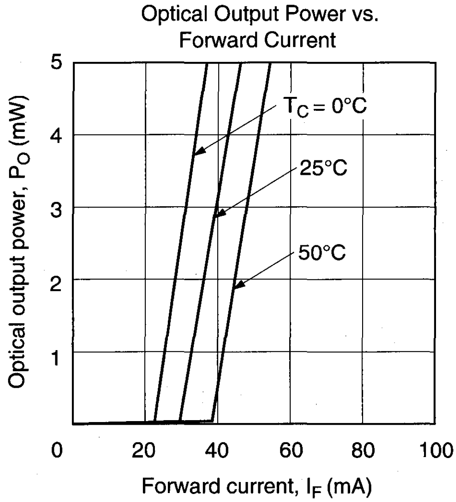
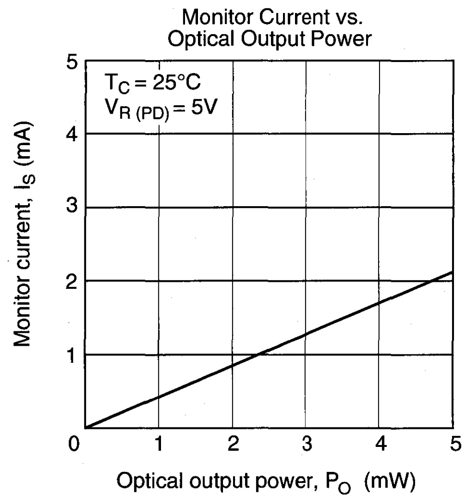
Optical and Electrical Characteristics (T_C = 25°C)

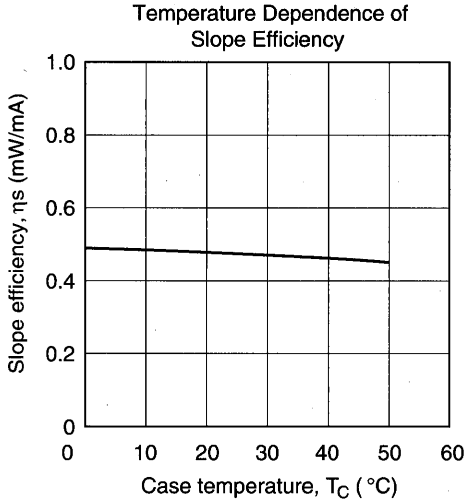
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	20	32	55	mA	
Optical output power	P_O	5	—	—	mW	Kink free
LD operating current	I_{op}	—	42	70	mA	P_O = 5 mW
LD operating voltage	V_{op}	—	—	2.7	V	P_O = 5 mW
Slope efficiency	η	0.3	0.5	0.7	mW/mA	3 mW / ($I_{(4\ mW)}-I_{(1\ mW)}$)
Lasing wavelength	λ_p	660	670	680	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	P_O = 5 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	22	30	38	deg.	P_O = 5 mW
Monitor current	I_S	1.0	—	3.0	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V

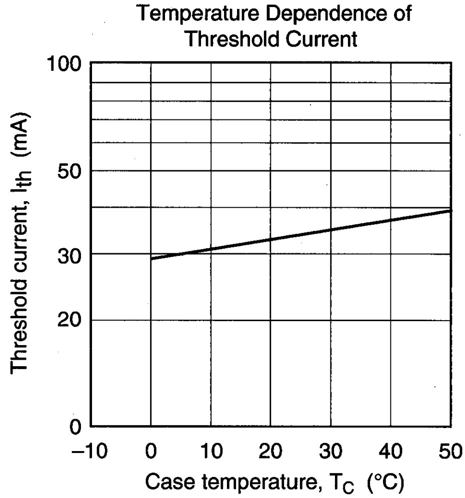
Typical Characteristic Curves

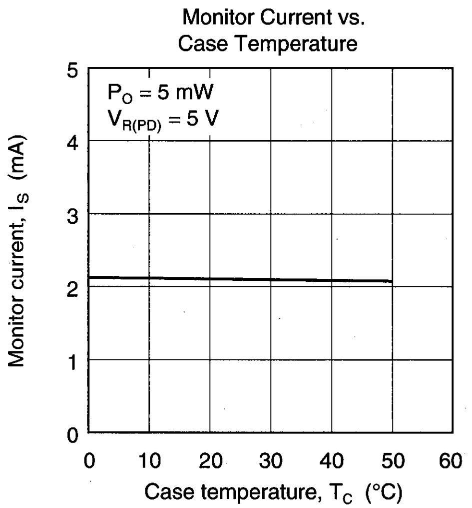


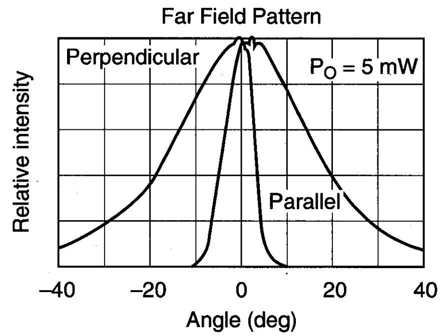


Typical Characteristic Curves (cont.)

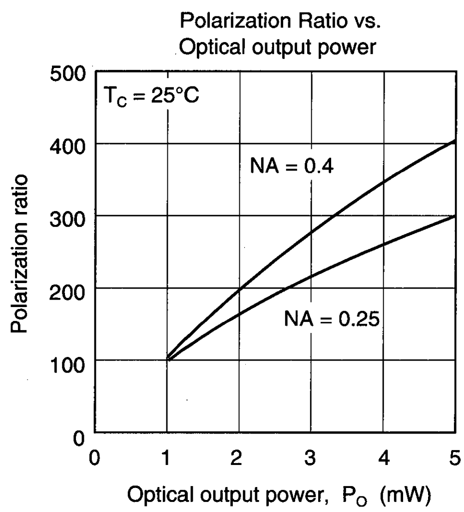


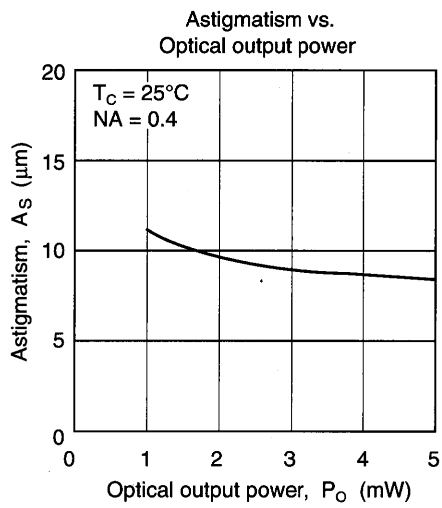






Typical Characteristic Curves (cont.)





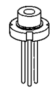
Description

The HL6724MG is a 0.67 µm band AlGaInP laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for pointers and optical equipment for amusement. Hermetic sealing of the package assures high reliability.

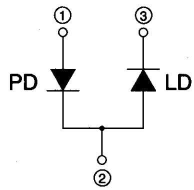
Features

- Visible light output at wavelengths up to 680 nm
- Continuous operating output: 5 mW CW
- Low operating current: 35 mA Typ.
- Low voltage operation: 2.7 V Max
- Built-in monitor photodiode

Package Type
- HL6724MG: MG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +50	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

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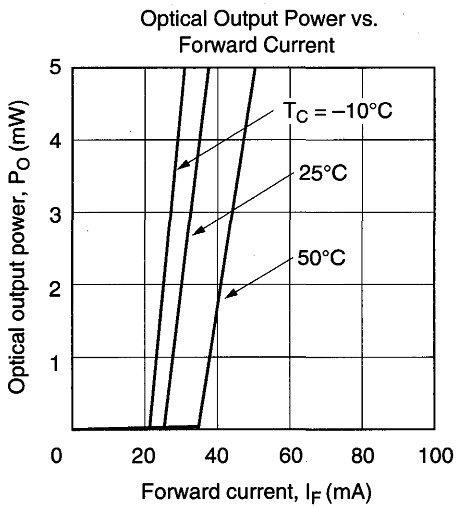
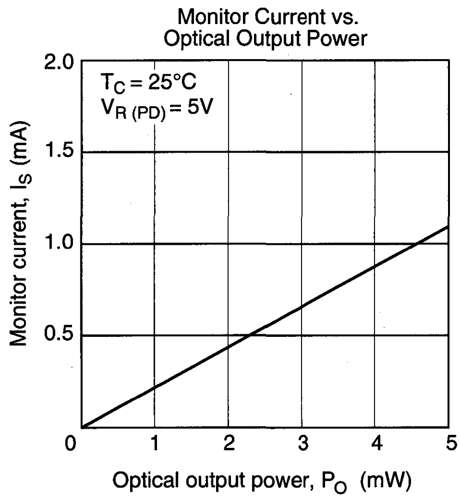
Optical and Electrical Characteristics (T_C = 25°C)

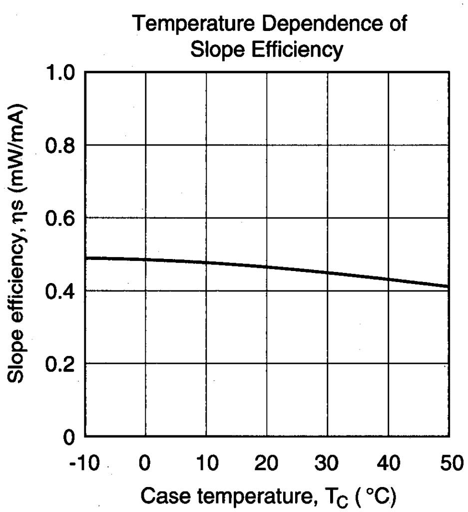
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	25	—	mA	
Optical output power	P_O	5	—	—	mW	Kink free
LD operating current	I_{op}	—	35	—	mA	P_O = 5 mW
LD operating voltage	V_{op}	—	—	2.7	V	P_O = 5 mW
Lasing wavelength	λ_p	660	670	680	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	P_O = 5 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	22	30	40	deg.	P_O = 5 mW
Monitor current	I_S	—	0.9	—	mA	P_O = 5 mW, $V_{R(PD)}$ = 5 V

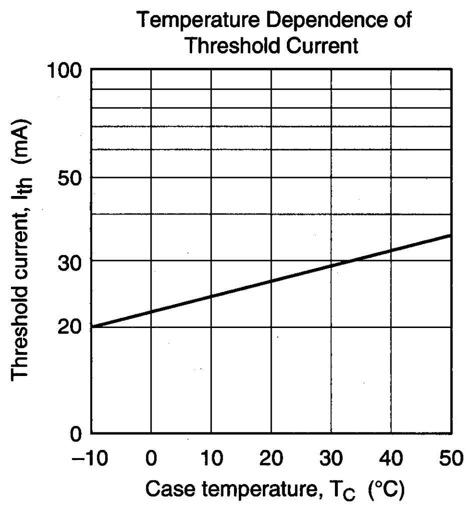
Typical Characteristic Curves

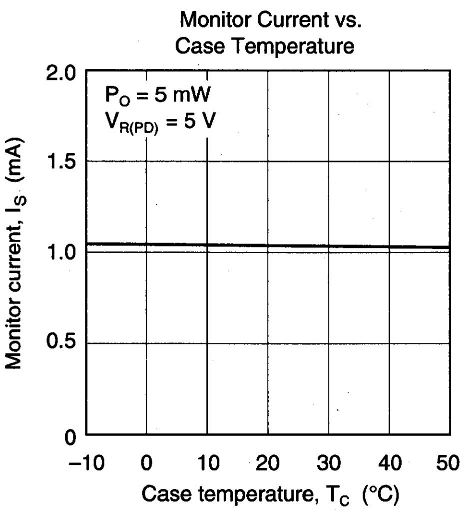


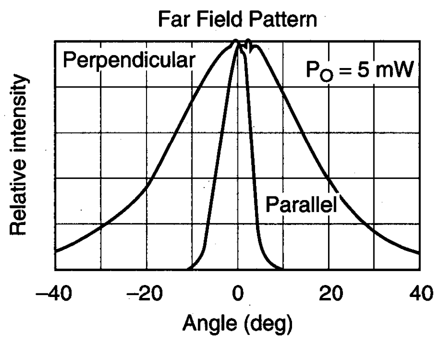


Typical Characteristic Curves (cont.)

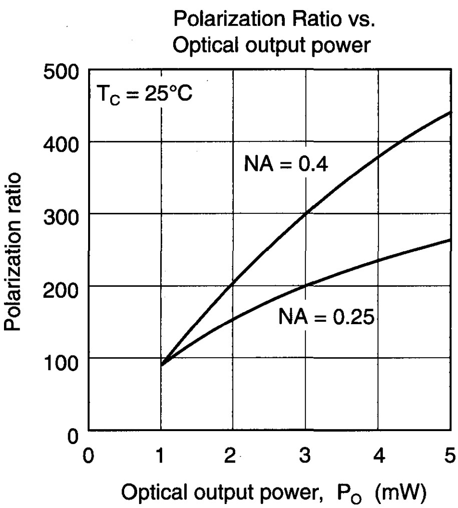


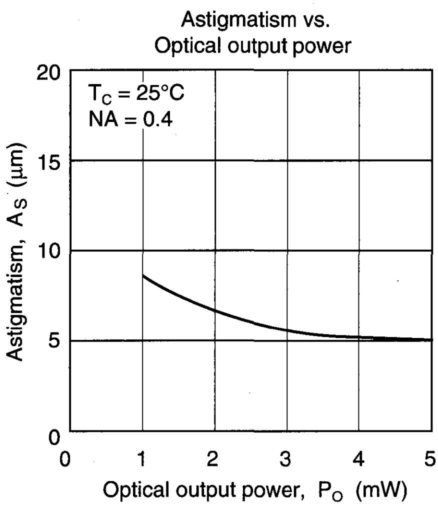






Typical Characteristic Curves (cont.)





1

HL7806G

GaAlAs LD

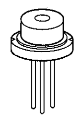
Description

The HL7806G is a 0.78 µm band GaAlAs laser diode with a double heterostructure. It is suitable as a light source for laser printers, laser levelers and various other types of optical equipment.

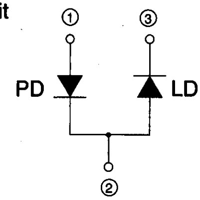
Features

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

Package Type
- HL7806G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

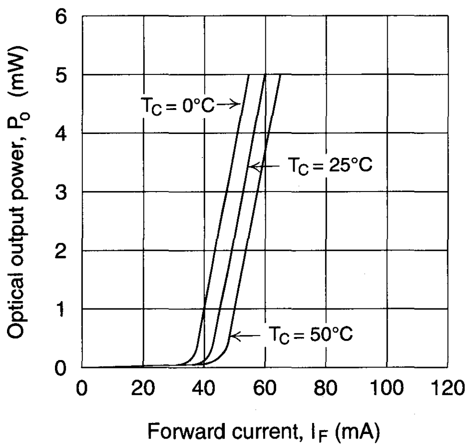
Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	—	40	65	mA	
Optical output power	P_O	5	—	—	mW	Kink free
Slope efficiency	η	0.15	0.25	0.40	mW/mA	3 (mW) / ($I_{(4\ mW)} - I_{(1\ mW)}$)
Lasing wavelength	λ_p	775	785	795	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	8	14	20	deg.	P_O = 5 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	20	27	45	deg.	P_O = 5 mW, FWHM
Monitor current	I_S	0.35	1.0	1.65	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V

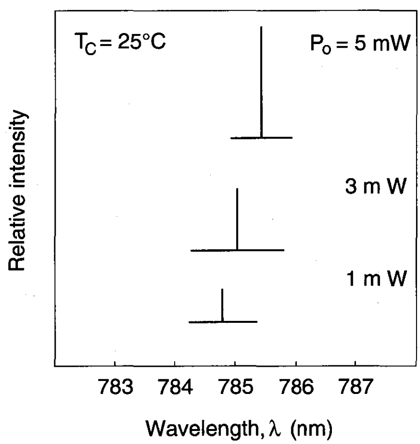
1

Typical Characteristic Curves

Optical Output Power vs. Forward Current

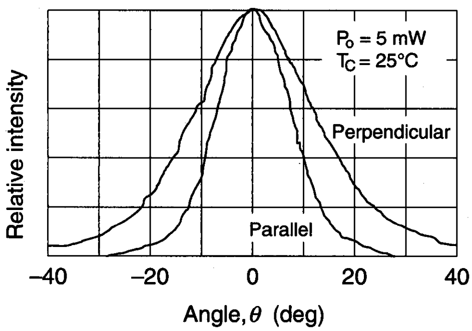


Lasing Spectrum

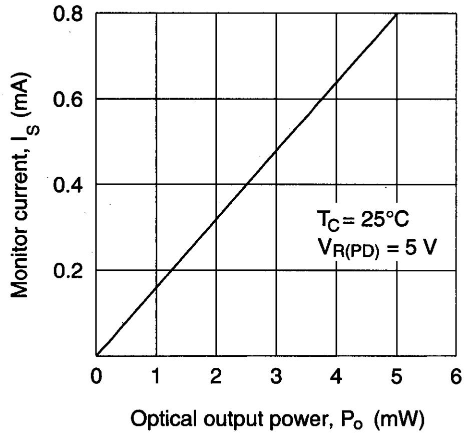


Typical Characteristic Curves (cont.)

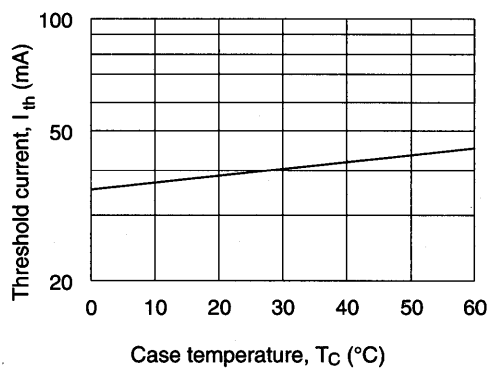
Far Field Pattern



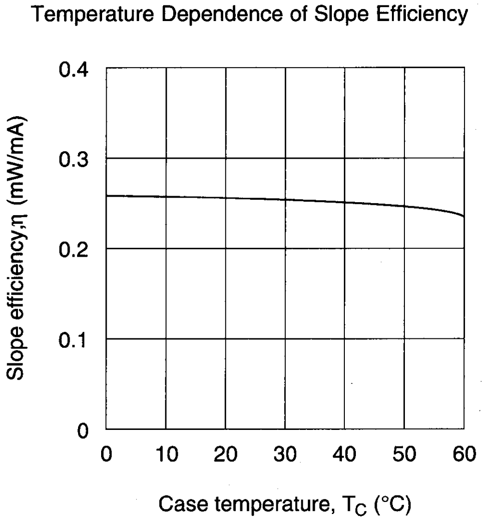
Monitor Current vs. Optical Output Power

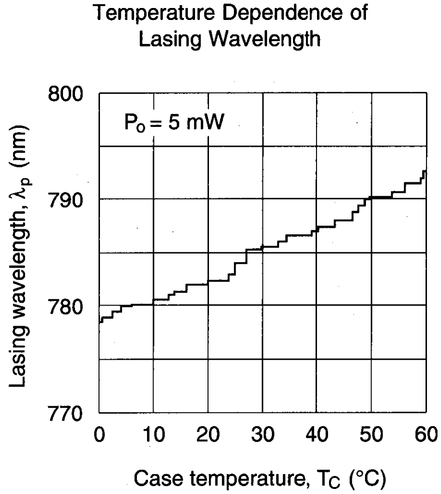


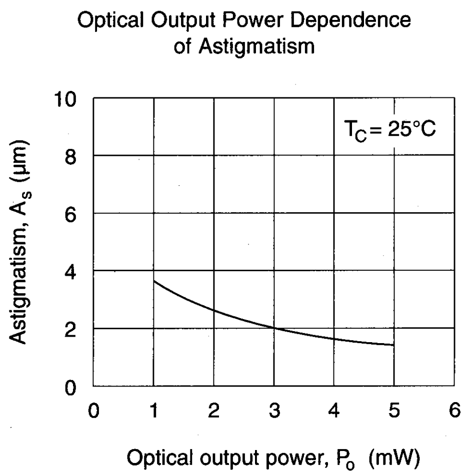
Temperature Dependence of Threshold Current

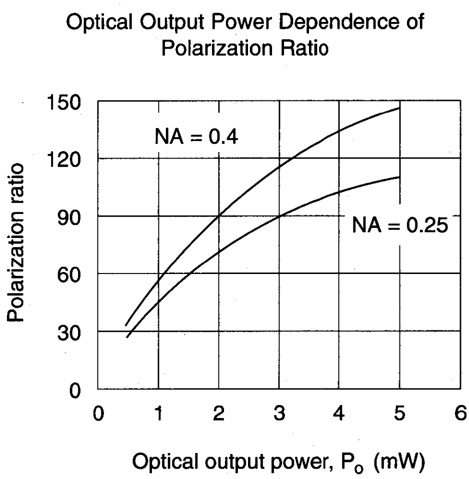


Typical Characteristic Curves (cont.)









HL7812G — GaAlAs LD

Description

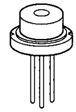
The HL7812G is a 0.78 μm band GaAlAs laser diode with a double heterostructure. It is suitable as a light source for laser printers, laser leveler and various other types of optical equipment.

Features

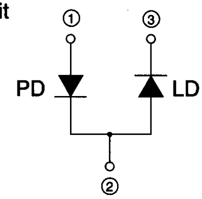
- Visible light output: λ_p = 770 to 795 nm
- Built-in monitor photodiode
- High monitor current output: 4 mA Typ.
- Single longitudinal mode
- Low astigmatism: A_S = 3 μm Typ.

Package Type

- HL7812G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	10	mW
Pulsed optical output power	$P_{O\ (pulse)}$	12*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

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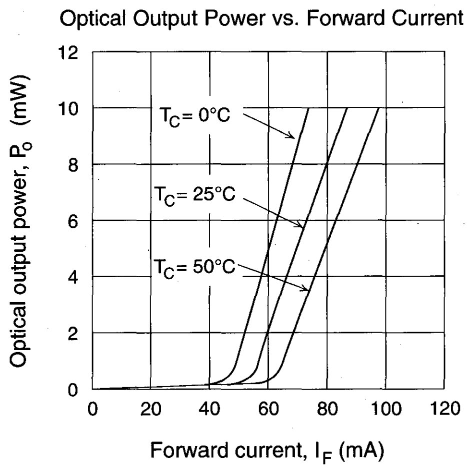
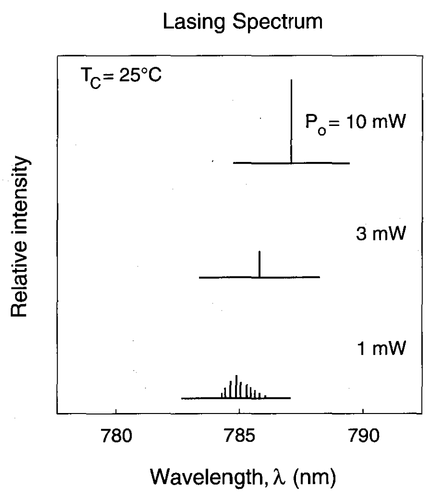
Optical and Electrical Characteristics (T_C = 25°C)

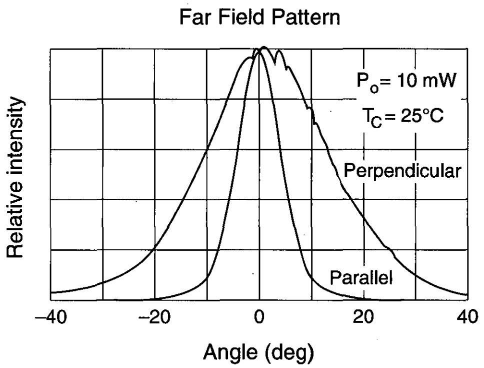
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	50	90	mA	
Optical ouput power	P_O	10	—	—	mW	Kink free
LD operating voltage	V_{op}	—	1.8	2.5	V	P_O = 10 mW
Slope efficiency	η	0.13	0.25	—	mW/mA	6 mW / ($I_{(8\ mW)}-I_{(2\ mW)}$)
Lasing wavelength	λ_p	770	785	795	nm	P_O = 10 mW
Beam divergence (parallel)	$\theta_{//}$	7	11	18	deg.	P_O = 10 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	20	30	40	deg.	P_O = 10 mW
Monitor current	I_S	2.0	4.0	6.0	mA	P_O = 10 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	3	—	µm	P_O = 10 mW, NA = 0.4

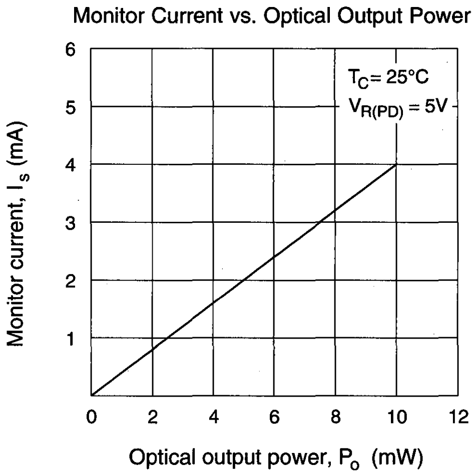
Typical Characteristic Curves

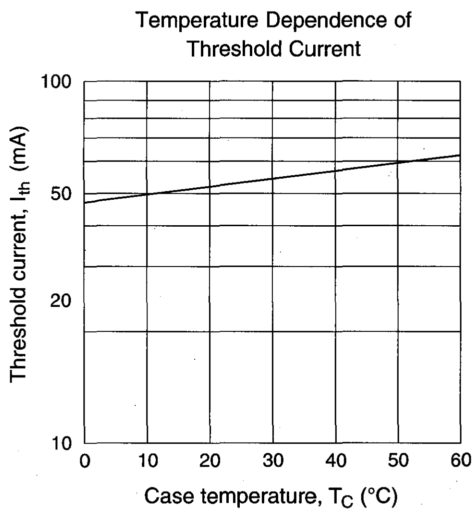


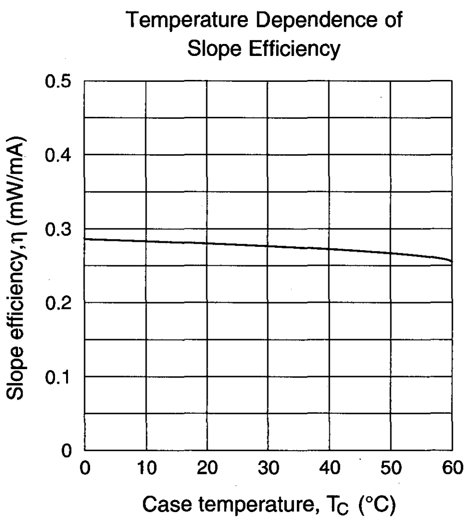


Typical Characteristic Curves (cont.)

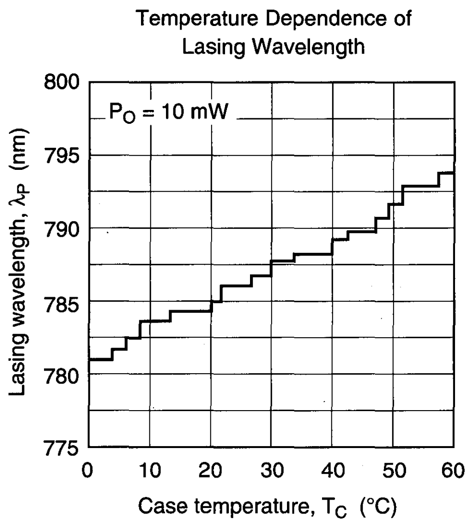


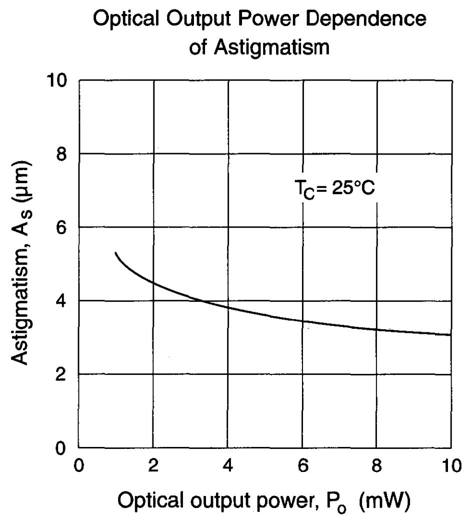


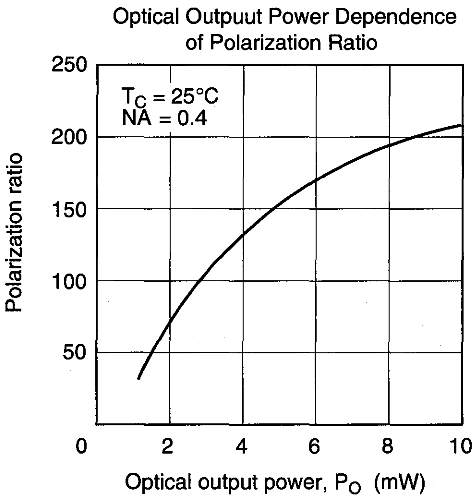




Typical Characteristic Curves (cont.)







HL7836MG GaAlAs LD

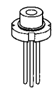
Description

The HL7836MG is a 0.78 μm band GaAlAs laser diode with a double heterostructure. It is designed to be used with a unitary positive voltage power supply, and is appropriate as a light source for various optical application devices, including laser beam printers and laser levellers.

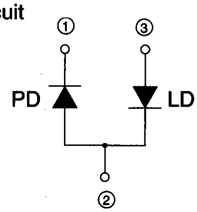
Features

- Visible light output: λ_p = 770 to 795 nm
- Built-in monitor photodiode
- Astigmatism: A_S = 3 μm Typ.
- Single longitudinal mode lasing

Package Type
- HL7836MG: MG



- Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

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Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	20	—	60	mA	
Optical output power	P_O	5	—	—	mW	Kink free
Slope efficiency	η	0.1	0.25	0.45	mW/mA	3 (mW) / ($I_{(4\ mW)} - I_{(1\ mW)}$)
Lasing wavelength	λ_p	770	785	795	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	8	11	16	deg.	P_O = 5 mW
Beam divergence (perpendicular)	$\theta_{\perp}$	20	27	35	deg.	P_O = 5 mW
Monitor current	I_S	0.25	0.6	1.0	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V

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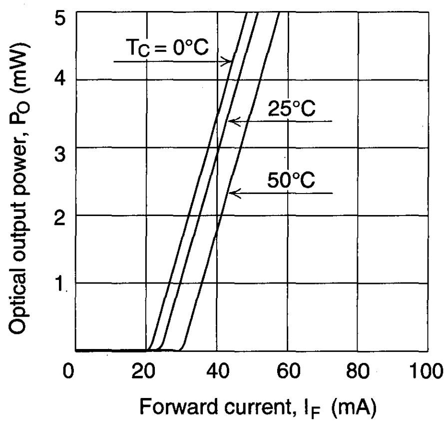
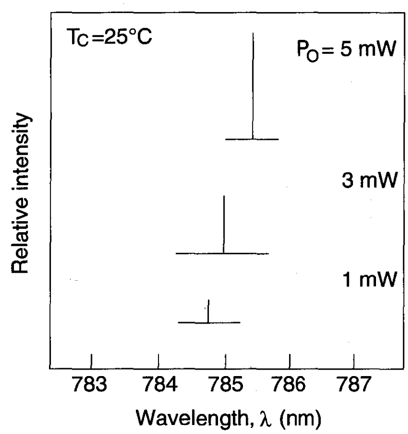
Typical Characteristic Curves

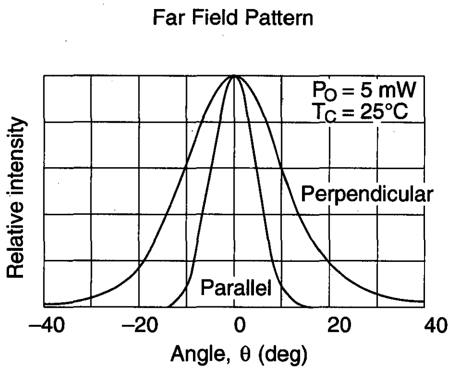
Optical Output Power vs. Forward Current

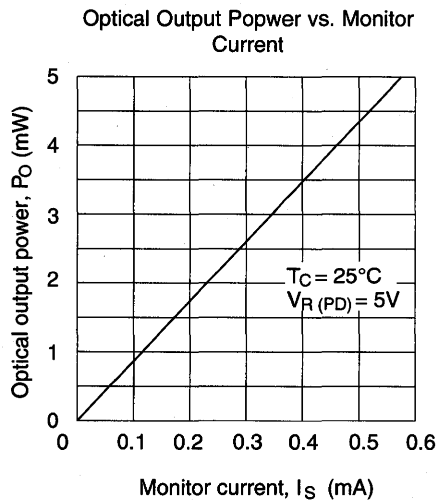


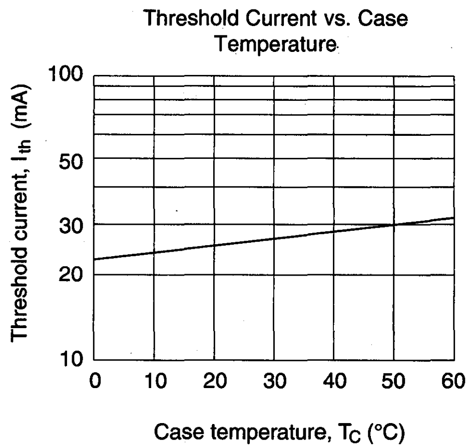
Lasing Spectrum



Typical Characteristic Curves (cont.)







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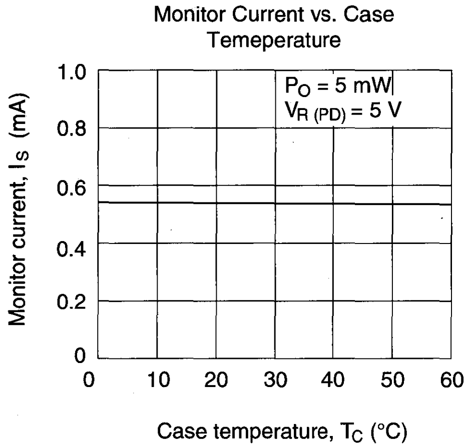
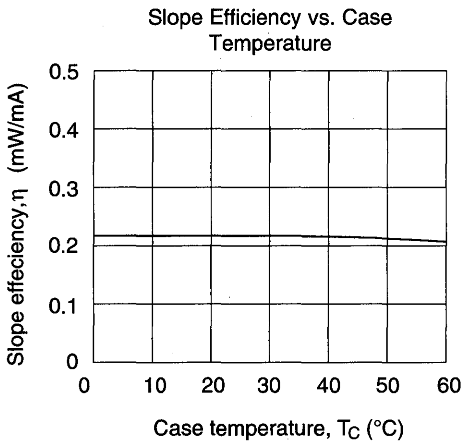
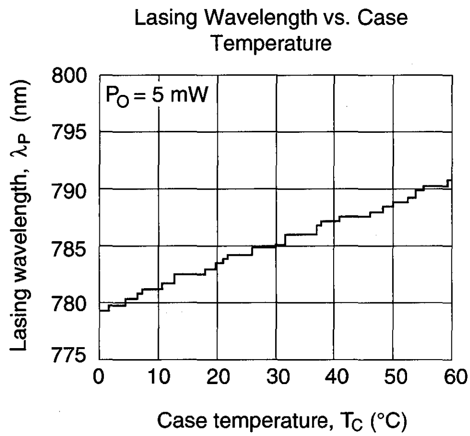
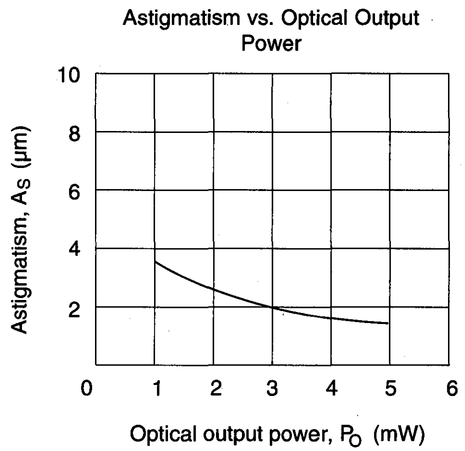
Typical Characteristic Curves (cont.)

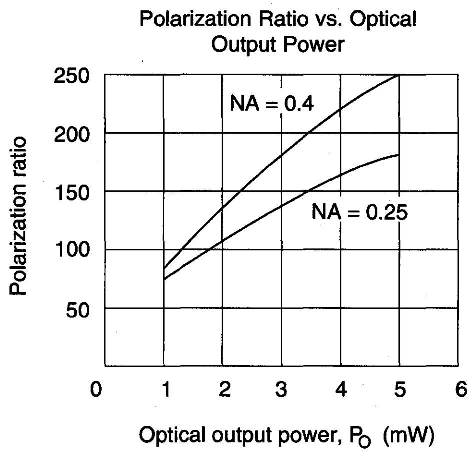






Typical Characteristic Curves (cont.)





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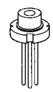
Description

The HL7843MG is a 0.78 µm band GaAlAs laser diode with a multi-quantum well (MQW) structure. It is especially suitable as a light source for laser beam printers with its low threshold current and low slope efficiency. Hermetic sealing of the package assures high reliability.

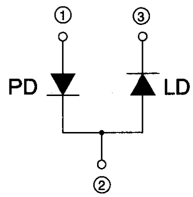
Features

- Visible light output : λ_p =775 to 795 nm
- Low slope efficiency: 0.2 mW/mA Typ.
- Low threshold current: 15 mA Typ.
- Low astigmatism: 5 µm Typ.
- Built-in monitor photodiode

Package Type
- HL7843MG: MG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

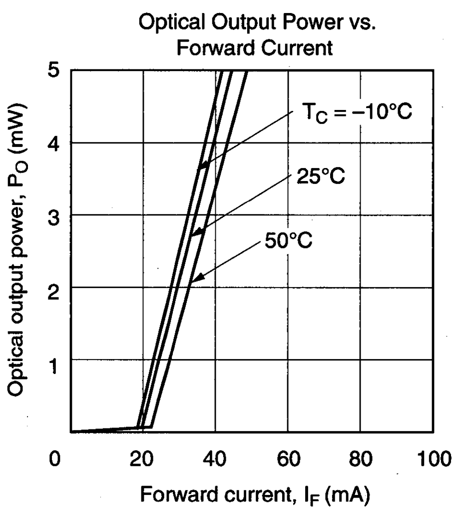
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
Pulsed optical output power	$P_{O\ (pulse)}$	6*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

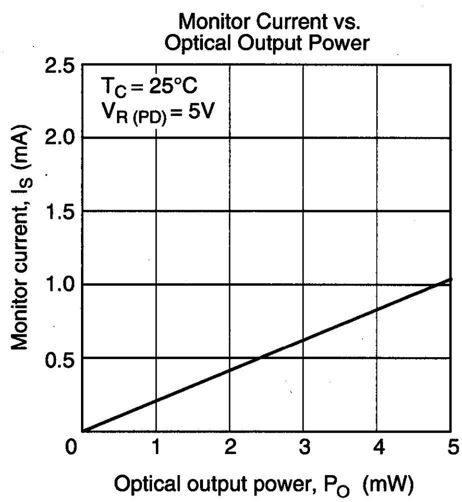
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

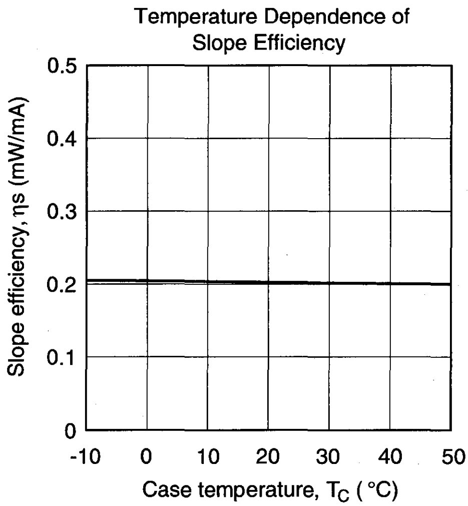
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	10	15	30	mA	
Optical output power	P_O	5	—	—	mW	Kink free
LD Operation voltage	V_{op}	—	—	2.3	V	P_O = 5 mW
Slope efficiency	η	0.1	0.2	0.35	mW/mA	3 mW / ($I_{(4\ mW)}-I_{(1\ mW)}$)
Lasing wavelength	λ_p	775	785	795	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	8	10	13	deg.	P_O = 5 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	20	24	30	deg.	P_O = 5 mW, FWHM
Monitor current	I_S	0.5	1.0	1.5	mA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	5	—	μA	P_O = 5 mW, NA = 0.4
Droop	$-R_{th}$	—	—	10	%	P_O = 5 mW, f = 600 Hz

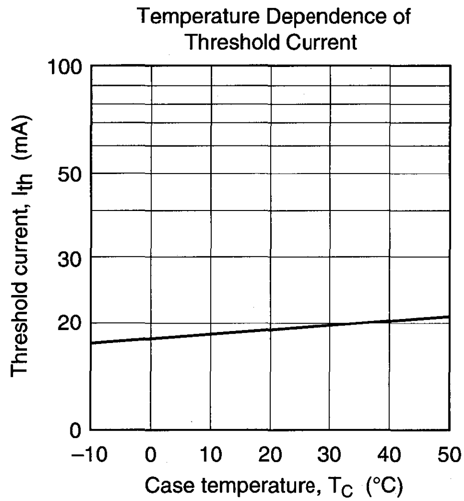
Typical Characteristic Curves

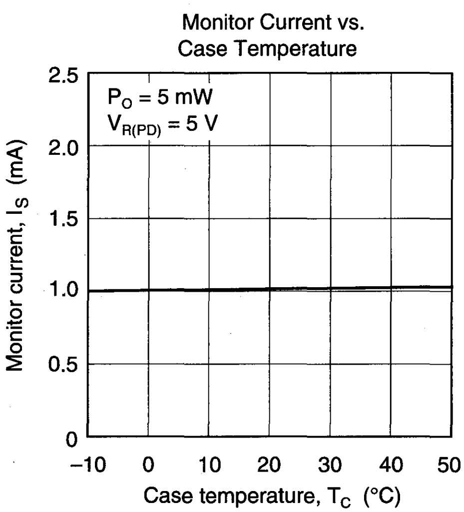


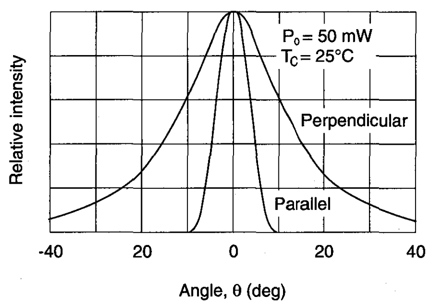


Typical Characteristic Curves (cont.)

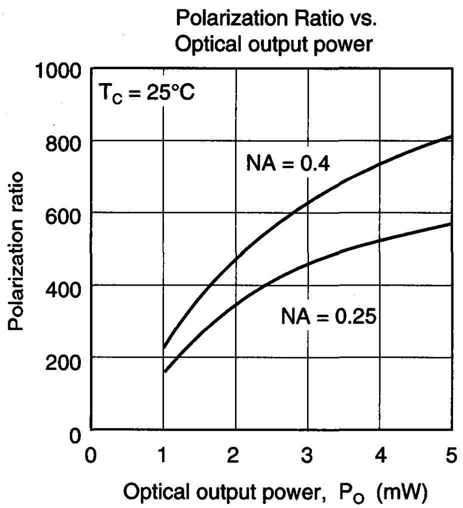


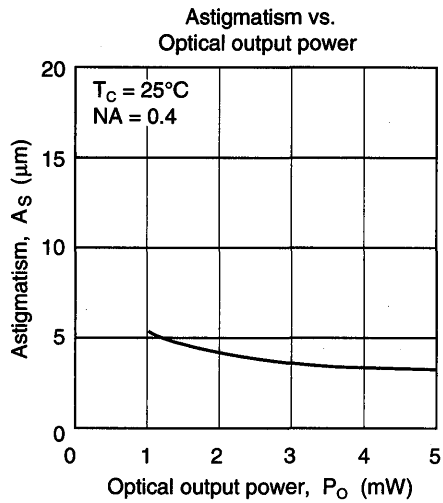






Typical Characteristic Curves (cont.)





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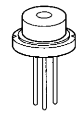
Description

The HL7851G is a high power 0.78 μm band GaAlAs laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for optical disk memories, levelers and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

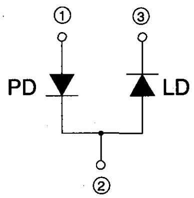
Features

- Visible light output: λ_p = 785 nm Typ.
- Small beam ellipticity: 9.5:23
- High output power: 50 mW (CW)
- Built-in monitor photodiode

Package Type
- HL7851G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	50	mW
Pulsed optical output power	$P_{O\ (pulse)}$	60*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

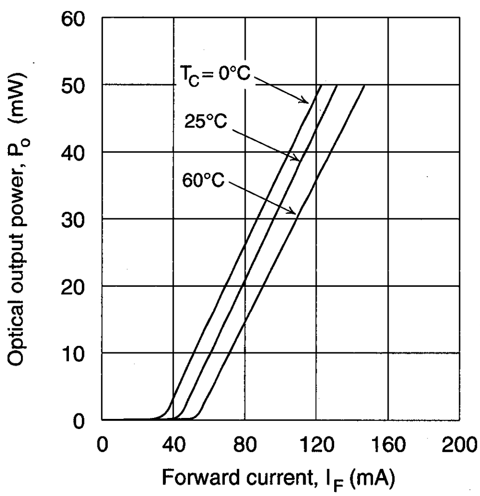
Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

Optical and Electrical Characteristics (T_C = 25 ±3°C)

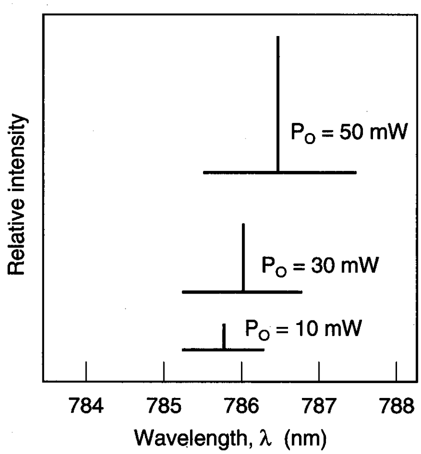
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	45	70	mA	
Optical output power	P_O	50	—	—	mW	Kink free
LD Operating voltage	V_{op}	—	2.3	2.7	V	P_O = 50 mW
Operating current	I_{op}	—	140	170	mA	P_O = 50 mW
Slope efficiency	η	0.35	0.55	0.7	mW/mA	40 mW / ($I_{(45\ mW)}-I_{(5\ mW)}$)
Lasing wavelength	λ_p	775	785	795	nm	P_O = 50 mW
Beam divergence (parallel)	$\theta_{//}$	8	9.5	12	deg.	P_O = 50 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	18	23	28	deg.	P_O = 50 mW, FWHM
Monitor current	I_S	25	—	150	μA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	5	—	μm	P_O = 5 mW, NA = 0.4

Typical Characteristic Curves

Optical Output Power vs. Forward Current



Lasing Spectrum



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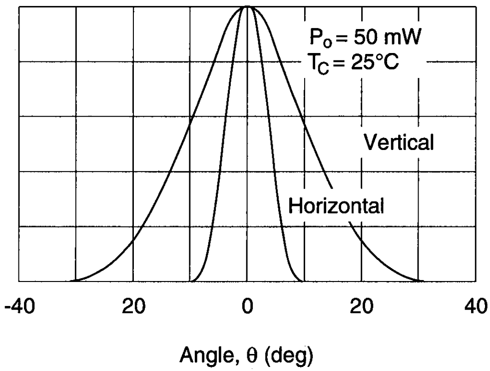
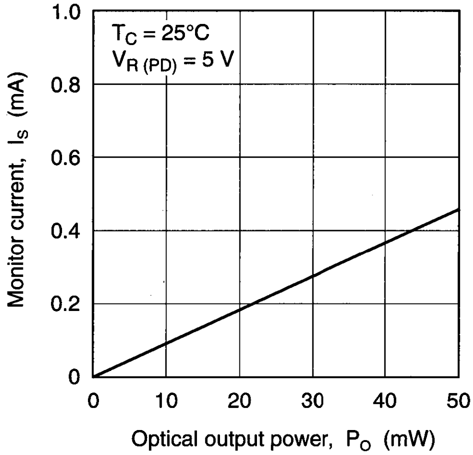
Typical Characteristic Curves (cont.)

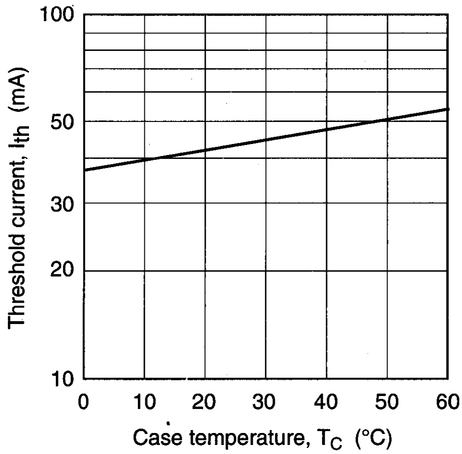
Far Field Pattern



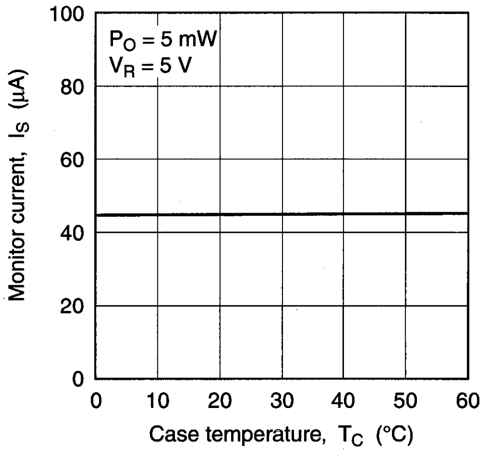
Optical Output Power vs. Monitor Current



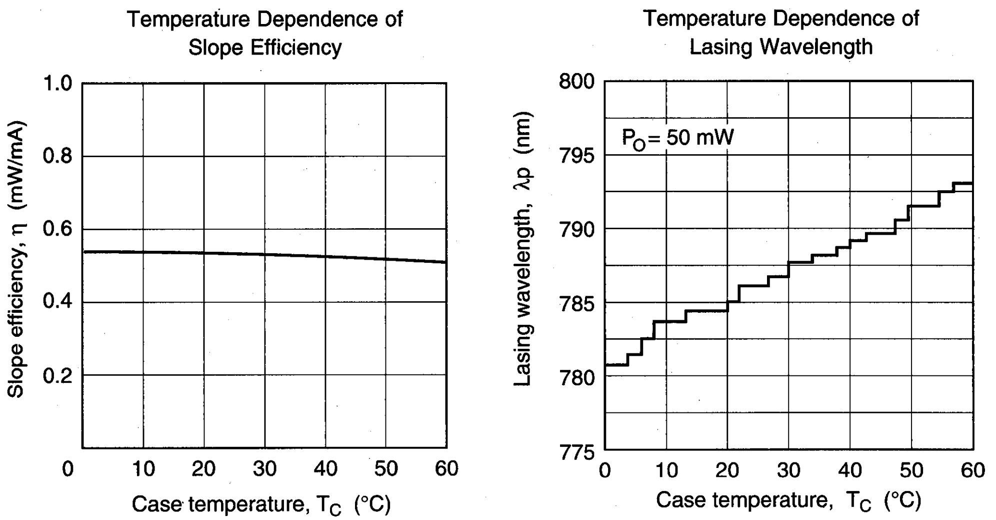
Temperature Dependence of Threshold Current



Temperature Dependence of Monitor Current



Typical Characteristic Curves (cont.)



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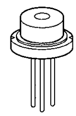
Description

The HL7852G is a high power 0.78 µm band GaAlAs laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for optical disk memories, levelers and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

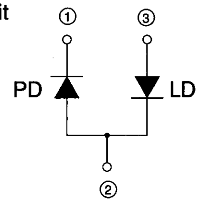
Features

- Visible light output: λ_p = 785 nm Typ.
- Small beam ellipticity: 9.5:23
- High output power: 50 mW (CW)
- Built-in monitor photodiode

Package Type
- HL7852G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	50	mW
Pulsed optical output power	$P_{O\ (pulse)}$	60*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

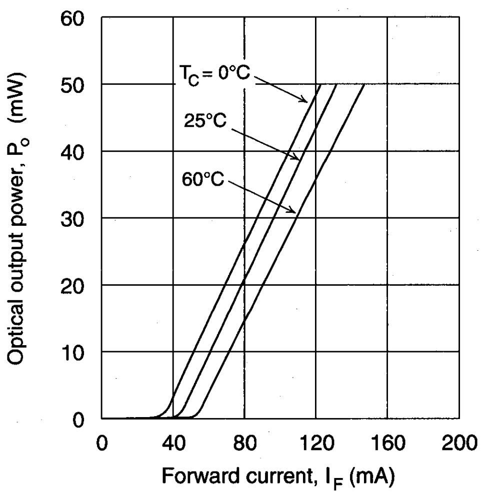
HL7852G

Optical and Electrical Characteristics (T_C = 25 ±3°C)

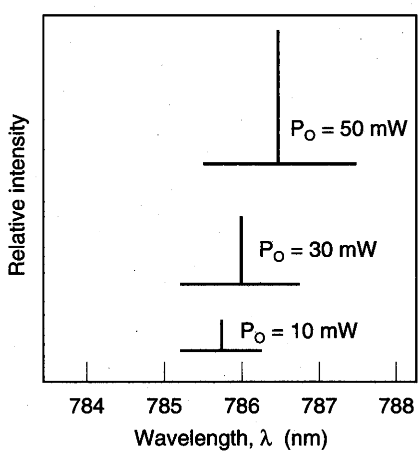
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	45	70	mA	
Optical output power	P_O	50	—	—	mW	Kink free
LD Operating voltage	V_{op}	—	2.3	2.7	V	P_O = 50 mW
Operating current	I_{op}	—	140	170	mA	P_O = 50 mW
Slope efficiency	η	0.35	0.55	0.7	mW/mA	40 mW / ($I_{(45\ mW)}-I_{(5\ mW)}$)
Lasing wavelength	λ_p	775	785	795	nm	P_O = 50 mW
Beam divergence (parallel)	$\theta_{//}$	8	9.5	12	deg.	P_O = 50 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	18	23	28	deg.	P_O = 50 mW, FWHM
Monitor current	I_S	25	—	150	μA	P_O = 5 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	5	—	μm	P_O = 5 mW, NA = 0.4

Typical Characteristic Curves

Optical Output Power vs. Forward Current



Lasing Spectrum



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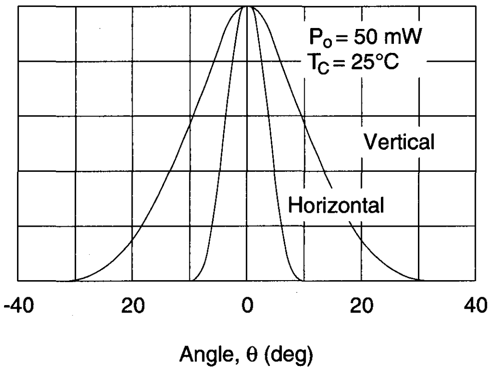
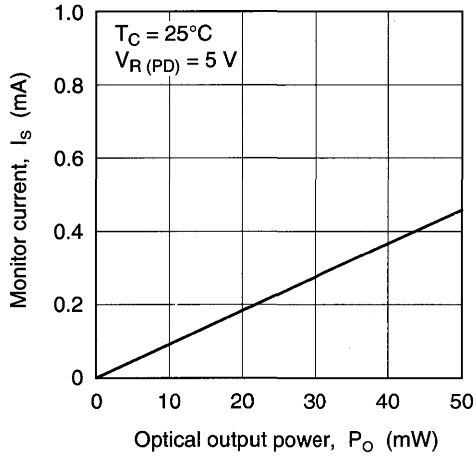
Typical Characteristic Curves (cont.)

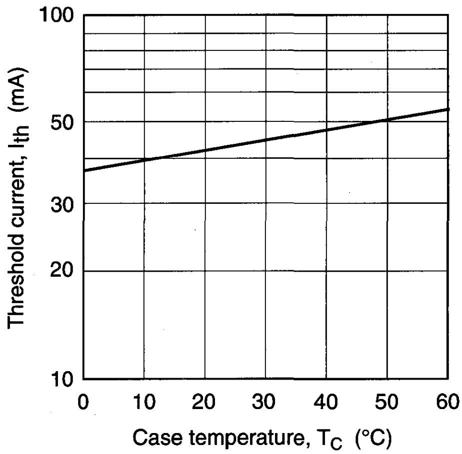
Far Field Pattern



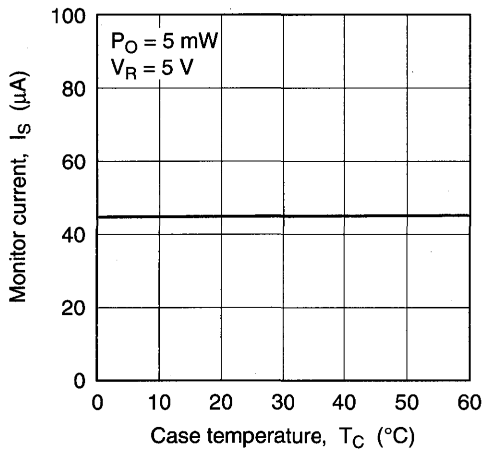
Optical Output Power vs. Monitor Current



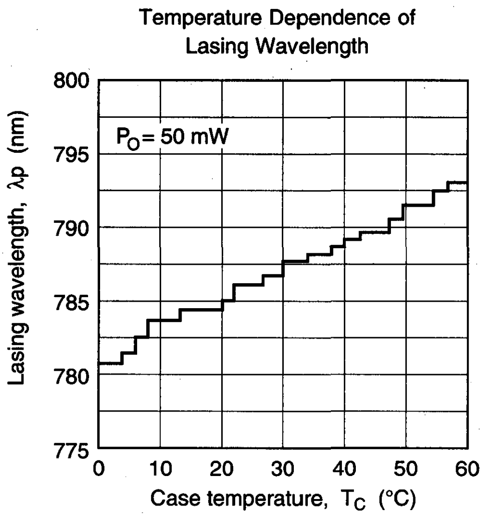
Temperature Dependence of Threshold Current



Temperature Dependence of Monitor Current



Typical Characteristic Curves (cont.)



HL7853MG   GaAlAs LD

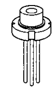
Description

The HL7853MG is a high power 0.78 µm band GaAlAs laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for optical disk memories, and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

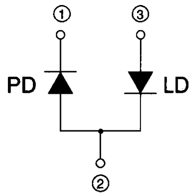
Features

- High output power: 40 mW CW
- Visible light output: λ_p = 785 mm Typ.
- Small beam ellipticity: 9.5 : 23
- Built-in monitor photodiode
- Compact package (ϕ5.6 mm)

Package Type
- HL7853MG: MG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

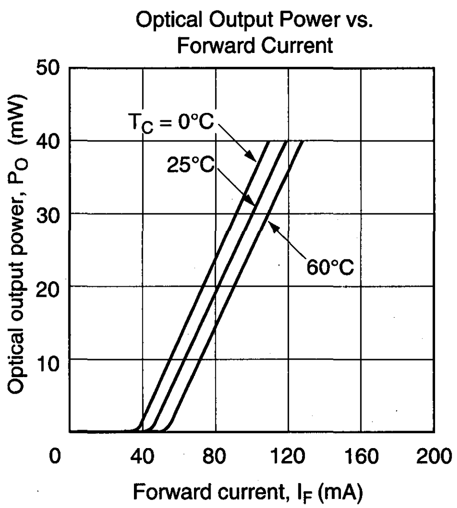
Item	Symbol	Rated Value	Unit
Optical output power	P_O	40	mW
Pulsed optical output power	$P_{O\ (pulse)}$	50*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

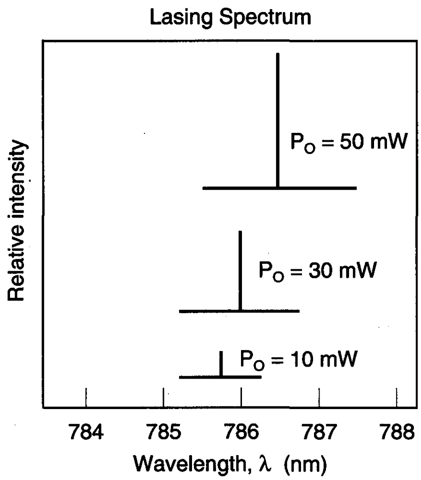
Note: 1. Maximum 50% duty cycle, maximum 1 µs pulse width

Optical and Electrical Characteristics (T_C = 25 ±3°C)

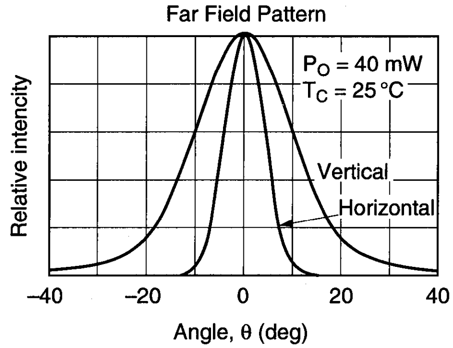
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	45	70	mA	
Optical ouput power	P_O	40	—	—	mW	Kink free
LD operating voltage	V_{op}	—	2.3	2.7	V	P_O = 40 mW
Slope efficiency	η	0.35	0.55	0.7	mW/mA	24 mW / ($I_{(32\ mW)}$−$I_{(8\ mW)}$)
Lasing wavelength	λ_p	775	785	795	nm	P_O = 40 mW
Beam divergence (parallel)	$\theta_{//}$	8	9.5	12	deg.	P_O = 40 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	18	23	28	deg.	P_O = 40 mW, FWHM
Monitor current	I_S	20	—	—	µA	P_O = 4 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	5	—	µm	P_O = 5 mW, NA = 0.4

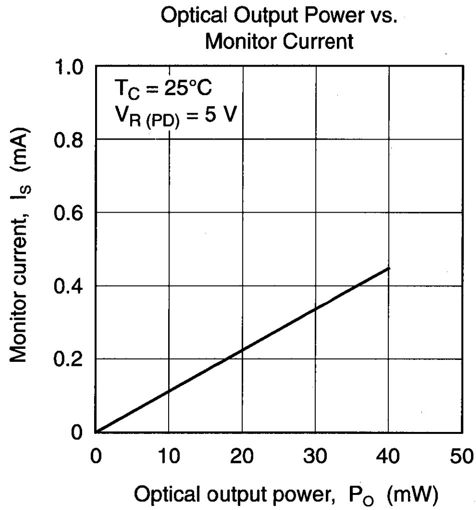
Typical Characteristic Curves

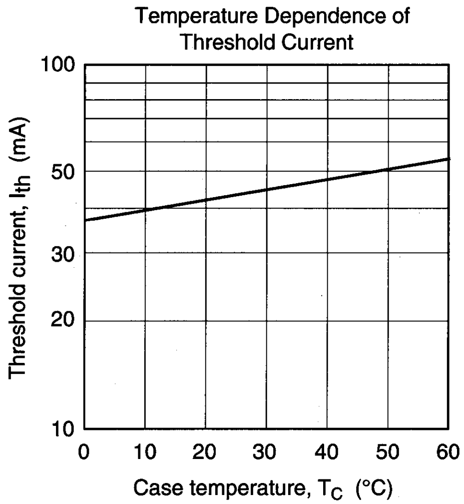


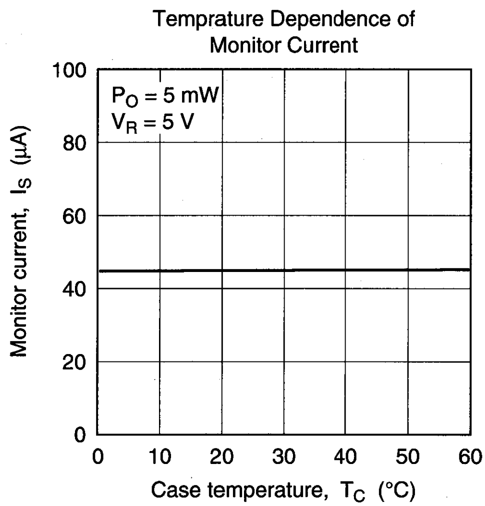


Typical Characteristic Curves (cont.)

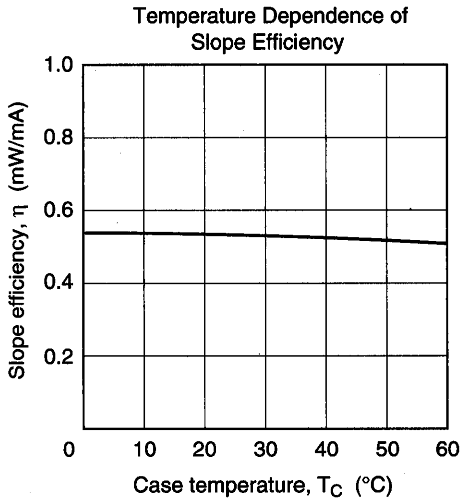


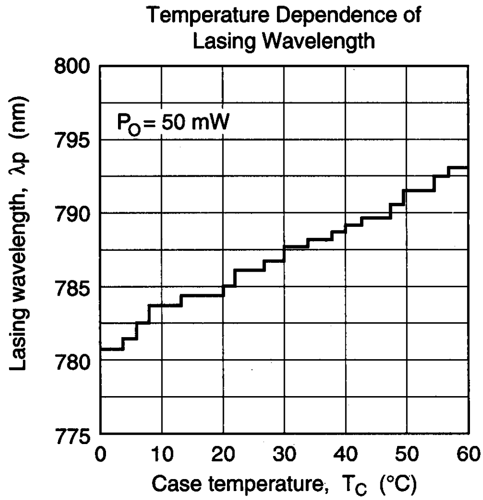






Typical Characteristic Curves (cont.)





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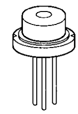
Description

The HL8325G is a high-power 0.8 μm band GaAlAs laser diode with a TQW (triple quantum well) structure. Its internal circuit configuration is suited for operation on a single positive supply voltage. It is suitable as a light source for optical disk memories, card readers and various other types of optical equipment.

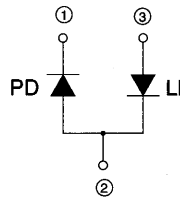
Features

- Infrared light output: λ_p = 820 to 840 nm
- High power: standard continuous operation at 40 mW (CW), pulsed operation at 50 mW
- Built-in monitor photodiode
- Single longitudinal mode

Package Type
- HL8325G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

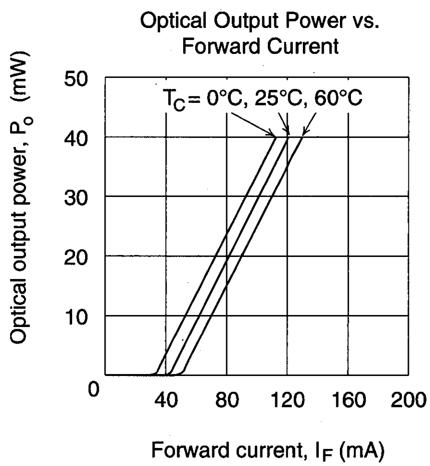
Item	Symbol	Rated Value	Unit
Optical output power	P_O	40	mW
Pulsed optical output power	$P_{O\ (pulse)}$	50*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +60	°C
Storage temperature	T_{stg}	–40 to +85	°C

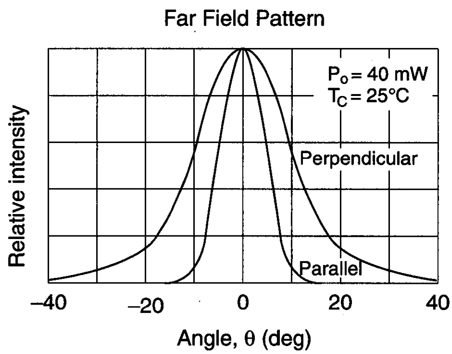
Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

Optical and Electrical Characteristics (T_C = 25 ±3°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	40	70	mA	
Optical output power	P_O	40	—	—	mW	Kink free
Slope efficiency	η	0.4	0.5	0.9	mW/mA	24 mW / ($I_{(32\ mW)}$–$I_{(8\ mW)}$)
Lasing wavelength	λ_p	820	830	840	nm	P_O = 40 mW
Beam divergence (parallel)	$\theta_{//}$	7	10	14	deg.	P_O = 40 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	18	22	32	deg.	P_O = 40 mW, FWHM
Monitor current	I_S	20	40	130	µA	P_O = 4 mW, $V_{R\ (PD)}$ = 5 V
Astigmatism	A_S	—	5	—	µm	P_O = 4 mW, NA = 0.4

Typical Characteristic Curves





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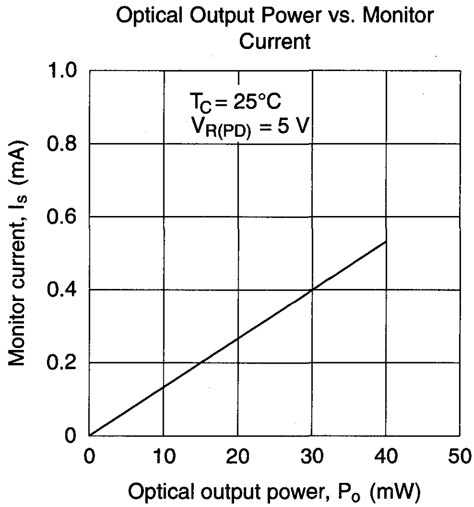
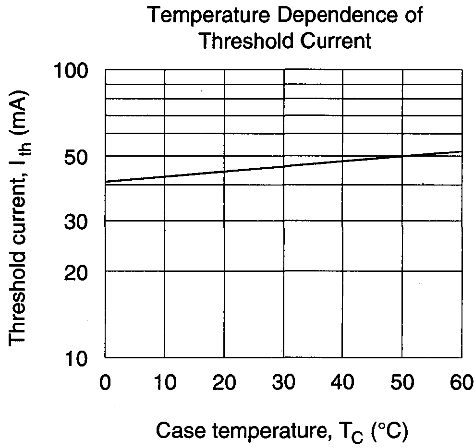
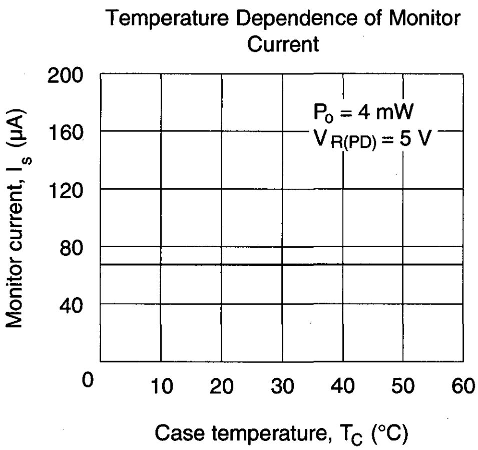
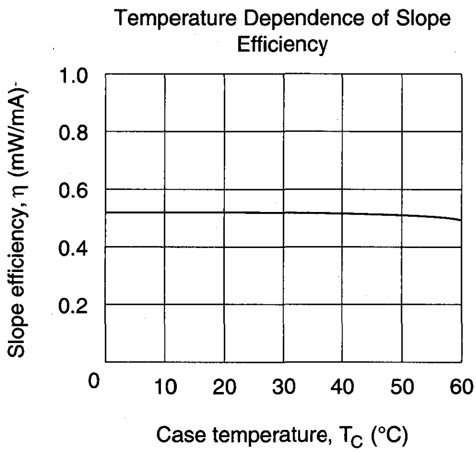
Typical Characteristic Curves (cont.)





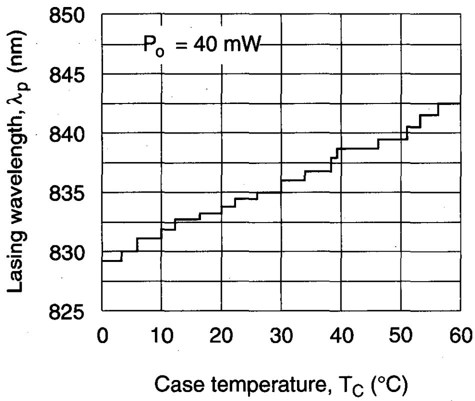




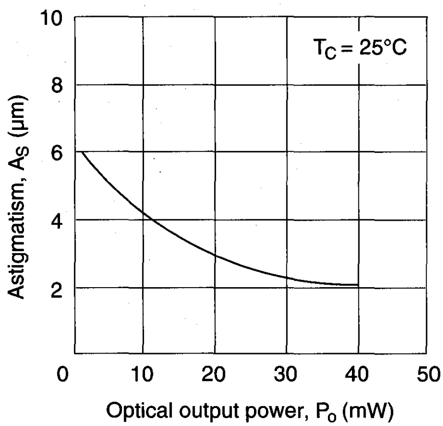
1

Typical Characteristic Curves (cont.)

Temperature Dependence of Lasing Wavelength



Optical Output Power Dependence of Astigmatism



HL1321AC/BF/DL/DM, HLP5400 InGaAsP LD

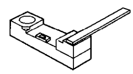
Description

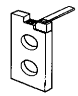
The HL1321AC/BF/DL/DM and HLP5400 are 1.3 μm band InGaAsP laser diodes with a double heterostructure. They are suitable as light sources for optical fiber communication systems and various types of optical equipment.

Features

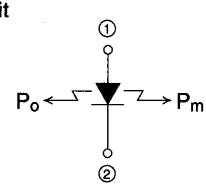
- Long wavelength oscillation:
  λ_p = 1270 to 1330 nm (AC, HLP5400)
- Long wavelength oscillation:
  λ_p = 1290 to 1330 nm (BF, DL, DM)
- Room temperature
  5mW CW operation (AC, HLP5400)
- High speed pulse response: t_r, $t_f \leq 0.5$ ns
- Attached single mode fiber (BF, DL, DM)
- High output:
  P_f = 1.2 mW (CW, pulse operation) (BF, DL)
- High output:
  P_f = 1.5 mW (CW, pulse operation) (DM)

Package Type
- HL1321AC: AC
- HLP5400: A1





Internal Circuit

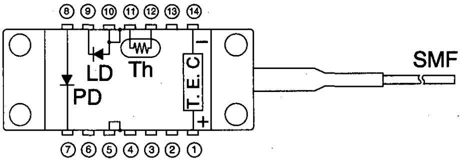


Fiber Specifications (BF, DL, DM only)

Mode field diameter: 10.0 ± 1.0 μm
Cutoff wavelength: 1.10 to 1.20 μm
Core diameter: 10 μm
External diameter: 125 μm
Jacket diameter: 900 μm
Fiber length: More than 500 mm

Pin Connections (Bottom view)

• HL1321BF

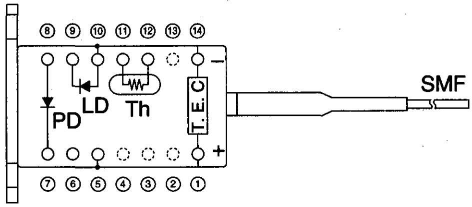


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
• HL1321BF: BF

• HL1321DL

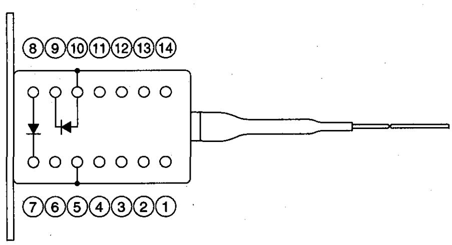


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
• HL1321DL: DL

• HL1321DM



① N. C.
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 N. C.
⑫ N. C.
⑬ N. C.
⑭ N. C.

Package Type
• HL1321DM: DM

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Absolute Maximum Ratings (T_C = 25°C)

Item		Symbol	Rated Value	Unit
Optical output power	HL1321AC / HLP5400	P_O	5	mW
Fiber optical output power	HL1321BF/DL	P_f	1.2	mW
	HL1321DM		1.5	
LD reverse voltage		$V_{R\,(LD)}$	2	V
PD reverse voltage	HL1321BF/DL/DM	$V_{R\,(PD)}$	15	V
PD forward current		$I_{F\,(PD)}$	1	mA
Cooler current	HL1321BF/DL	I_C	1.4	A
Operating temperature	HL1321AC/BF/DL	T_{opr}	0 to + 60	°C
	HL1321DM		0 to + 65	
	HLP5400		0 to + 50	
Storage temperature	HL1321AC	T_{stg}	0 to + 80	°C
	HL1321BF/DL		– 40 to + 70	
	HL1321DM		– 20 to + 70	
	HLP5400		0 to + 60	

Optical and Electrical Characteristics (T_C = 25°C)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	HL1321AC/ BF/DM/DL	I_{th}	—	30	50	mA	
	HLP5400		—	30	80		
Optical output power	HL1321AC/ HLP5400	P_O	5	—	—	mW	Kink free
			1.5	3.0	—		$I_F = I_{th} + 20$ mA
Fiber optical output power	HL1321BF/DL	P_f	1.2	—	—	mW	Kink free
			0.6	—	—		$I_F = I_{th} + 20$ mA
	HL1321DM		1.5	—	—		Kink free
			0.75	—	—		$I_F = I_{th} + 20$ mA
Monitor output	HL1321AC/ HLP5400	P_m	1.0	—	—	mW	$I_F = I_{th} + 20$ mA
Lasing Wave-length	HL1321AC/ HLP5400	λ_p	1270	1300	1330	nm	P_O = 3 mW
	HL1321BF/DL		1290	1310	1330		P_f = 0.5 mW
	HL1321DM		1290	1310	1330		P_f = 1.2 mW

Optical and Electrical Characteristics (T_C = 25°C) (cont.)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Spectral width at half power	HL1321AC/ HLP5400	$\Delta\lambda$	—	2	—	nm	P_O = 3 mW
	HL1321BF/DL		—	2	—		P_f = 0.5 mW
	HL1321DM		—	2	—		P_f = 1.2 mW
Beam divergence (parallel)	HL1321AC/ HLP5400	$\theta_{//}$	—	30	—	deg.	P_O = 3mW, FWHM
Beam divergence (perpendicular)		$\theta_{\perp}$	—	40	—	deg.	P_O = 3mW, FWHM
PD dark current	HL1321BF/DL/ DM	I_{DARK}	—	—	350	nA	$V_{R(PD)}$ = 5 V
Monitor current	HL1321BF/DL	I_S	50	—	—	μA	$V_{R(PD)}$ = 5 V, P_f = 0.5 mW
	HL1321DM		100	—	—		$V_{R(PD)}$ = 5 V, P_f = 1.2 mW
PD capacitance	HL1321BF/DL/	C_t	—	10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation bias voltage		$V_{R(S)}$	—	—	2	V	
Cooling capacity	HL1321BF/DL	ΔT	40	—	—	°C	P_f = 1.0 mW
Cooler current		I_C	—	—	1.4	A	ΔT = 40°C
Cooler voltage		V_C	—	—	1.8	V	ΔT = 40°C
Thermistor resistance		R_{TM}	—	10	—	kΩ	
Rise time		t_r	—	—	0.5	ns	
Fall time		t_f	—	—	0.5	ns	

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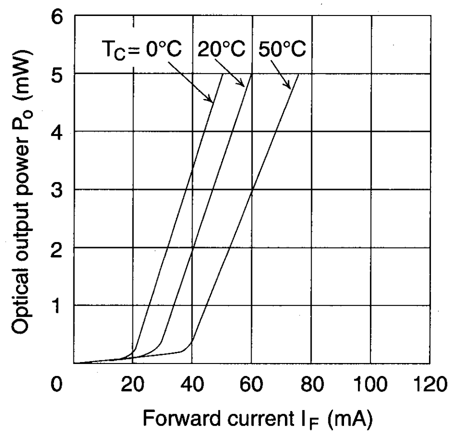
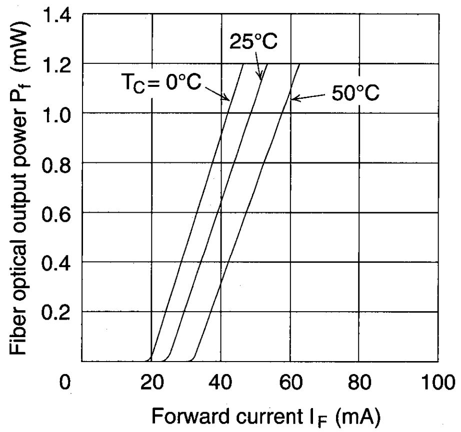
Typical Characteristic Curves

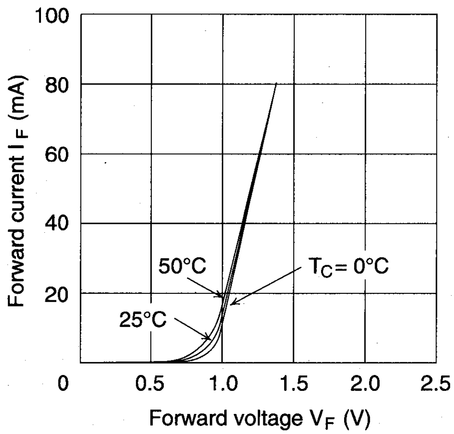
Optical Output Power vs. Forward Current (HL1321AC, HLP5400)



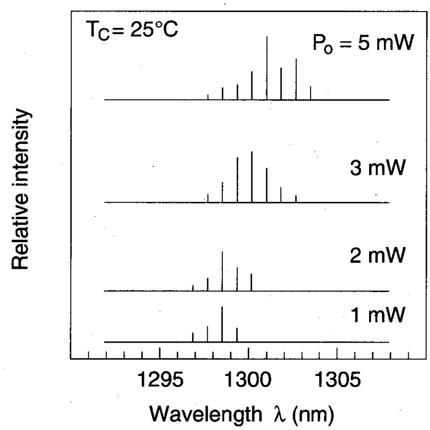
Optical Output Power vs. Forward Current (HL1321BF, DL, DM)



Forward Current vs. Forward Voltage

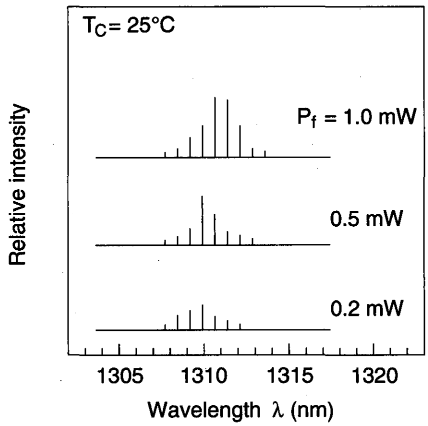


Lasing Wavelength (HL1321AC, HLP5400)

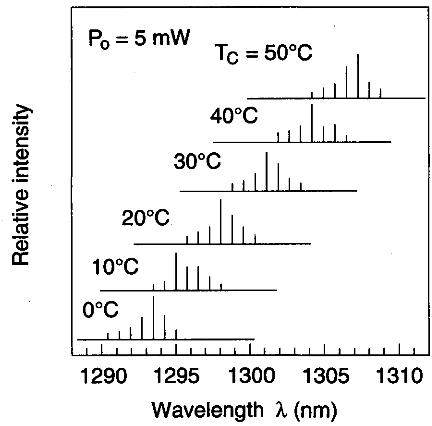


Typical Characteristic Curves (cont.)

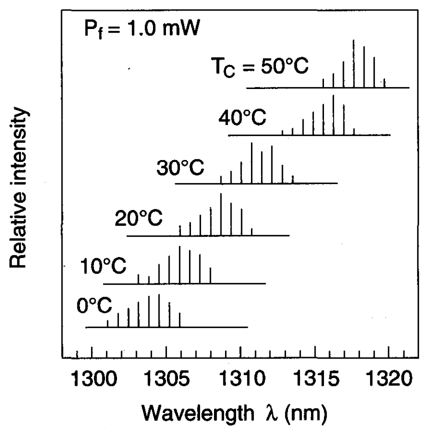
Lasing Wavelength (HL1321BF/DL/DM)



Lasing Wavelength Temperature Dependence (HL1321AC, HLP5400)



Lasing Wavelength Temperature Dependence (HL1321BF/DL/DM)



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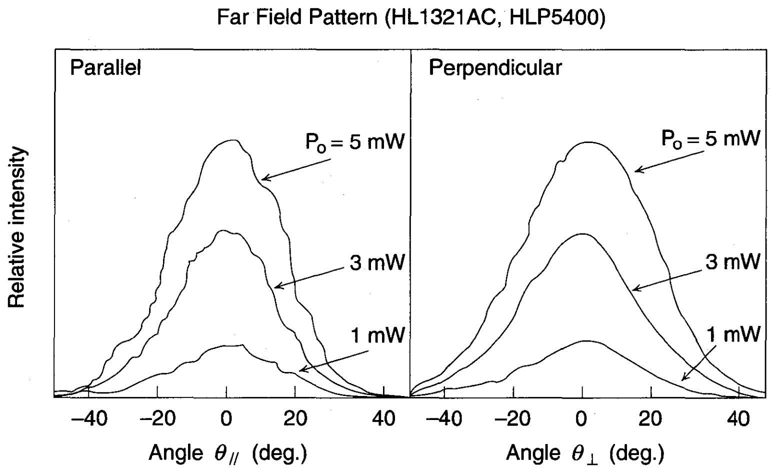
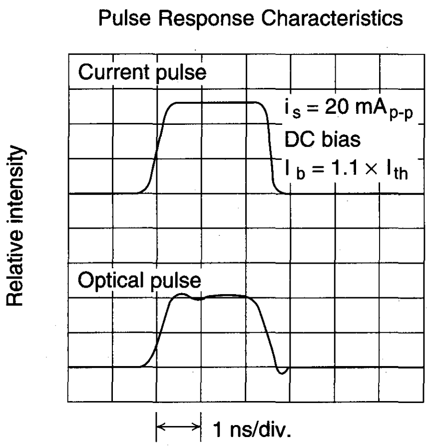
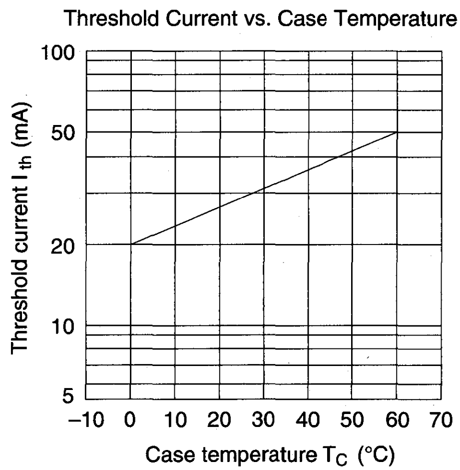
Typical Characteristic Curves (cont.)

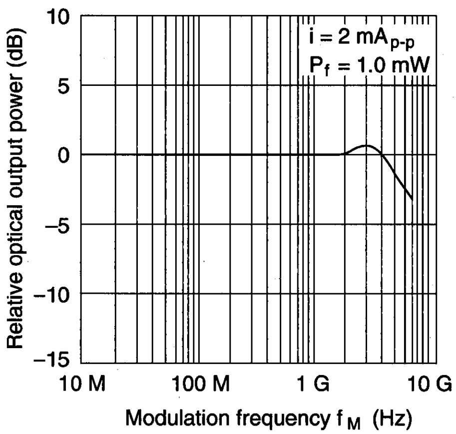




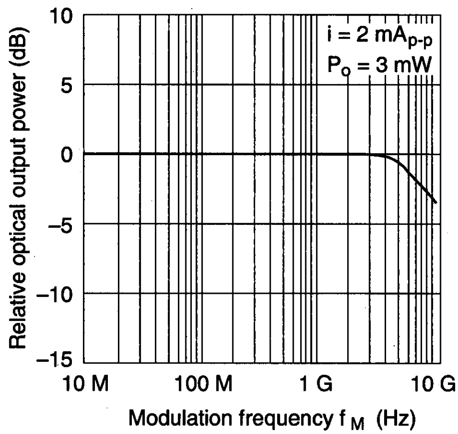


Typical Characteristic Curves (cont.)

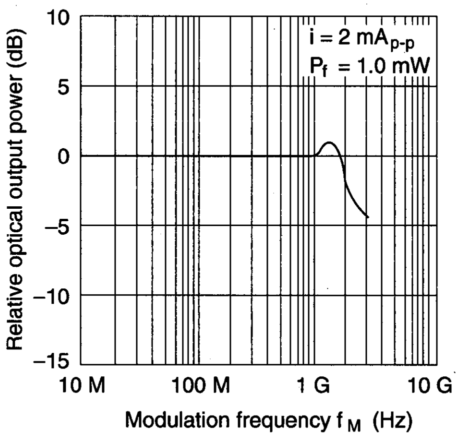
Frequency Response Characteristics
(LD) (HL1321BF)



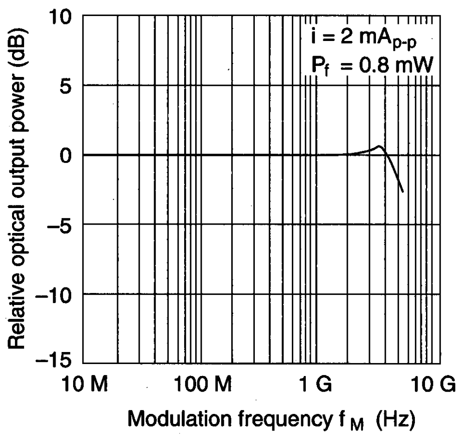
Frequency Response Characteristics
(LD) (HL1321AC, HLP5400)



Frequency Response Characteristics
(LD) (HL1321DL)



Frequency Response Characteristics
(LD) (HL1321DM)



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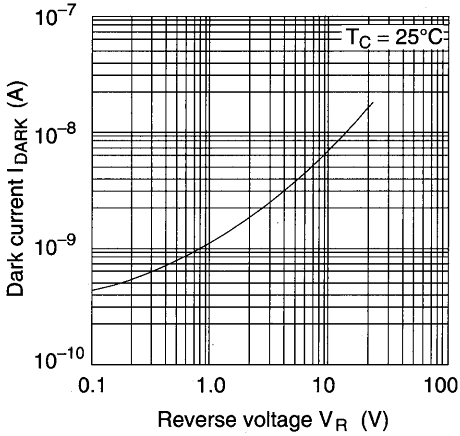
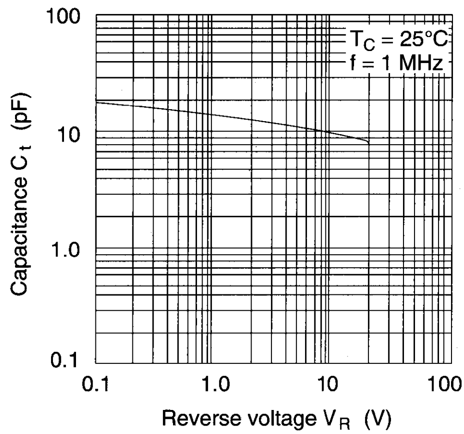
Typical Characteristic Curves (cont.)

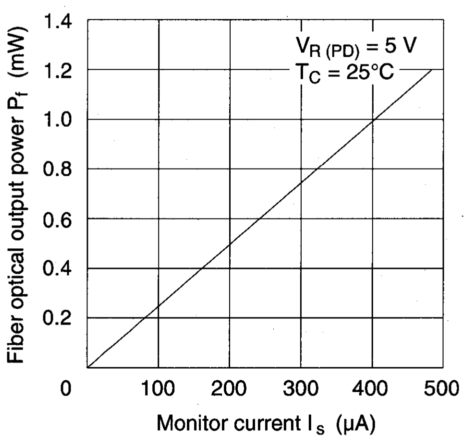
Dark Current vs. Reverse Voltage (HL1321BF/DL/DM)



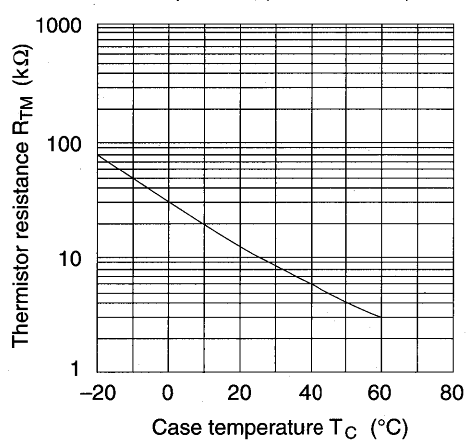
Capacitance vs. Reverse Voltage (PD) (HL1321BF/DL/DM)



Optical Output Power vs. Monitor Current (HL1321BF/DL)

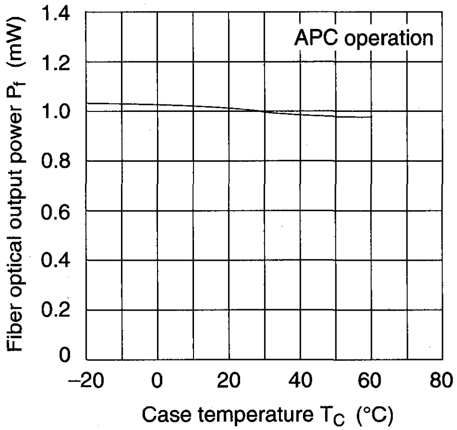


Thermistor Resistance vs. Case Temperature (HL1321BF/DL)



Typical Characteristic Curves (cont.)

Tracking Characteristics (HL1321BF/DL)



HL1322A/AC

InGaAsP LD

1

Description

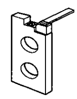
The HL1322A/AC are 1.3 μm band InGaAsP laser diodes with a double heterojunction structure. They are relatively high power output (10 mW) devices as compared to the HLP5400 or the HL1321AC. They are suitable as light sources for high capacity long distance optical fiber communication systems and various types of optical equipment.

Features

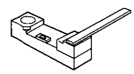
- Long wavelength output: λ_p = 1290 to 1330 nm
- 10 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leq 0.5$ ns

Package Type

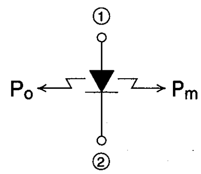
- HL1322A: A1



- HL1322AC: AC



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

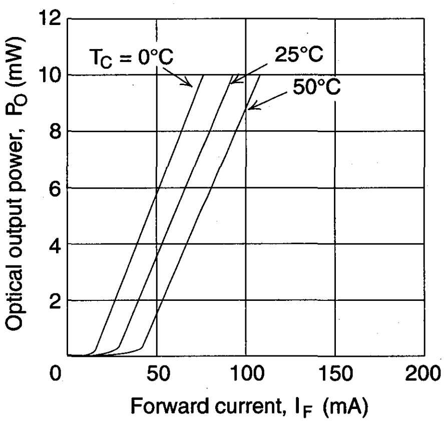
Item	Symbol	Rated Value	Unit
Optical output power	P_O	10	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

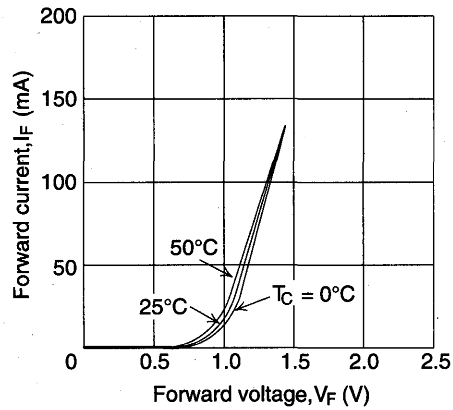
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	30	50	mA	
Optical output power	P_O	10	—	—	mW	Kink free
		4	—	—	mW	$I_F = I_{th} + 40$ mA
Monitor output	P_m	2	—	—	mW	$I_F = I_{th} + 40$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 6 mW
Spectral width	$\Delta\lambda$	—	2	—	nm	P_O = 6 mW
Beam divergence (parallel)	$\theta_{//}$	—	30	—	deg.	P_O = 6 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	—	40	—	deg.	P_O = 6 mW, FWHM
Rise time	t_r	—	—	0.5	ns	
Fall time	t_f	—	—	0.5	ns	

Typical Characteristic Curves

Optical Output Power vs. Forward Current



Forward Current vs. Forward Voltage



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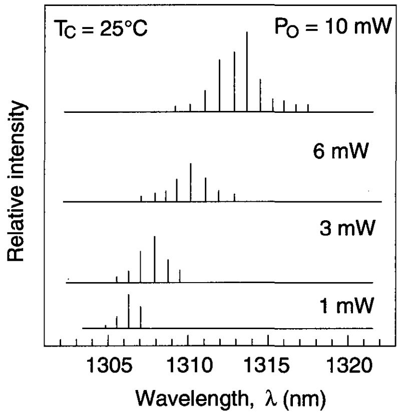
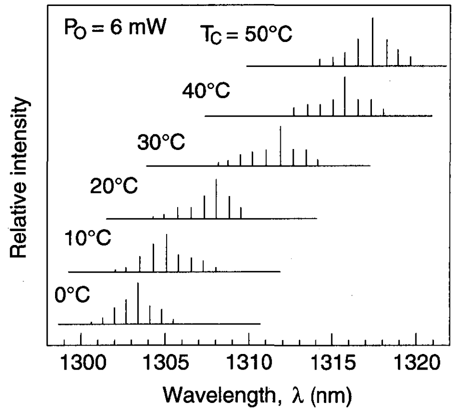
Typical Characteristic Curves (cont.)

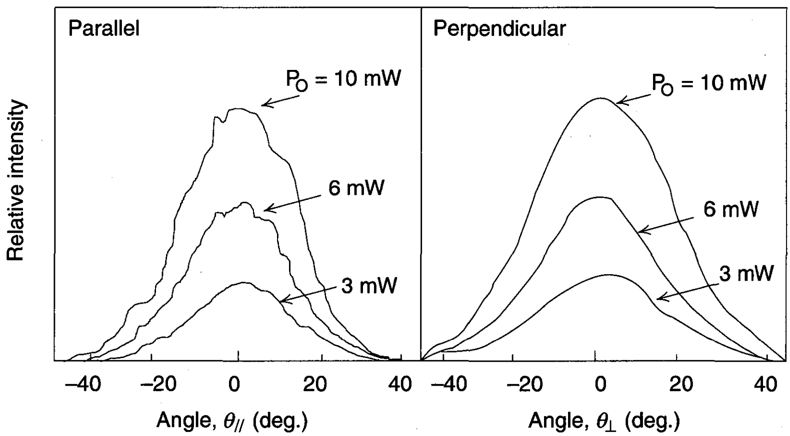
Lasing Spectrum



Lasing Spectrum Temperature Dependence

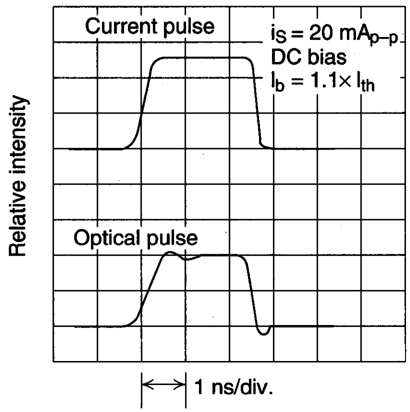


Far Field Pattern

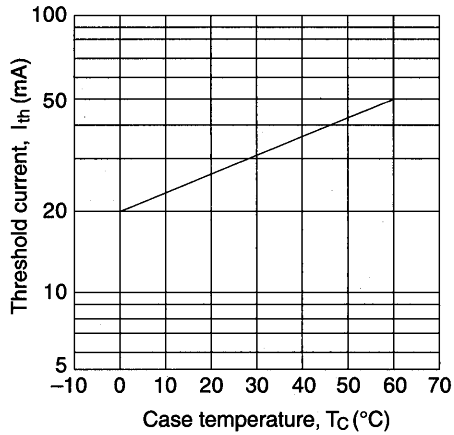


Typical Characteristic Curves (cont.)

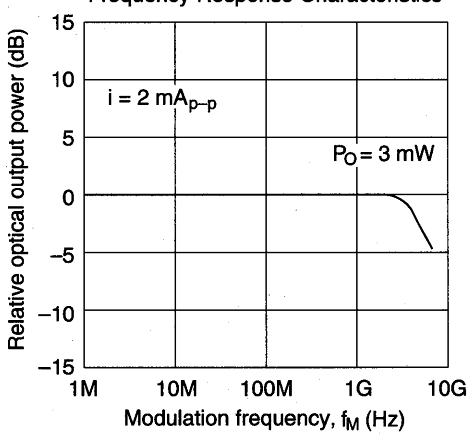
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response Characteristics



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Description

The HL1323DM is a 1.3 μm band InGaAsP laser diode with a double heterostructure. It is suitable as a light source for optical fiber communication systems, such as LAN, CATV, and LJN.

Features

- Long wavelength output: λ_p = 1260 to 1340 nm
- 0.3 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \le 0.5$ ns
- Built-in monitor photodiode
- Miniature, thinner package

Fiber Specifications

Mode field diameter: 10.0 ±1.0 μm
Cutoff wavelength: 1.10 to 1.20 μm
Core diameter: 10 μm
External diameter: 125 μm
Jacket diameter: 900 μm
Fiber length: More than 500 mm

1

Absolute Maximum Ratings (T_C = 25°C)

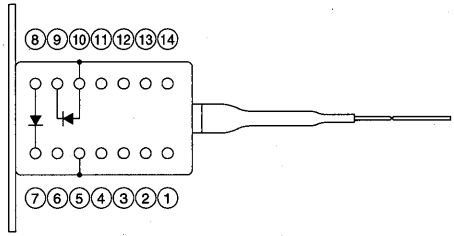
Item	Symbol	Rated Value	Unit
Optical output power	P_O	0.3	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	15	V
PD forward current	$I_{F\ (PD)}$	1	mA
Operating temperature	T_{opr}	0 to +65	°C
Storage temperature	T_{stg}	–20 to +70	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	30	50	mA	
Fiber optical output power	P_f	300	—	—	μW	Kink free
		140	—	—		$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1260	1300	1340	nm	P_f = 150 μW, CW
Spectral width	$\Delta\lambda$	—	2	—	nm	P_f = 150 μW, CW
Photodiode dark current	I_{DARK}	—	—	350	nA	$V_{R\ (PD)}$ = 5 V
Monitor current	I_S	100	—	—	μA	$V_{R\ (PD)}$ = 5 V, P_f = 150 μW
PD capacitance	C_t	—	10	20	pF	$V_{R\ (PD)}$ = 5V, f = 1 MHz
Rise time	t_r	—	—	0.5	ns	P_f = 150 μW, $I_{bias} = I_{th}$, 10 to 90 %
Fall time	t_f	—	—	0.5	ns	P_f = 150 μW, $I_{bias} = I_{th}$, 10 to 90 %

Pin Arrangement (Bottom View)

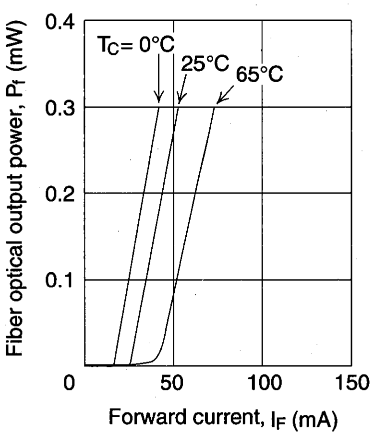
- HL1323DM

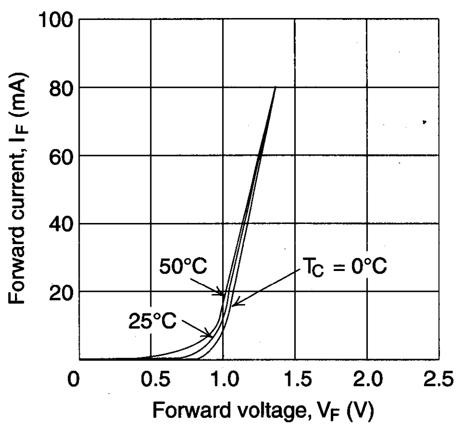


① N. C.
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ N. C.
⑫ N. C.
⑬ N. C.
⑭ N. C.

Package Type
- HL1323DM: DM

Typical Characteristic Curves





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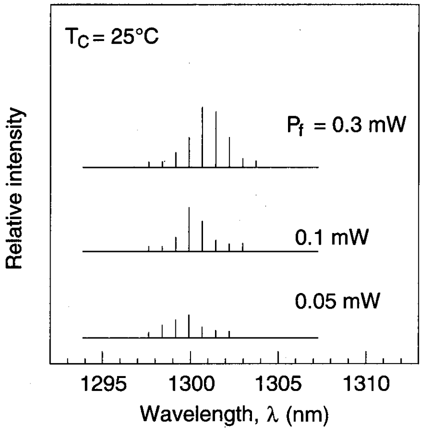
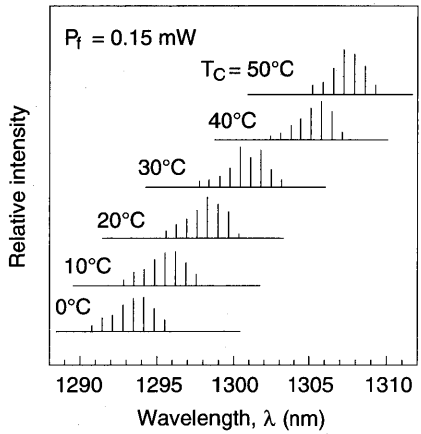
Typical Characteristic Curves (cont.)

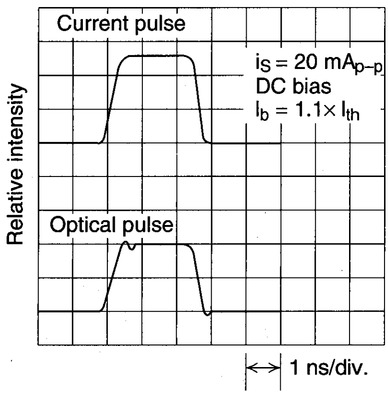
Lasing Spectrum



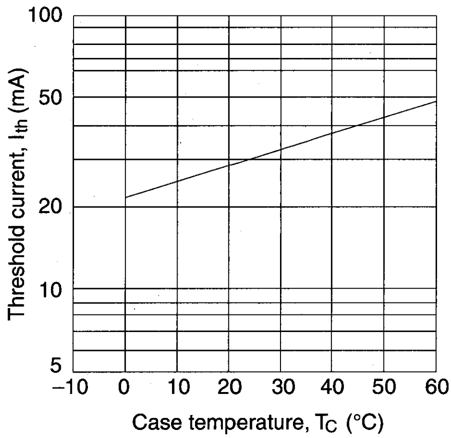
Lasing Spectrum Temperature Dependence



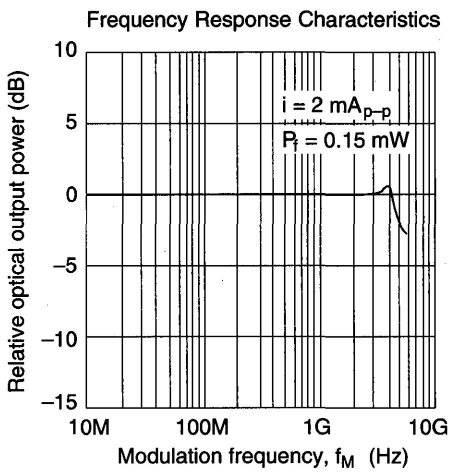
Pulse Response Characteristics

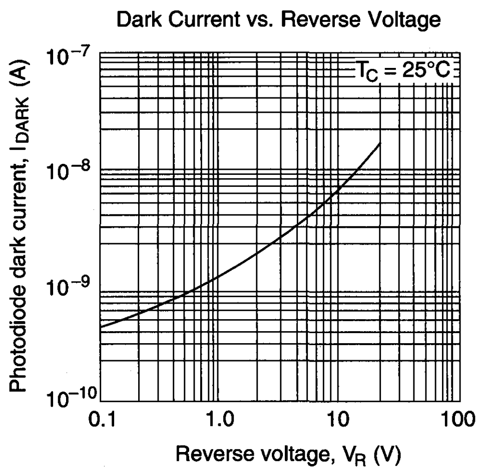


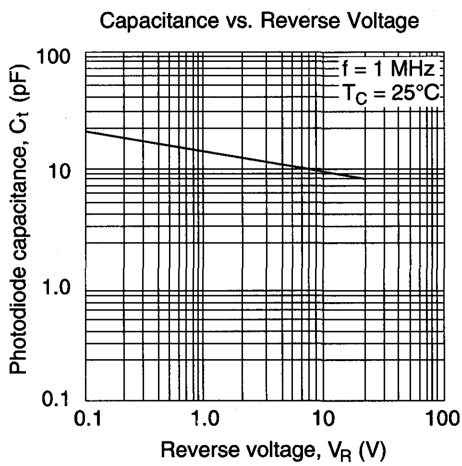
Threshold Current vs. Case Temperature

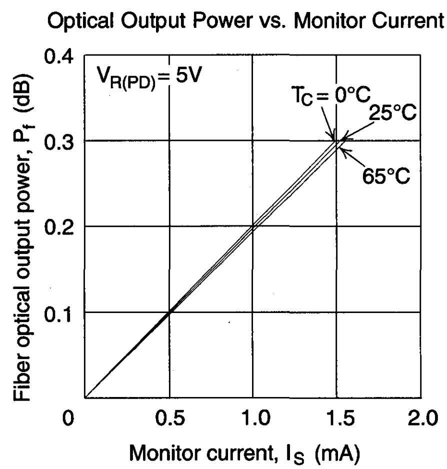


Typical Characteristic Curves (cont.)









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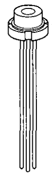
Description

The HL1326MF is a 1.3 µm InGaAsP Fabry-Perot laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for short and medium - range fiberoptic communication systems and other applied optical equipment. It has high optical power with low drive current and wide operating temperature range (–40 to +85°C). The compact package is suitable for module assembly.

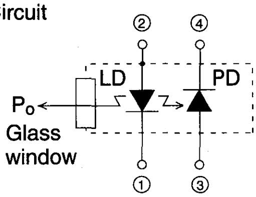
Features

- Wide operating temperature range: T_{opr} = –40 to +85°C
- High output power: 10 mW (Pulse)
  5 mW (CW)
- Low operating current:
  I_{op} (P_O = 5 mW) = 25 mA (Typ. @T_C = 25°C)
  I_{op} (P_O = 5 mW) = 45 mA (Typ. @T_C = 85°C)

Package Type
- HL1326MF: MF



Internal Circuit



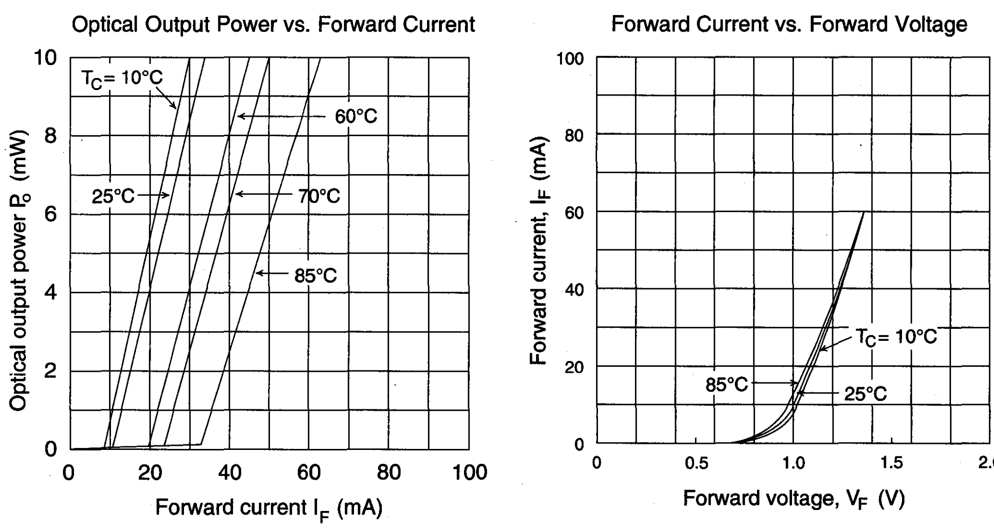
Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	10 (pulse)	mW
		5 (CW)	
LD reverse voltage	$V_{R\,(LD)}$	2	V
PD reverse voltage	$V_{R\,(PD)}$	15	V
PD forward current	$I_{F\,(PD)}$	1	mA
Operating temperature	T_{opr}	–40 to +85	°C
Storage temperature	T_{stg}	–40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	10	20	mA	
Optical output power	P_O	5	—	—	mW	Kink free
Slope efficiency	η	0.3	0.4	—	mW/mA	T_C = 25°C
		0.15	0.25	—		T_C = 85°C
Lasing wavelength	λ_c	1280	1310	1340	nm	P_O = 5 mW, RMS
Spectral width	σ	—	2	—	nm	P_O = 5 mW, RMS
Beam divergence (parallel)	$\theta_{//}$	—	30	—	deg.	P_O = 5 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	—	40	—	deg.	P_O = 5 mW, FWHM
Rise time	t_r	—	—	0.5	ns	10 to 90%
Fall time	t_f	—	—	0.5	ns	90 to 10%
Monitor current	I_S	100	—	—	μA	P_O = 5 mW, $V_{R\,(PD)}$ = 5 V
PD dark current	I_{DARK}	—	—	350	nA	$V_{R\,(PD)}$ = 5 V
PD capacitance	C_t	—	15	20	pF	$V_{R\,(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R\,(S)}$	—	—	2	V	

Typical Characteristic Curves



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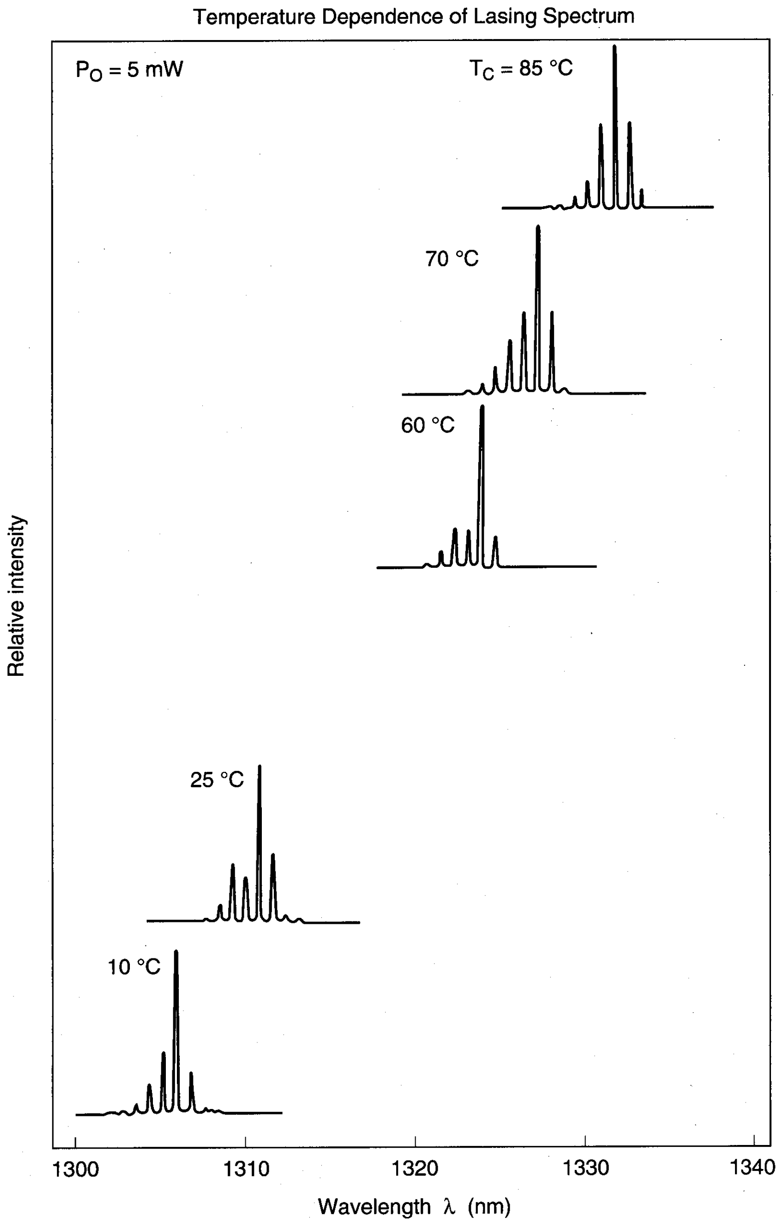
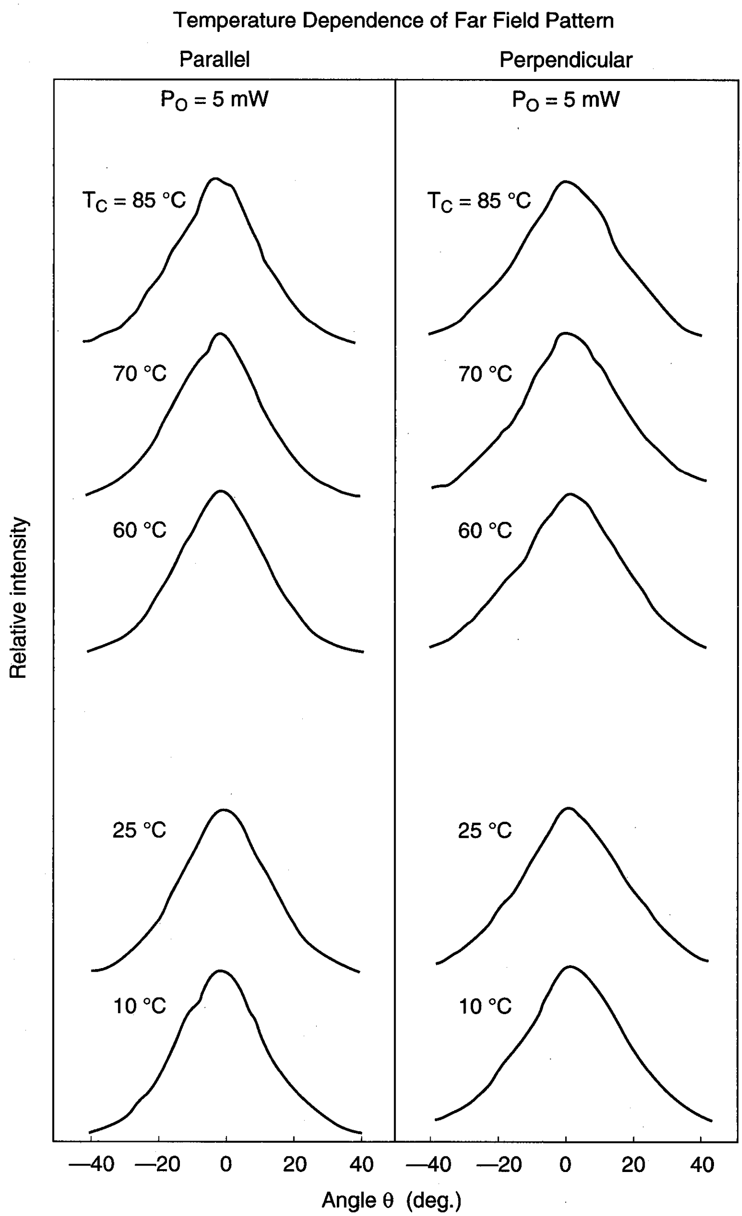
Typical Characteristic Curves (cont.)



Typical Characteristic Curves (cont.)



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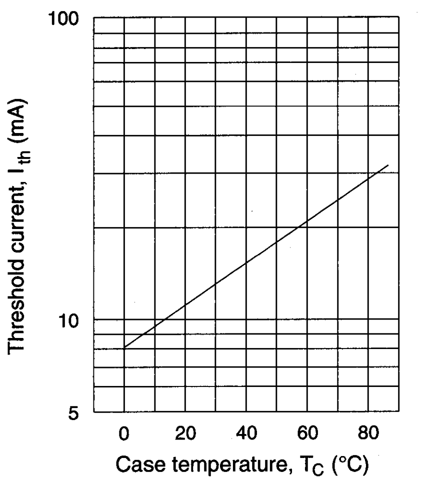
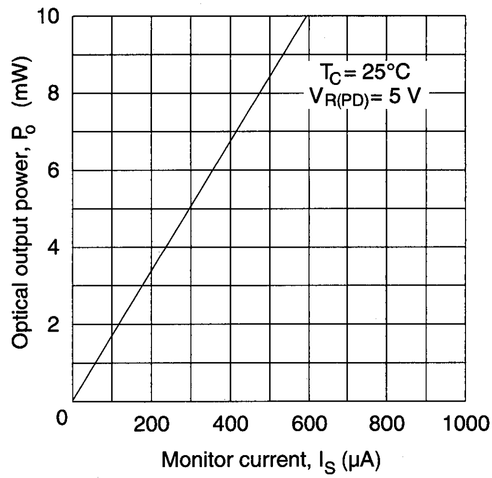
Typical Characteristic Curves (cont.)

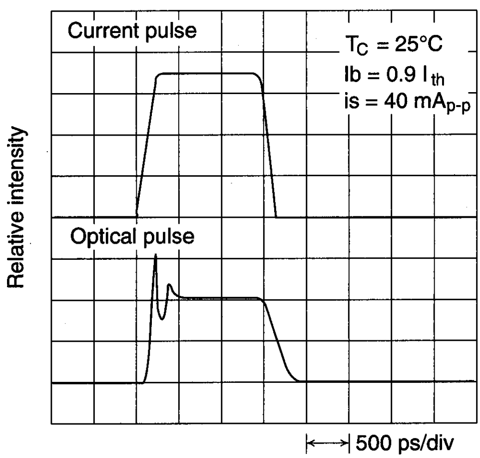
Threshold Current vs. Case Temperature



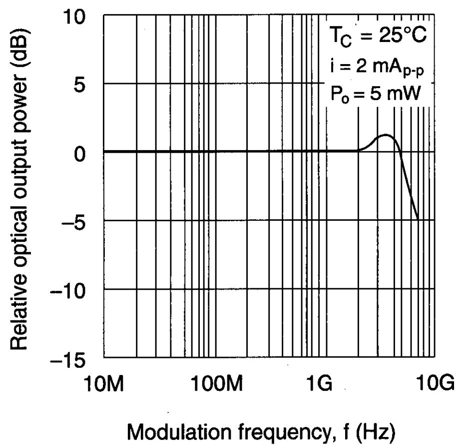
Optical Output Power vs. Monitor Current



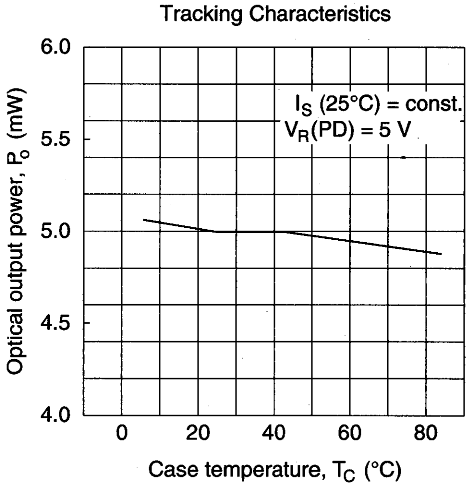
Pulse Response of Laser Diode

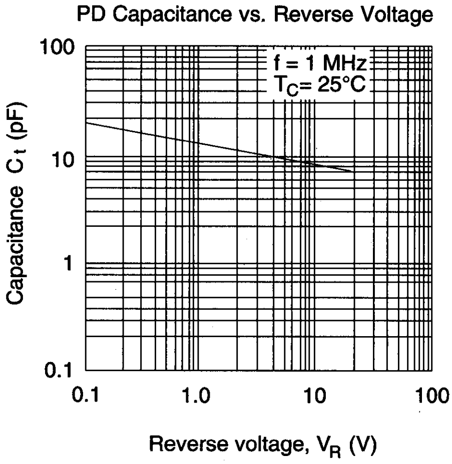


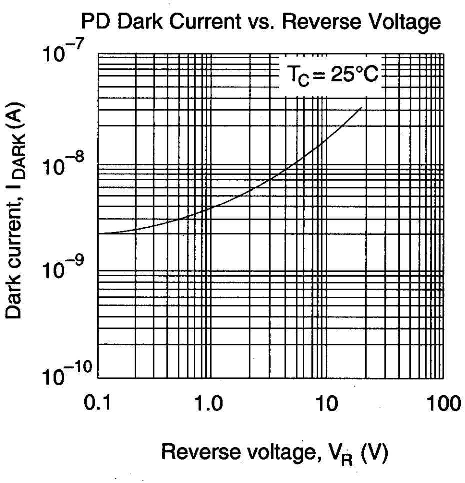
Frequency Response of Laser Diode



Typical Characteristic Curves (cont.)







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HL1326CF/CN (Preliminary) InGaAsP LD

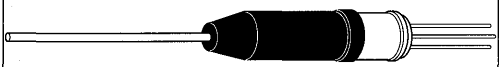
Description

The HL1326CF/CN are 1.3 µm InGaAsP Fabry-Perot laser diodes with a multi-quantum well (MQW) structure. They are suitable as light sources for short and medium - range fiberoptic communication systems. Laser output is delivered from the coaxial package through an attached single mode fiber. A built-in photodiode provides monitor current output.

Features

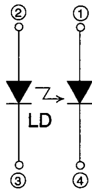
- Wide operating temperature range: T_{opr} = –40 to +85°C
- High output power: 3 mW (Pulse)
  2 mW (CW)
- Low operating current:
  I_{op} (P_f = 1.5 mW) = 25 mA (Typ. @T_C = 25°C)
  I_{op} (P_f = 1.5 mW) = 45 mA (Typ. @T_C = 85°C)

Package Type
HL1326CF: CF
HL1326CN: CN

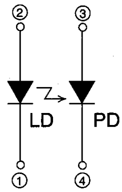


Internal Circuit

• CF



• CN



Fiber Specifications

Mode field diameter: 10.0 ±1.0 µm
Cutoff wavelength: 1.10 to 1.20 µm
Core diameter: 10 µm
External diameter: 125 µm
Jacket diameter: 900 µm
Fiber length: More than 500 mm

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Fiber optical output power	P_f	3 (pulse)	mW
		2 (CW)	
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	15	V
PD forward current	$I_{F\ (PD)}$	1	mA
Operating temperature	T_{opr}	–40 to +85	°C
Storage temperature	T_{stg}	–40 to +85	°C

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

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	10	20	mA	
Fiber optical output power	P_f	2	—	—	mW	Kink free
Slope efficiency	η	0.08	0.2	—	mW/mA	$T_C = 25°C$
		0.04	0.12	—		$T_C = 85°C$
Lasing wavelength	λ_c	1280	1310	1340	nm	$P_f = 1.5$ mW, RMS
Spectral width	σ	—	2	—	nm	$P_f = 1.5$ mW, RMS
Rise time	t_r	—	—	0.5	ns	10 to 90%
Fall time	t_f	—	—	0.5	ns	90 to 10%
Monitor current	I_S	100	—	—	μA	$P_f = 1.5$ mW, $V_{R\ (PD)} = 5$ V
PD dark current	I_{DARK}	—	—	350	nA	$V_{R\ (PD)} = 5$ V
PD capacitance	C_t	—	15	20	pF	$V_{R\ (PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R\ (S)}$	—	—	2	V	

HL1327CF/CN (Preliminary) InGaAsP LD

Description

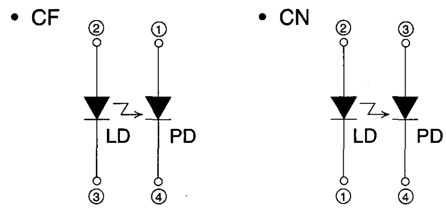
The HL1327CF/CN are 1.3 µm InGaAsP Fabry-Perot laser diodes with a multi-quantum well (MQW) structure. They are suitable as light sources for short and medium - range fiberoptic communication systems. Laser output is delivered from the coaxial package through an attached single mode fiber. A built-in photodiode provides monitor current output.

Features

- Wide operating temperature range: T_{opr} = –40 to +85°C
- High output power: 0.6 mW (Pulse)
  0.4 mW (CW)
- Low operating current:
  I_{op} (P_f = 0.3 mW) = 25 mA (Typ. @T_C = 25°C)
  I_{op} (P_f = 0.3 mW) = 45 mA (Typ. @T_C = 85°C)

Package Type
HL1327CF: CF
HL1327CN: CN

Internal Circuit



Fiber Specifications

Mode field diameter: 10.0 ±1.0 µm
Cutoff wavelength: 1.10 to 1.20 µm
Core diameter: 10 µm
External diameter: 125 µm
Jacket diameter: 900 µm
Fiber length: More than 500 mm

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Fiber optical output power	P_f	0.6 (pulse)	mW
		0.4 (CW)	
LD reverse voltage	$V_{R\,(LD)}$	2	V
PD reverse voltage	$V_{R\,(PD)}$	15	V
PD forward current	$I_{F\,(PD)}$	1	mA
Operating temperature	T_{opr}	–40 to +85	°C
Storage temperature	T_{stg}	–40 to +85	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	10	20	mA	
Fiber optical output power	P_f	0.4	—	—	mW	Kink free
Slope efficiency	η	0.01	0.025	—	mW/mA	T_C = 25°C
		0.005	0.015	—		T_C = 85°C
Lasing wavelength	λ_c	1280	1310	1340	nm	P_f = 0.3 mW, RMS
Spectral width	σ	—	2	—	nm	P_f = 0.3 mW, RMS
Rise time	t_r	—	—	0.5	ns	10 to 90%
Fall time	t_f	—	—	0.5	ns	90 to 10%
Monitor current	I_S	100	—	—	μA	P_f = 0.3 mW, $V_{R\ (PD)}$ = 5 V
PD dark current	I_{DARK}	—	—	350	nA	$V_{R\ (PD)}$ = 5 V
PD capacitance	C_t	—	15	20	pF	$V_{R\ (PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R\ (S)}$	—	—	2	V	

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HL1341A/AC/MF/BF/DL — InGaAsP LD

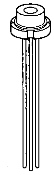
Description

The HL1341A/AC/MF/BF/DL are 1.3 μm InGaAsP distributed feedback (DFB) laser diodes with a double heterostructure. They are suitable as light sources for high-bit-rate long distance optical fiber communication systems and various other types of optical equipment.

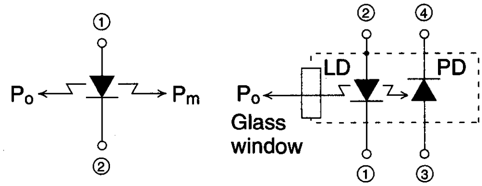
Features

- Long wavelength oscillation:
  λ_p = 1290 to 1330 nm
- Room temperature 5 mW CW operation (A/AC/MF)
- High output:
  P_f = 1.0 mW (CW, pulse operation) (BF/DL)
- Dynamic single mode to side mode ratio Sr = 35 dB (typ)
- Built-in monitor photo diode (MF/BF/DL)
- High speed pulse response:
  t_r, $t_f \leq$ 0.5 ns (A/AC/MF)

Package Type
- HL1341A: A1
- HL1341AC: AC
- HL1341MF: MF



Internal Circuit



Fiber Specifications (BF, DL only)

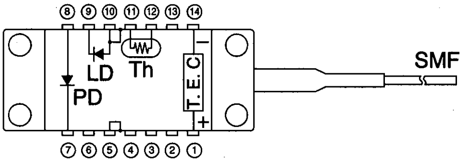
Mode field diameter: 10.0 ± 1.0 μm
Cutoff wavelength: 1.10 to 1.20 μm
Core diameter: 10 μm
External diameter: 125 μm
Jacket diameter: 900 μm
Fiber length: More than 500 mm

Absolute Maximum Ratings (T_C = 25°C)

Item		Symbol	Rated Value	Unit
Optical output power	HL1341A/AC/MF	P_O	5	mW
Fiber optical output power	HL1341BF/DL	P_f	1.0	mW
LD reverse voltage		$V_{R\ (LD)}$	2	V
PD reverse voltage	HL1341MF/BF/DL	$V_{R\ (PD)}$	15	V
PD forward current		$I_{F\ (PD)}$	1	mA
Cooler current	HL1341BF/DL	I_C	1.4	A
Operating temperature		T_{opr}	0 to +60	°C
Storage temperature	HL1341A/AC	T_{stg}	0 to +80	°C
	HL1341MF		–40 to +80	
	HL1341BF/DL		–40 to +70	

Pin Connections (Bottom view)

- HL1341BF

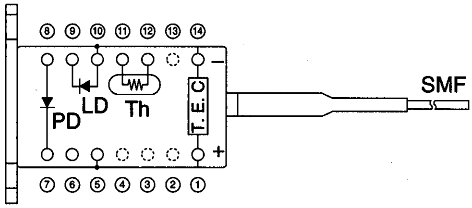


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
- HL1341BF: BF

- HL1341DL



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

Package Type
- HL1341DL: DL

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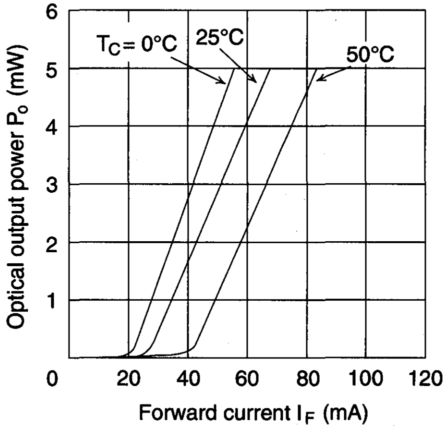
Optical and Electrical Characteristics (T_C = 25°C)

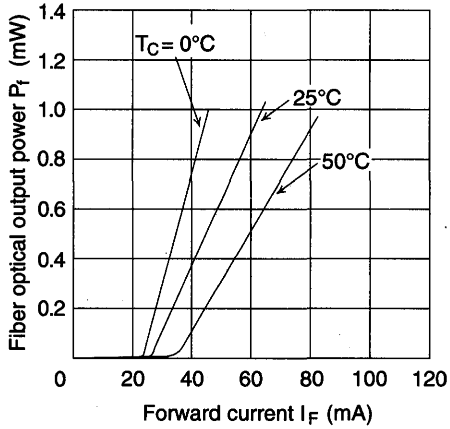
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current		I_{th}	—	25	50	mA	
Optical output power	HL1341A/AC/MF	P_O	5	—	—	mW	Kink free
			2.5	—	—		$I_F = I_{th}$ + 20 mA
Fiber optical output power	HL1341BF/DL	P_f	1	—	—	mW	Kink free
			0.5	—	—		$I_F = I_{th}$ + 20 mA
Monitor output	HL1341A/AC	P_m	1	—	—	mW	$I_F = I_{th}$ + 20 mA
Lasing Wave-length	HL1341A/AC/MF	λ_p	1290	1310	1330	nm	P_O = 3 mW
	HL1341BF/DL		1290	1310	1330		P_f = 0.5 mW
Side mode sup-pression ratio	HL1341A/AC/MF	S_r	30	35	—	dB	P_O = 3 mW
	HL1341BF/DL		30	35	—		P_f = 0.5 mW
Beam divergence (parallel)	HL1341A/AC/MF	$\theta_{//}$	—	30	—	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	HL1341A/AC/MF	$\theta_{\perp}$	—	40	—	deg.	P_O = 3 mW, FWHM
Rise time		t_r	—	—	0.5	ns	$I_{bias} = I_{th}$ 10 to 90 %
Fall time		t_f	—	—	0.5	ns	$I_{bias} = I_{th}$ 90 to 10 %
PD dark current	HL1341MF/BF/DL	I_{DARK}	—	—	350	nA	$V_{R\,(PD)}$ = 5 V
Monitor current	HL1341MF	I_S	50	—	—	μA	$V_{R\,(PD)}$ = 5 V, P_O = 3 mW
	HL1341BF/DL		50	—	—		$V_{R\,(PD)}$ = 5 V, P_f = 0.5 mW
PD capacitance	HL1341MF/BF/DL	C_t	—	10	20	pF	$V_{R\,(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation bias voltage	HL1341MF/BF/DL	$V_{R\,(S)}$	—	—	2	V	
Cooling capacity	HL1341BF/DL	ΔT	40	—	—	°C	P_f = 0.5 mW, T_C = 60°C
Cooler current		I_C	—	—	1.4	A	ΔT = 40°C
Cooler voltage		V_C	—	—	1.8	V	ΔT = 40°C
Thermistor resistance		R_{TM}	—	10	—	kΩ	

Typical Characteristic Curves

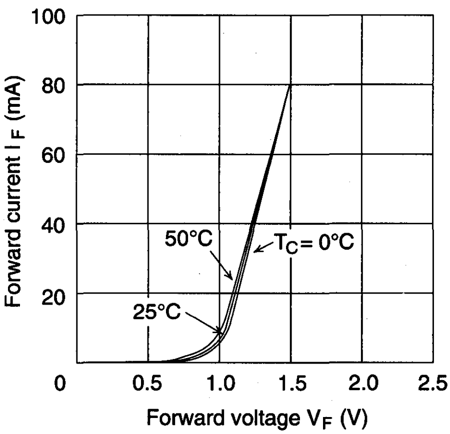
Optical Output Power vs. Forward Current
(HL1341A, AC, MF)



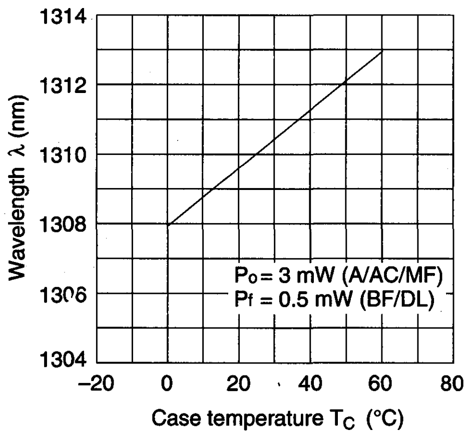
Optical Output Power vs. Forward Current
(HL1341BF, DL)



Forward Current vs. Forward Voltage



Lasing Wavelength Temperature Dependence



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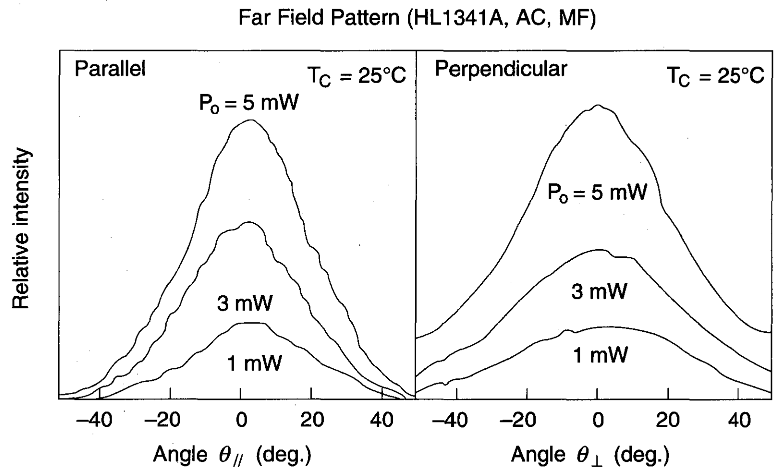
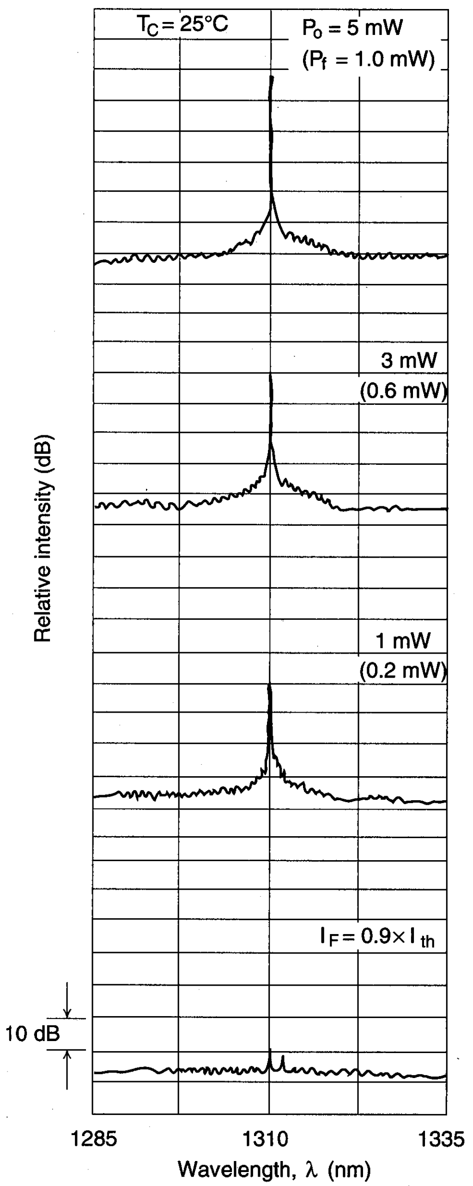
Typical Characteristic Curves (cont.)

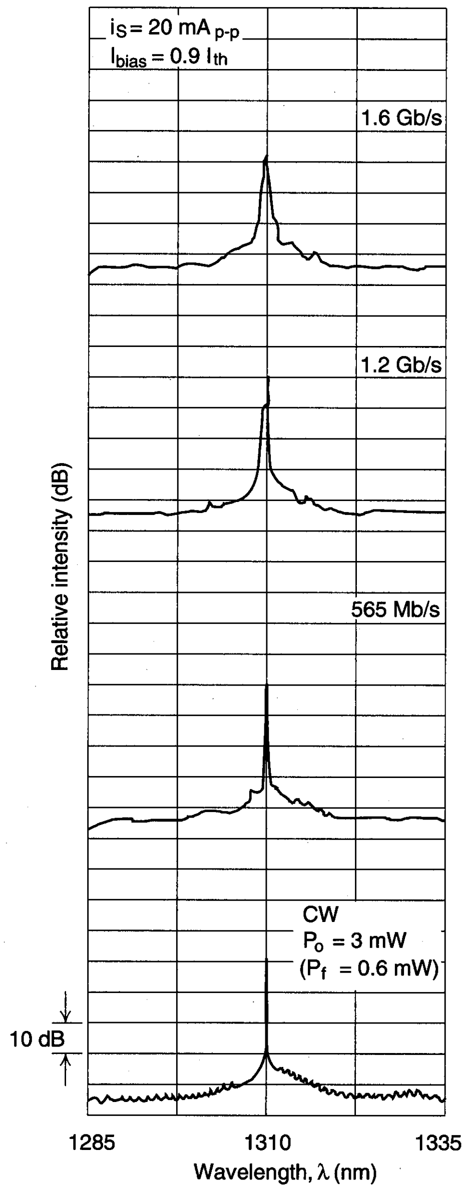


Typical Characteristic Curves (cont.)

Output Power Dependence of Lasing Spectrum (HL1341BF/DL)

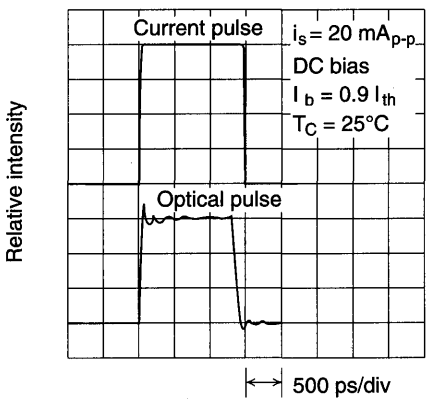


Frequency Dependence of Lasing Spectrum (HL1341BF/DL)

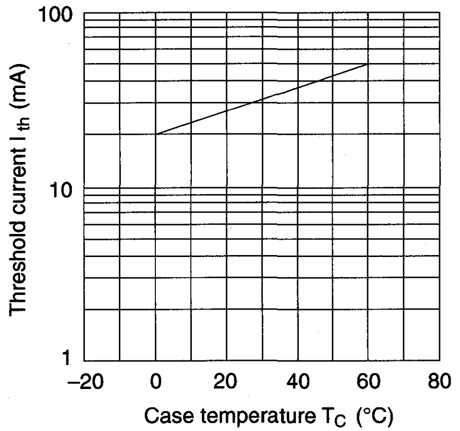


Typical Characteristic Curves (cont.)

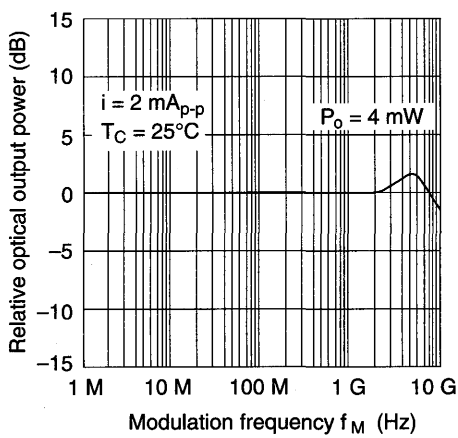
Pulse Response Characteristics (LD)



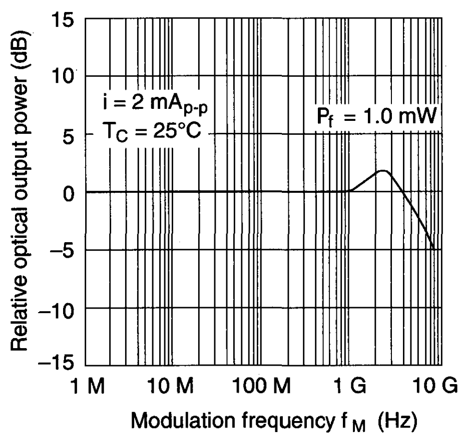
Threshold Current vs. Case Temperature



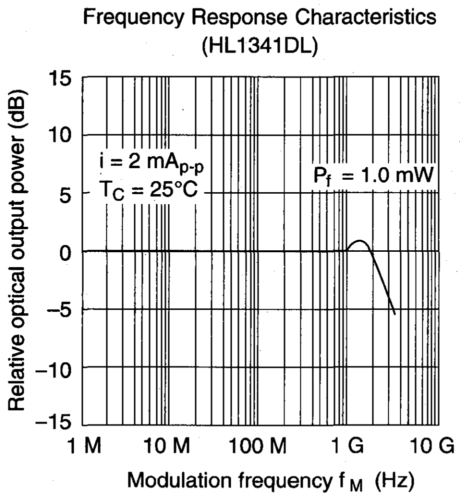
Frequency Response Characteristics
(HL1341A, AC, MF)

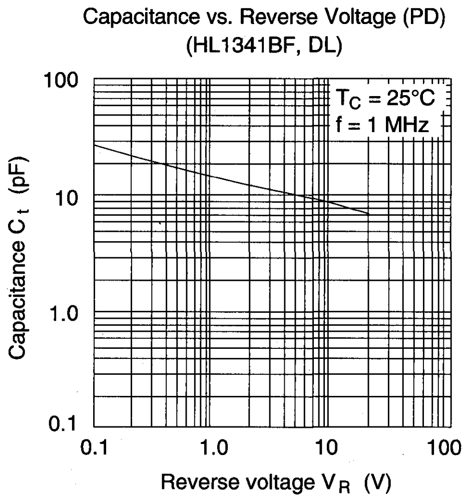


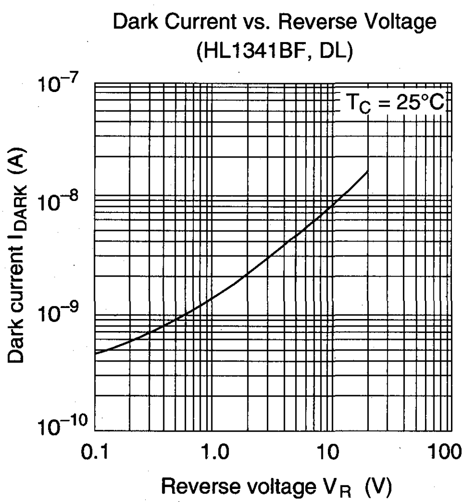
Frequency Response Characteristics
(HL1341BF)

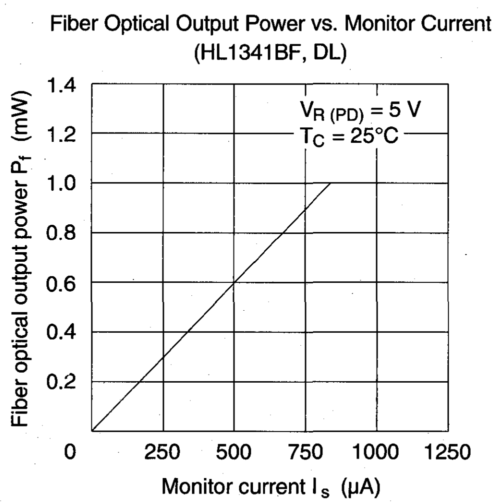


Typical Characteristic Curves (cont.)









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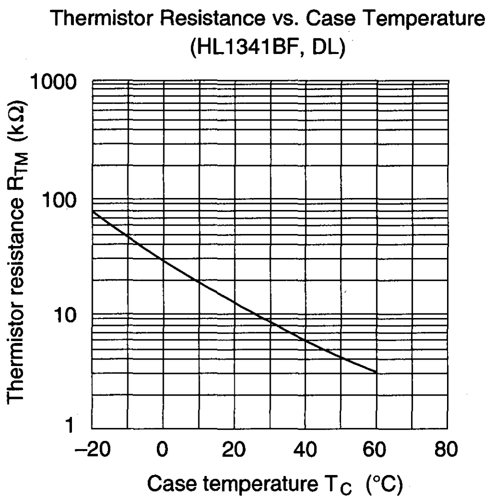
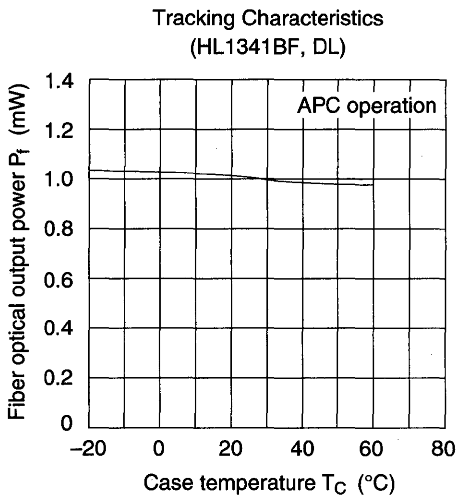
Typical Characteristic Curves (cont.)





HL1352MF (Preliminary) InGaAsP LD

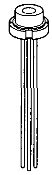
Description

The HL1352MF is a 1.3 μm InGaAsP distributed-feedback laser diode (DFB LD) with a multi-quantum well (MQW) structure. It is suitable as a light source for short and medium - range fiberoptic communication systems and other applied optical equipment. It has high optical power with low drive current and wide operating temperature range (–20 to +85°C). The compact package is suitable for module assembly.

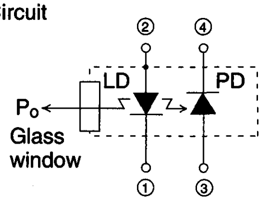
Features

- Wide operating temperature range: T_{opr} = –20 to +85°C
- High output power: 10 mW (Pulse)
  5 mW (CW)
- Low operating current:
  I_{op} (P_O = 5 mW) = 30 mA (Typ. @T_C = 25°C)
  I_{op} (P_O = 5 mW) = 80 mA (Typ. @T_C = 85°C)

Package Type
- HL1352MF: MF



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Optical output power	P_O	10 (pulse)	mW
		5 (CW)	
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	15	V
PD forward current	$I_{F\ (PD)}$	1	mA
Operating temperature	T_{opr}	–20 to +85	°C
Storage temperature	T_{stg}	–40 to +100	°C

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Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	15	30	mA	
Optical output power	P_O	5	—	—	mW	Kink free
Slope efficiency	η	0.25	0.35	—	mW/mA	T_C = 25°C
		0.10	0.15	—		T_C = 85°C
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 5 mW
Side-mode suppression ratio	S_r	30	38	—	nm	P_O = 5 mW
Beam divergence (parallel)	$\theta_{//}$	—	30	—	deg.	P_O = 5 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	—	40	—	deg.	P_O = 5 mW, FWHM
Rise time	t_r	—	—	0.5	ns	10 to 90%
Fall time	t_f	—	—	0.5	ns	90 to 10%
Monitor current	I_S	100	—	—	μA	P_O = 5 mW, $V_{R\,(PD)}$ = 5 V
PD dark current	I_{DARK}	—	—	350	nA	$V_{R\,(PD)}$ = 5 V
PD capacitance	C_t	—	15	20	pF	$V_{R\,(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R\,(S)}$	—	—	2	V	

HL1352CF/CN (Preliminary) — InGaAsP LD

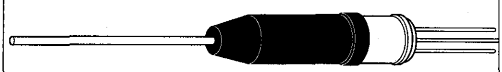
Description

The HL1352CF/CN are 1.3 μm InGaAsP DFB laser diodes with a multi-quantum well (MQW) structure. They are suitable as light sources for short and medium - range fiberoptic communication systems. Laser output is delivered from the coaxial package through an attached single mode fiber. A built-in photodiode provides monitor current output.

Features

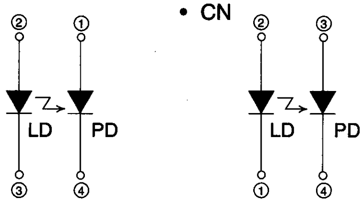
- Wide operating temperature range: T_{opr} = –20 to +85°C
- High output power: 3 mW (Pulse)
  2 mW (CW)
- Low operating current:
  I_{op} (P_f = 1.5 mW) = 30 mA (Typ. @T_C = 25°C)
  I_{op} (P_f = 1.5 mW) = 80 mA (Typ. @T_C = 85°C)

Package Type
HL1352CF: CF
HL1352CN: CN



Internal Circuit

• CF • CN



Fiber Specifications

Mode field diameter: 10.0 ±1.0 μm
Cutoff wavelength: 1.10 to 1.20 μm
Core diameter: 10 μm
External diameter: 125 μm
Jacket diameter: 900 μm
Fiber length: More than 500 mm

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Unit
Fiber optical output power	P_f	3 (pulse)	mW
		2 (CW)	
LD reverse voltage	$V_{R (LD)}$	2	V
PD reverse voltage	$V_{R (PD)}$	15	V
PD forward current	$I_{F (PD)}$	1	mA
Operating temperature	T_{opr}	–20 to +85	°C
Storage temperature	T_{stg}	–40 to +85	°C

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Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	15	30	mA	
Fiber optical output power	P_f	2	—	—	mW	Kink free
Slope efficiency	η	0.08	0.17	—	mW/mA	T_C = 25°C
		0.04	0.7	—		T_C = 85°C
Lasing wavelength	λ_p	1290	1310	1330	nm	P_f = 1.5 mW
Side-mode suppression ratio	S_r	30	—	—	nm	P_f = 1.5 mW
Rise time	t_r	—	—	0.5	ns	10 to 90%
Fall time	t_f	—	—	0.5	ns	90 to 10%
Monitor current	I_S	100	—	—	µA	P_f = 1.5 mW, $V_{R\ (PD)}$ = 5 V
PD dark current	I_{DARK}	—	—	350	nA	$V_{R\ (PD)}$ = 5 V
PD capacitance	C_t	—	15	20	pF	$V_{R\ (PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R\ (S)}$	—	—	2	V	

HL1362A/AC — InGaAsP LD

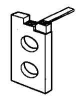
Description

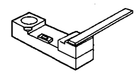
The HL1362A/AC are 1.3 µm InGaAsP λ/4 phase-shifted distributed-feedback laser diodes (DFB-LD) with a low capacitance structure. They are suitable as light sources for high-bit-rate, long-haul fiberoptic communication systems and other applied optical equipment. The compact package is suitable for module assembly.

Features

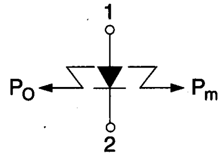
- Long wavelength output: 1290 to 1330 nm
- High-power output: 12 mW
- High quantum efficiency: $\eta_s \geq 0.2$ mW/mA
- Fast pulse response: t_r and $t_f \leq 0.2$ ns
- Dynamic single longitudinal mode: $S_r = 40$ dB Typ.
- High frequency response: $f_r = 10$ GHz Typ.

Package Type
- HL1362A: A1
- HL1362AC: AC





Internal Circuit



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

Item	Symbol	Rated Value	Unit
Optical output power	P_O	12	mW
LD reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

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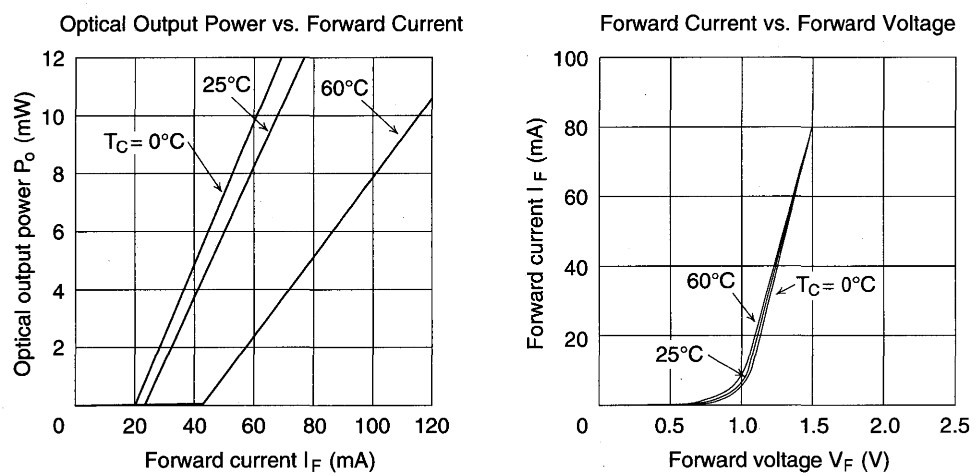
Optical and Electrical Characteristics (T_C = 25°C)

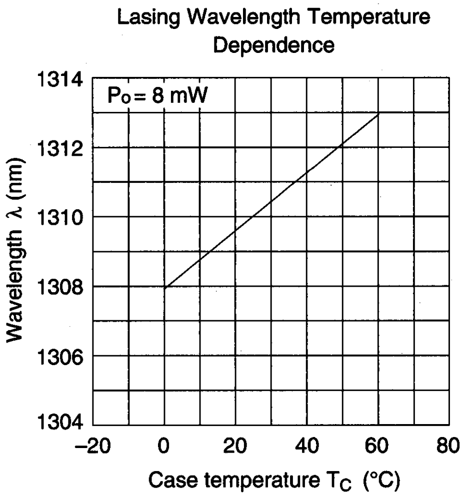
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	25	50	mA	
Optical ouput power	P_O	12	—	—	mW	Kink free
Monitor optical output power	P_m	2	—	—	mW	P_O = 8 mW
Slope efficiency	η	0.2	—	—	mW/mA	
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 8 mW
Side-mode suppression ratio	S_r	30	40	—	dB	2.4 Gb/s
Beam divergence (parallel)	$\theta_{//}$	—	30	—	deg.	P_O = 8 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	—	40	—	deg.	P_O = 8 mW, FWHM
Rise time	t_r	—	0.1	—	ns	P_O = 3 mW, I_{bias} = I_{th}, 10 to 90%
Fall time	t_f	—	0.15	—	ns	P_O = 3 mW, I_{bias} = I_{th}, 90 to 10%

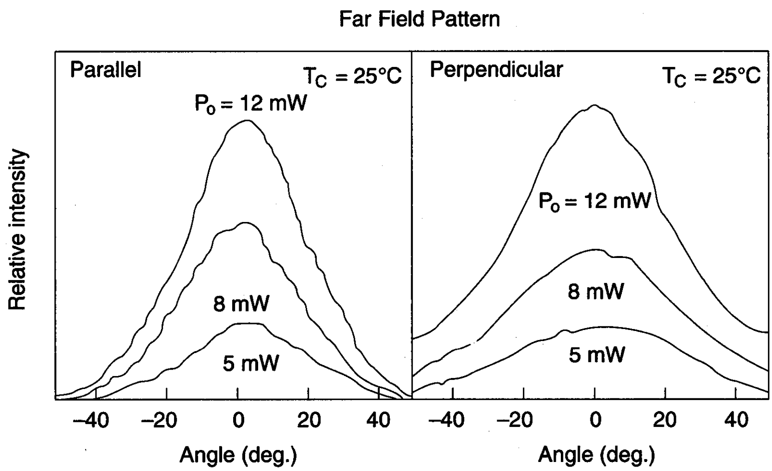
1

Typical Characteristic Curves



Typical Characteristic Curves (cont.)





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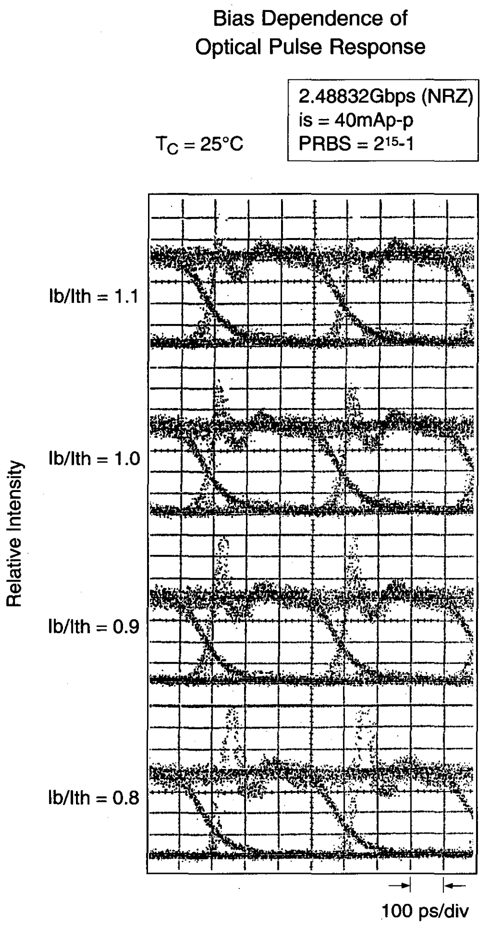
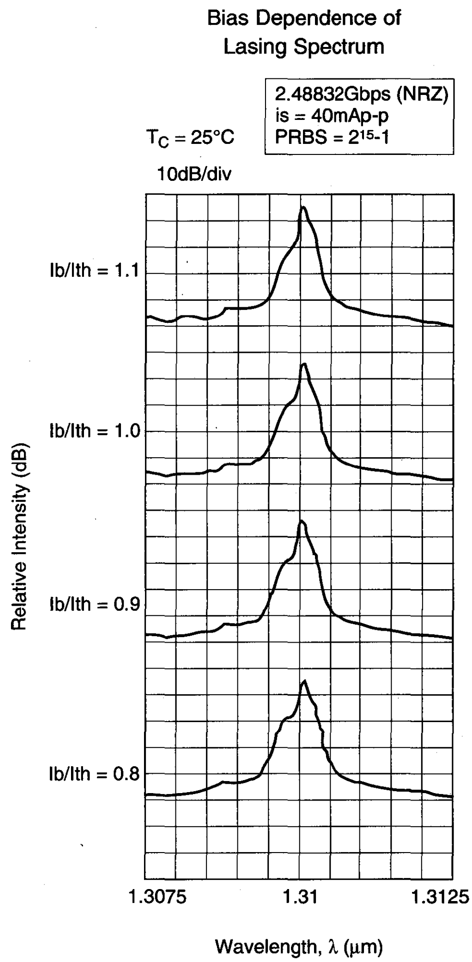
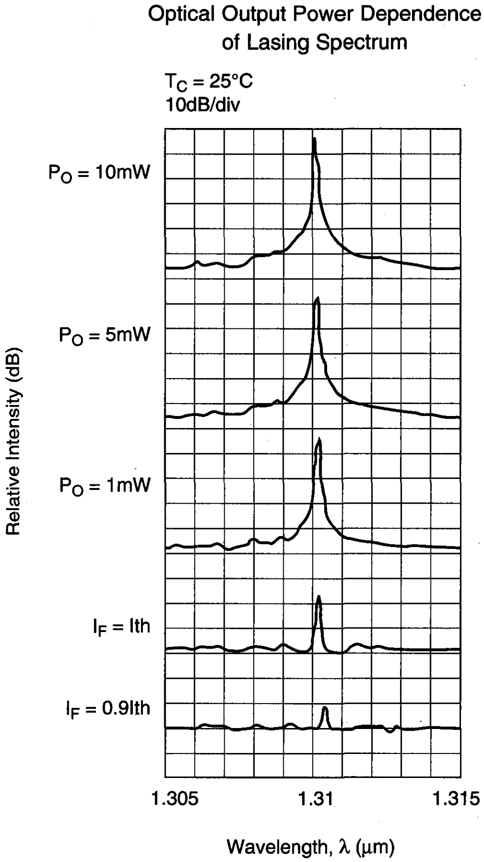
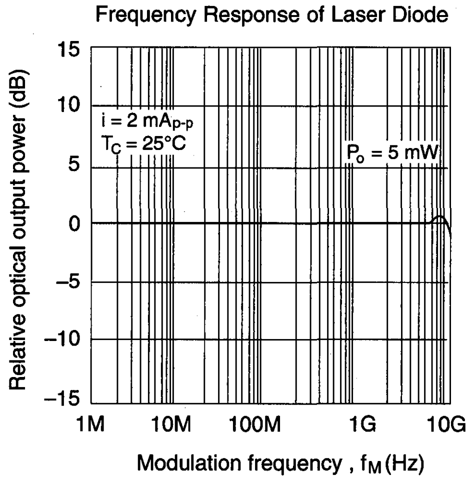
Typical Characteristic Curves (cont.)

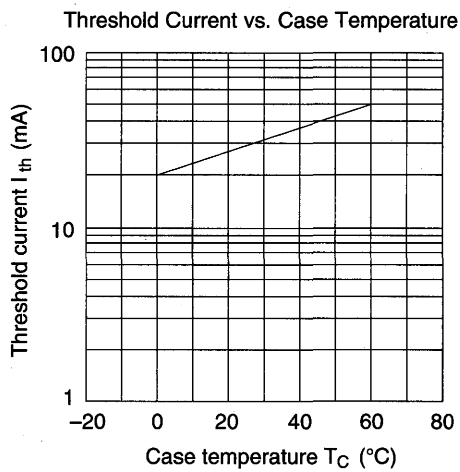




Typical Characteristic Curves (cont.)







HL1521A/AC

InGaAsP LD

1

Description

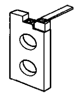
The HL1521A/AC are 1.55 µm band laser diodes with a double heterostructure.

Features

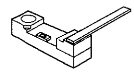
- Long wavelength output: λ_p = 1530 to 1570 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leq 0.5$ ns

Package Type

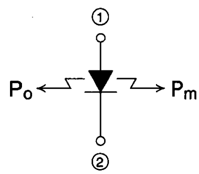
- HL1521A: A1



- HL1521AC: AC



Internal Circuit



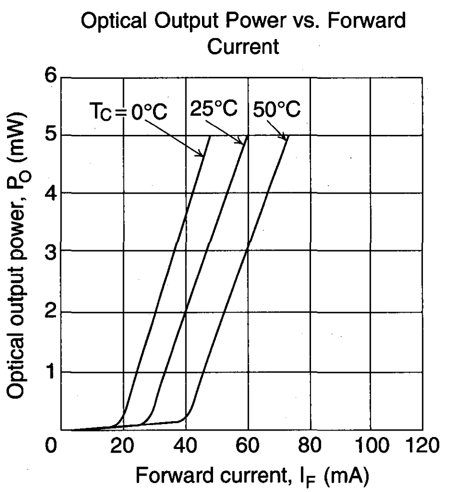
Absolute Maximum Ratings (T_C = 25°C)

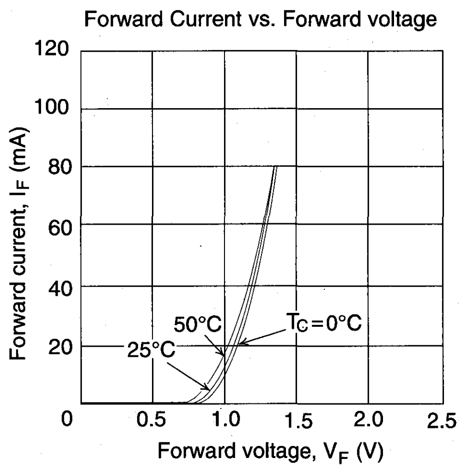
Item	Symbol	Rated Value	Unit
Optical output power	P_O	5	mW
LD reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	—	30	50	mA	
Optical power output	P_O	5	—	—	mW	Kink free
		2.0	—	—		$I_F = I_{th}$ + 20 mA
Monitor output	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 (horizontal)	$\theta_{//}$	—	30	—	deg.	P_O = 3 mW, FWHM
Beam divergence (vertical)	$\theta_{\perp}$	—	40	—	deg.	P_O = 3 mW, FWHM
Rise time	t_r	—	—	0.5	ns	$I_{bias} = I_{th}$, 10 to 90 %
Fall time	t_f	—	—	0.5	ns	$I_{bias} = I_{th}$, 90 to 10 %

Typical Characteristic Curves





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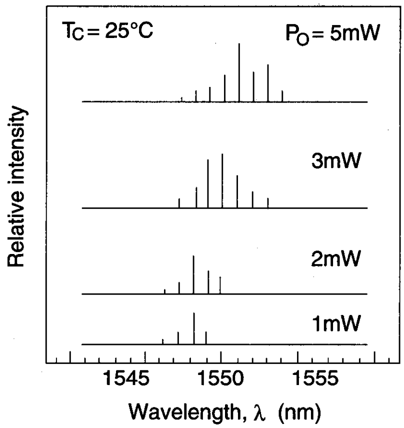
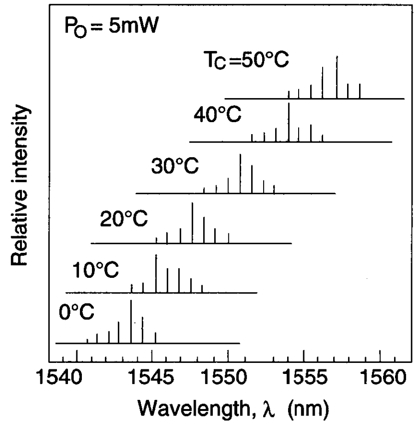
Typical Characteristic Curves (cont.)

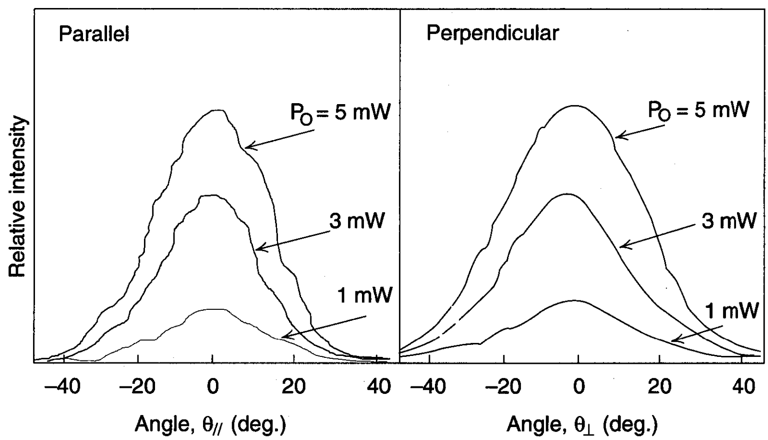
Lasing Spectrum



Lasing Spectrum Temperature Dependence

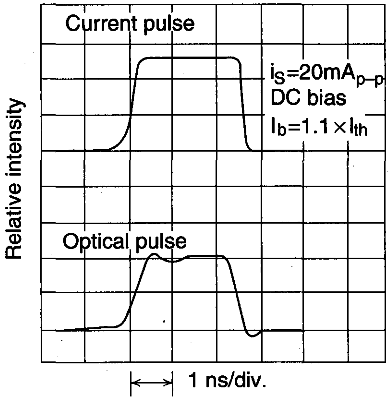


Far Field Pattern

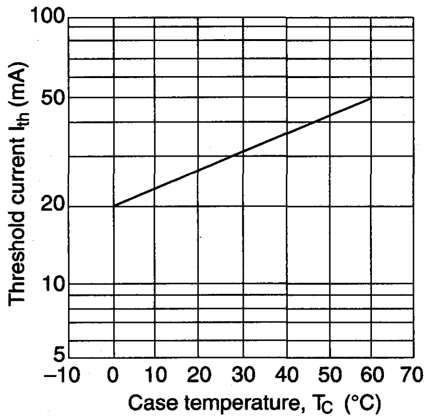


Typical Characteristic Curves (cont.)

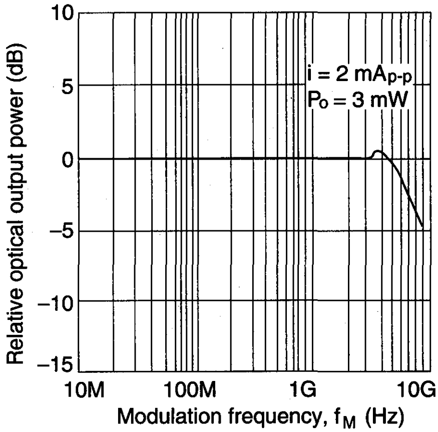
Pulse Response Characteristics



Threshold Current vs. Case Temperature



Frequency Response Characteristics



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Description

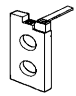
The HL1541A/AC/BF/DL/DM are 1.55 µm band laser diodes.

Features

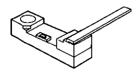
- The HL1541A/AC are packaged in chip carrier type miniature packages, and are appropriate for incorporating in modules.
- The HL1541BF is packaged in a butterfly-type package with attached fiber optics cable and has a Peltier cooler, and the HL1541DL is packaged in a DIP package with attached fiber optics cable and also has a Peltier cooler. Thus these models provide stable operation.
- The HL1541DM is packaged in a thin form DIP package with attached fiber optics cable, and is appropriate for application miniaturization.
- Wavelength output λp = 1530 to 1570 nm
- Side mode suppression ration S_r: 35 dB (Typ.)
- Fast pulse response: t_r = 0.2 ns, t_f = 0.3 ns (Typ.)

Package Type

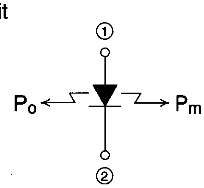
- HL1541A: A1



- HL1541AC: AC



Internal Circuit

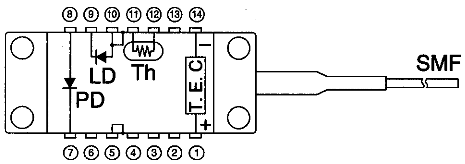


Fiber Specifications
(HL1541BF/DL/DM)

Mode field diameter: 10.0 ± 1.0 µm
Cutoff wavelength: 1.10 to 1.20 µm
Core diameter: 10 µm
Outer diameter: 125 µm
Jacket diameter: 900 µm
Fiber length: over 500 mm

Pin Connections (Bottom view)

• HL1541BF

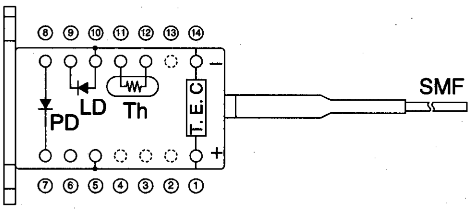


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
• HL1541BF: BF

• HL1541DL

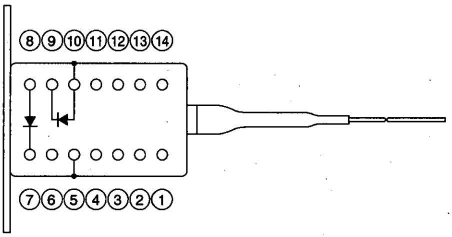


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
• HL1541DL: DL

• HL1541DM



① N. C.
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 N. C.
⑫ N. C.
⑬ N. C.
⑭ N. C.

Package Type
• HL1541DM: DM

Absolute Maximum Ratings (T_C = 25°C)

Item		Symbol	Rated Value	Unit
Optical output power	HL1541A/AC	P_O	5	mW
Fiber optical output power	HL1541BF/DL	P_f	1.0	mW
	HL1541DM		1.2	
LD reverse voltage		$V_{R (LD)}$	2	V
PD reverse voltage	HL1541BF/DL/DM	$V_{R (PD)}$	15	V
PD forward current		$I_{F (PD)}$	1	mA
Cooler current	HL1541BF/DL	I_C	1.4	A
Operating temperature	HL1541A/AC/BF/DL	T_{opr}	0 to +60	°C
	HL1541DM		0 to +50	
Storage temperature	HL1541A/AC	T_{stg}	0 to +80	°C
	HL1541BF/DL		–40 to +70	
	HL1541DM		–40 to +60	

Optical and Electrical Characteristics (T_C = 25°C)

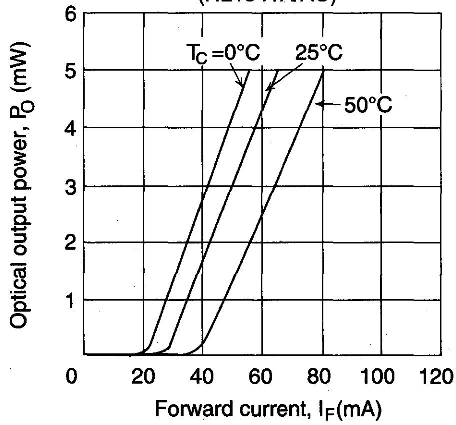
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current		I_{th}	—	25	50	mA	
Optical output power	HL1541A/AC	P_O	5	—	—	mW	Kink free
			1.5	—	—		$I_F = I_{th}$ + 20 mA
Fiber optical output power	HL1541BF/DL	P_f	1.0	—	—	mW	Kink free
			0.3	—	—		$I_F = I_{th}$ + 20 mA
	HL1541DM		1.2	—	—		Kink Free
			0.3	—	—		$I_F = I_{th}$ + 20 mA
Monitor output	HL1541A/AC	P_m	0.5	—	—	mW	$I_F = I_{th}$ + 20 mA
Lasing Wave-length	HL1541A/AC	λ_p	1530	1550	1570	nm	P_O = 3 mW
	HL1541BF/DL/DM		1530	1550	1570		P_f = 0.5 mW
Side mode sup-pression ratio	HL1541A/AC	S_r	30	35	—	dB	P_O = 3 mW
	HL1541BF/DL/DM		30	35	—		P_f = 0.5 mW
Beam divergence (parallel)	HL1541A/AC	$\theta_{//}$	—	30	—	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	HL1541A/AC	$\theta_{\perp}$	—	40	—	deg.	P_O = 3 mW, FWHM
Rise time		t_r	—	—	0.5	ns	$I_{bias} = I_{th}$ 10 to 90 %
Fall time		t_f	—	—	0.5	ns	$I_{bias} = I_{th}$ 90 to 10 %

Optical and Electrical Characteristics (T_C = 25°C) (cont.)

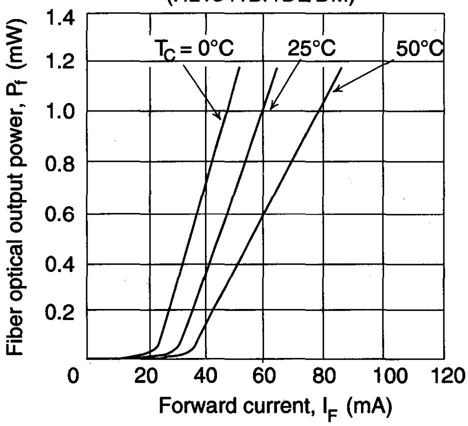
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
PD dark current	HL1541BF/DL/DM	I_{DARK}	—	—	350	nA	$V_{R (PD)}$ = 5 V
Monitor current	HL1541BF/DL/DM	I_S	50	—	—	μA	$V_{R (PD)}$ = 5 V, P_O = 0.5 mW
PD capacitance	HL1541BF/DL/DM	C_t	—	10	20	pF	$V_{R (PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation bias voltage	HL1541BF/DL/DM	$V_{R (S)}$	—	—	2	V	
Cooling capacity	HL1541BF/DL	ΔT	40	—	—	°C	P_f = 0.5 mW, T_C = 60°C
Cooler current		I_C	—	—	1.4	A	ΔT = 40°C
Cooler voltage		V_C	—	—	1.8	V	ΔT = 40°C
Thermistor resistance		R_{TM}	—	10	—	kΩ	

Typical Characteristic Curves

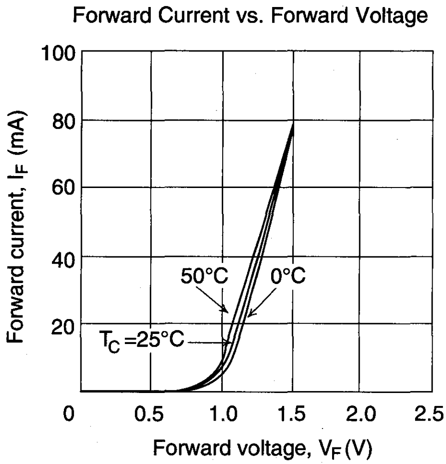
Optical Output Power vs. Forward Current (HL1541A/AC)

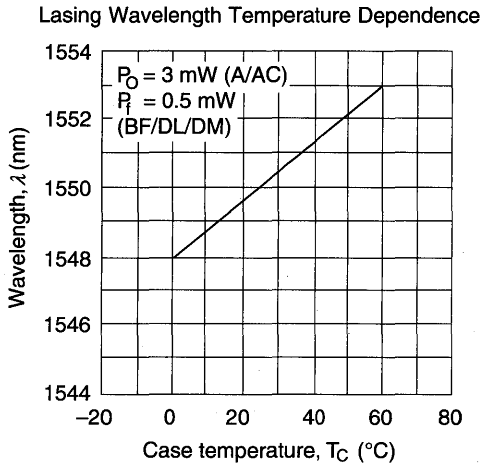


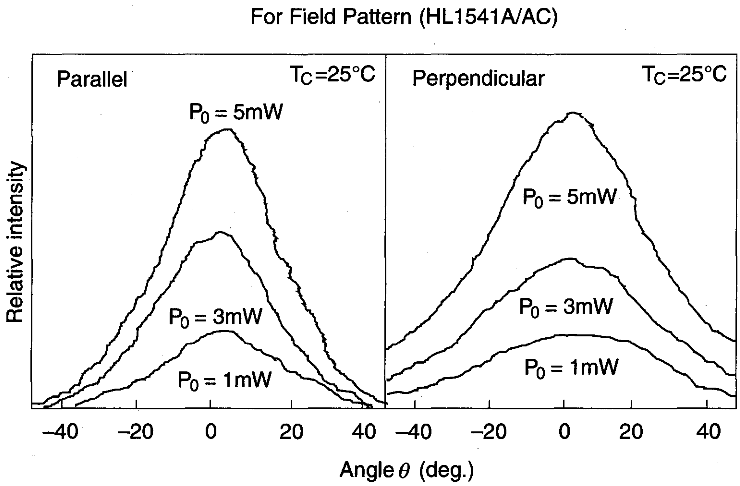
Optical Output Power vs. Forward Current (HL1541BF/DL/DM)



Typical Characteristic Curves (cont.)

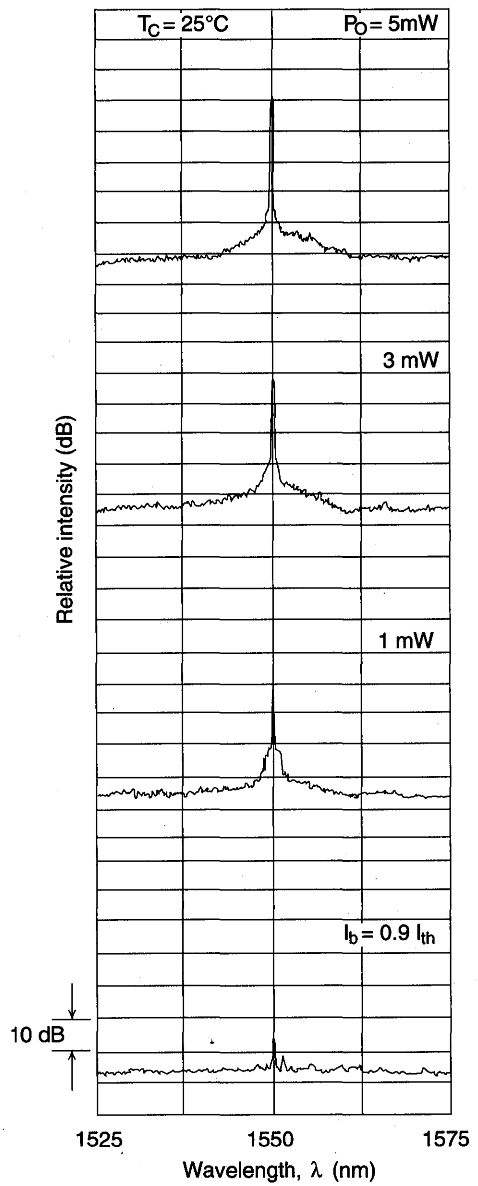




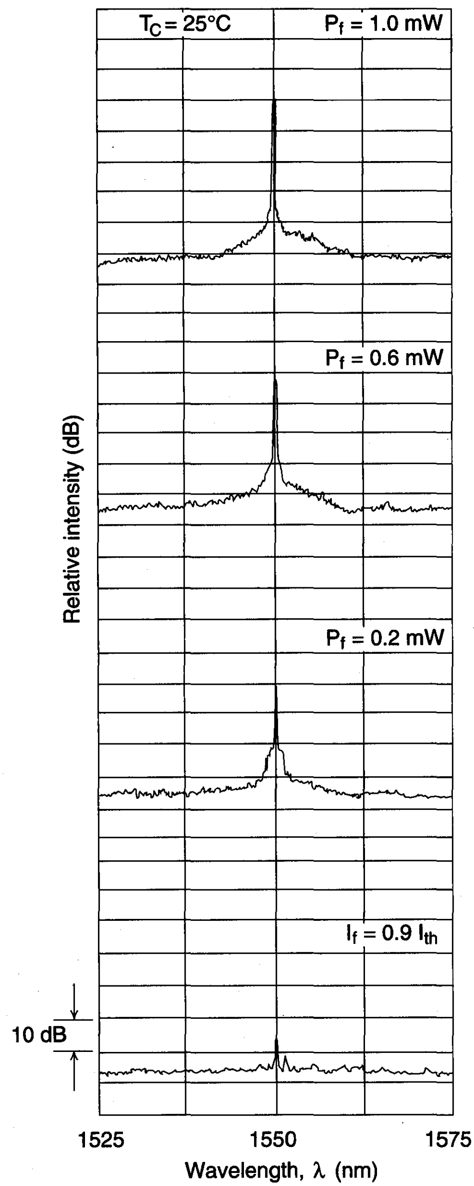


Typical Characteristic Curves (cont.)

Output Wavelength (HL1541A/AC)



Output Wavelength (HL1541BF/DL/DM)



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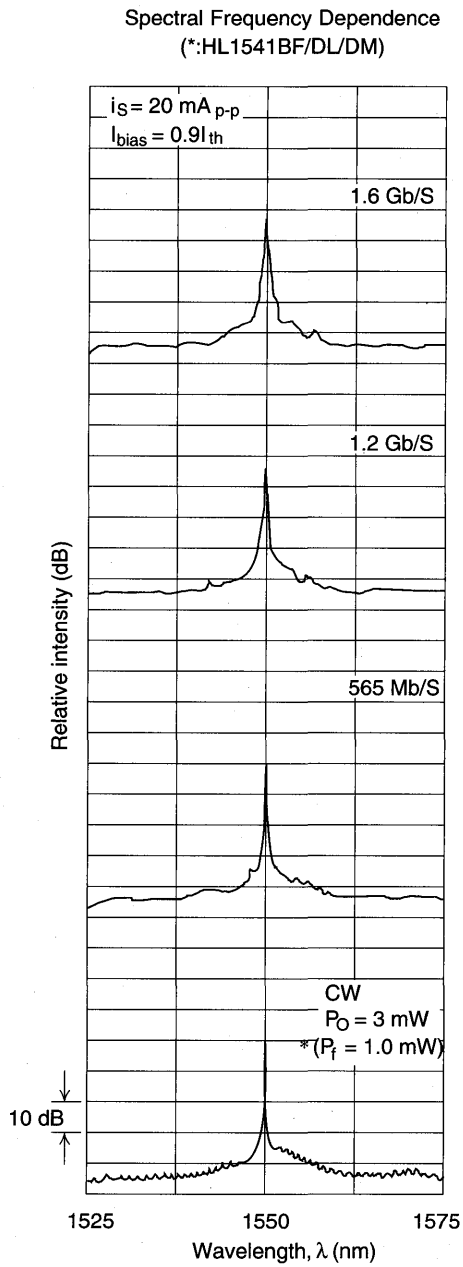
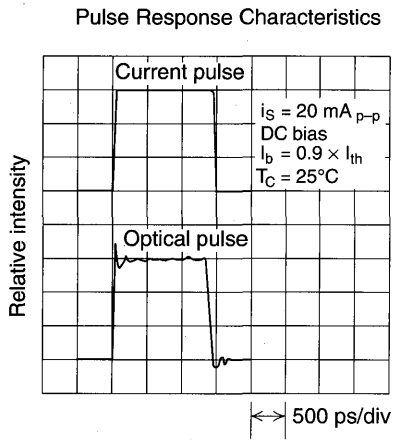
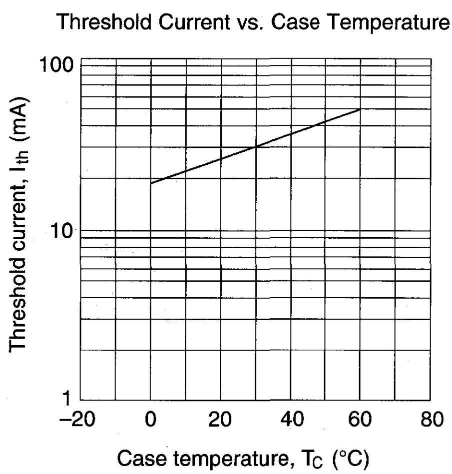
Typical Characteristic Curves (cont.)

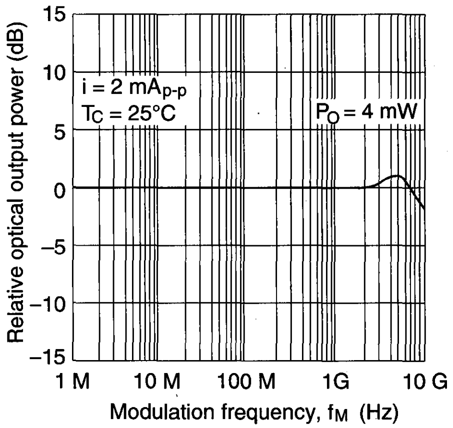




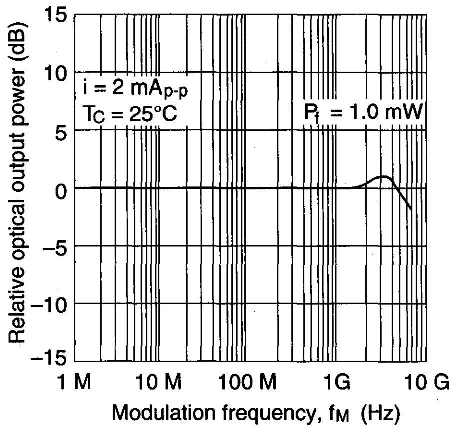


Typical Characteristic Curves (cont.)

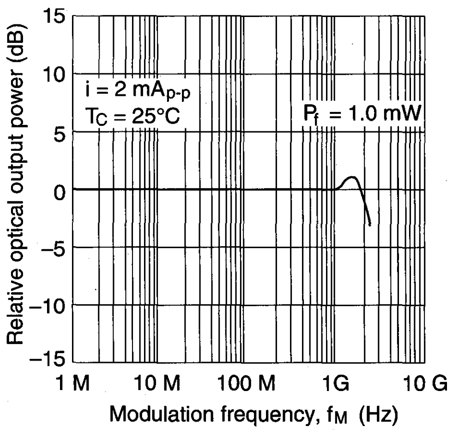
Frequency Response Characteristics
(HL1541A/AC)



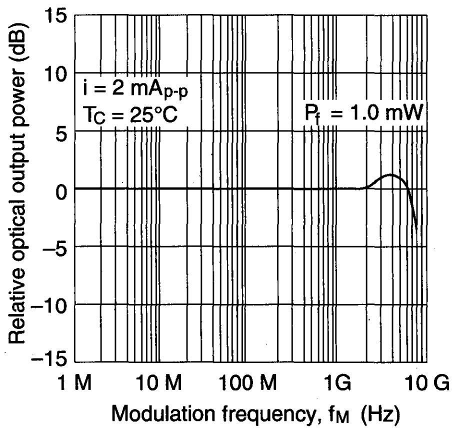
Frequency Response Characteristics
(HL1541BF)



Frequency Response Characteristics
(HL1541DL)



Frequency Response Characteristics
(HL1541DM)



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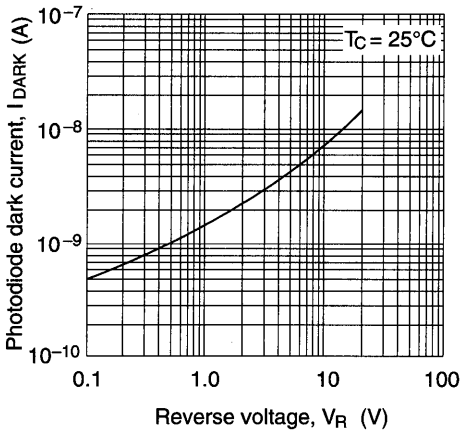
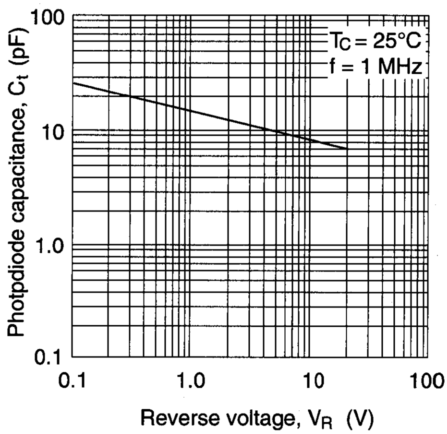
Typical Characteristic Curves (cont.)

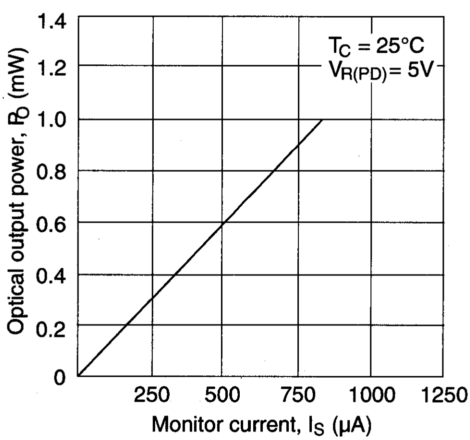
Dark Current vs. Reverse Voltage
(HL1541BF/DL/DM)



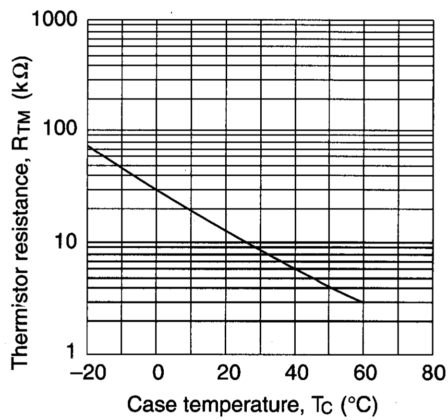
Capacitance vs. Reverse Voltage
(HL1541BF/DL/DM)



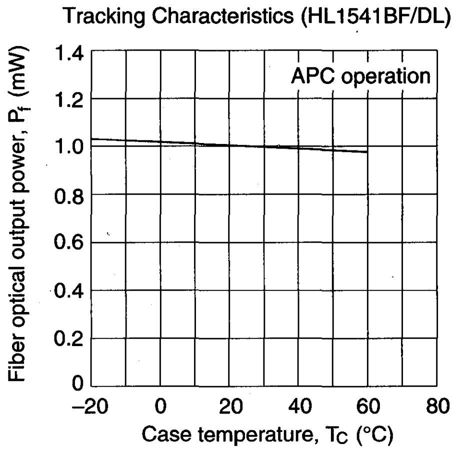
Optical Output Power vs. Monitor Current
(HL1541BF/DL/DM)



Thermistor Resistance vs. Case Temperature
(HL1541BF/DL)



Typical Characteristic Curves (cont.)



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HL1551A/AC

Description

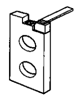
The HL1551A/AC are 1.55 µm InGaAsP λ/4 phase-shifted distributed-feedback laser diodes (DFB-LD) with a multi-quantum well (MQW) structure. They are suitable as light sources for high-bit-rate, long- haul fiberoptic communication systems and other applied optical equipment. The compact package is suitable for module assembly.

Features

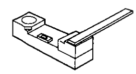
- Long wavelength output: 1530 to 1570 nm
- High-power output: 12 mW
- High quantum efficiency: $\eta_s \geq 0.125$ mW/mA
- Fast pulse response: t_r, t_f: ≤ 0.2 ns
- Dynamic single longitudinal mode: S_r = 40 dB Typ.
- Narrow spectral width (2.4 Gb/s): $\Delta\lambda$ = 0.5 nm Typ.

Package Type

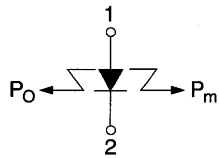
- HL1551A: A1



- HL1551AC: AC



Internal Circuit



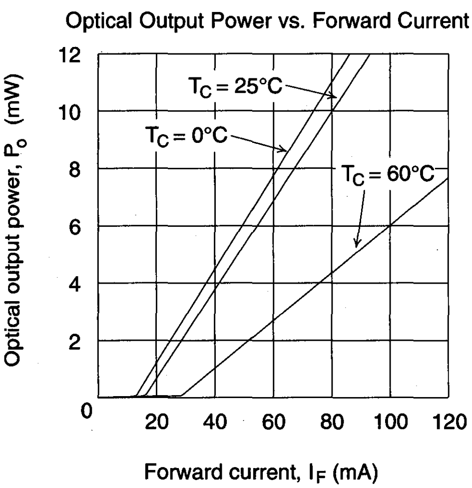
Absolute Maximum Ratings (T_C = 25°C)

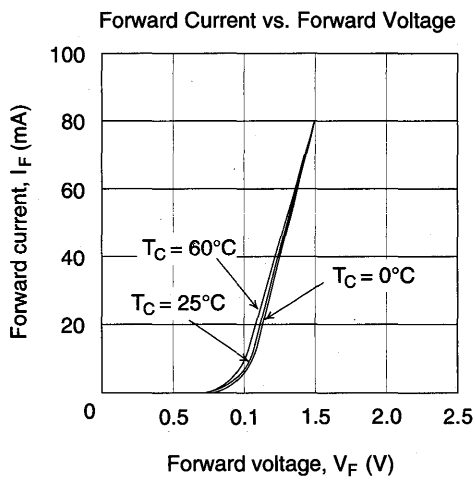
Item	Symbol	Rated Value	Unit
Optical output power	P_O	12	mW
LD reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	—	15	50	mA	
Optical ouput power	P_O	12	—	—	mW	Kink free
Monitor optical output power	P_m	2	—	—	mW	P_O = 8 mW
Slope efficiency	η	0.125	0.15	—	mW/mA	
Spectral width	$\Delta\lambda$	—	0.5	—	nm	–27 dB, 2.4 Gb/s
Lasing wavelength	λ_p	1530	1550	1570	nm	P_O = 8 mW
Side-mode suppression ratio	S_r	30	40	—	dB	2.4 Gb/s
Beam divergence (parallel)	$\theta_{//}$	—	30	—	deg.	P_O = 8 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	—	40	—	deg.	P_O = 8 mW, FWHM
Rise time	t_r	—	0.1	—	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f	—	0.15	—	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 90 to 10%

Typical Characteristic Curves





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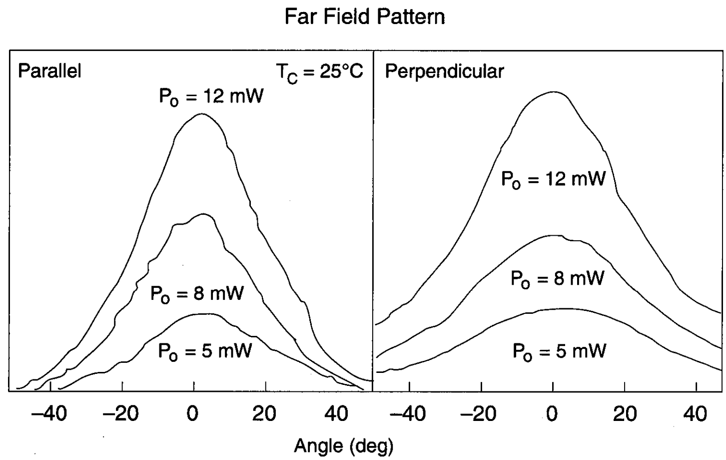
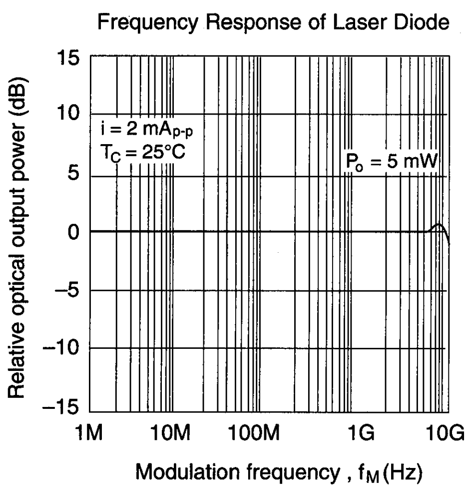
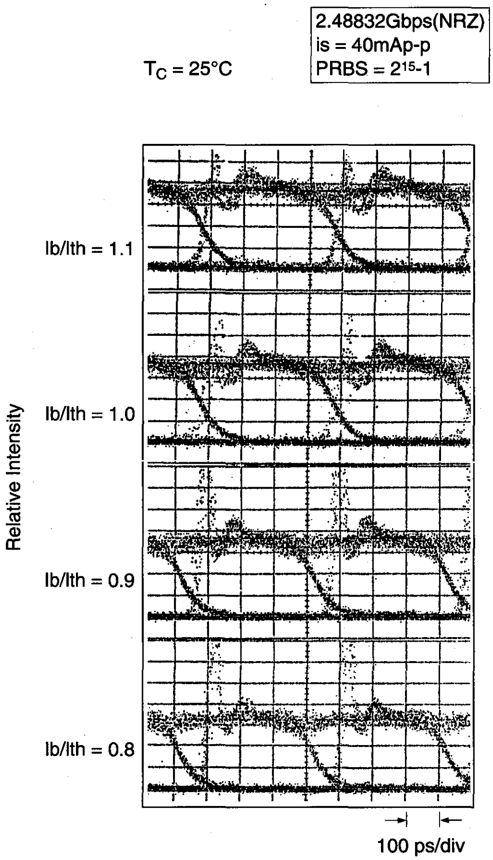
Typical Characteristic Curves (cont.)



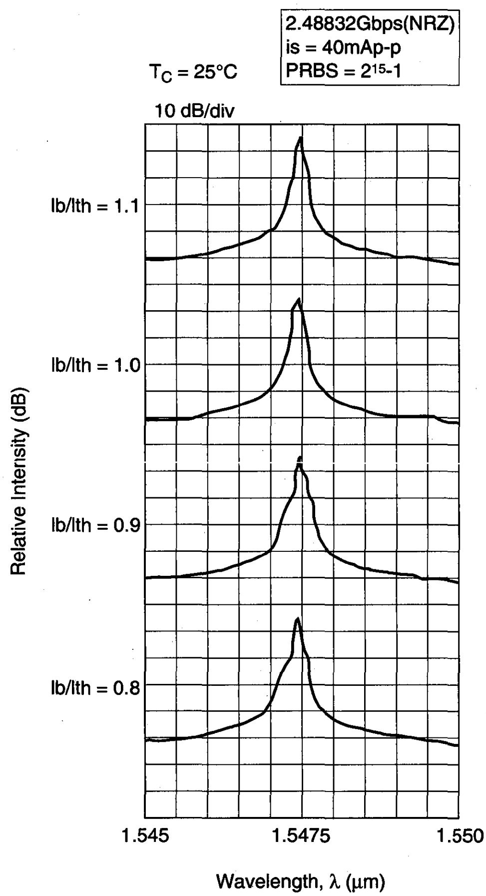


Typical Characteristic Curves (cont.)

Bias Dependence of Optical Pulse Response



Bias Dependence of Lasing Spectrum



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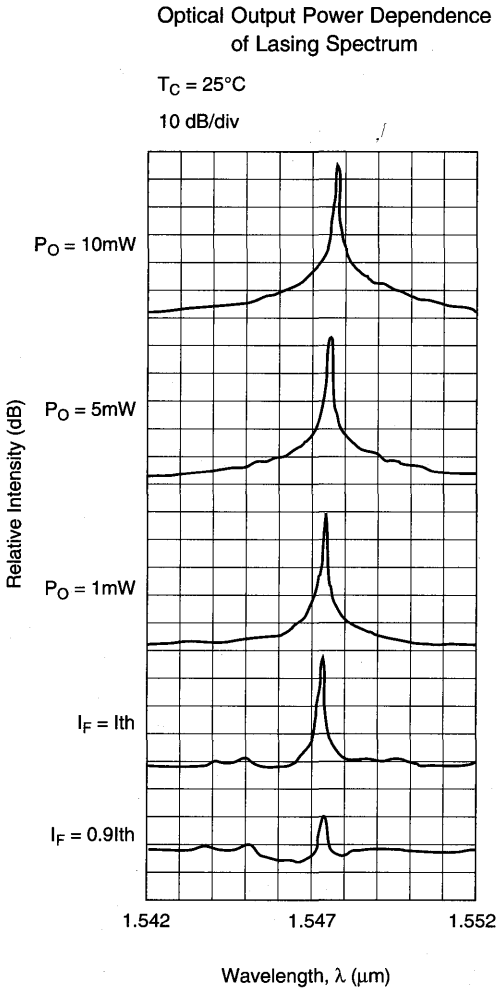
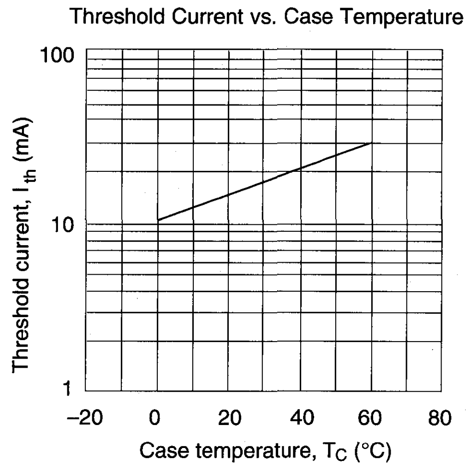
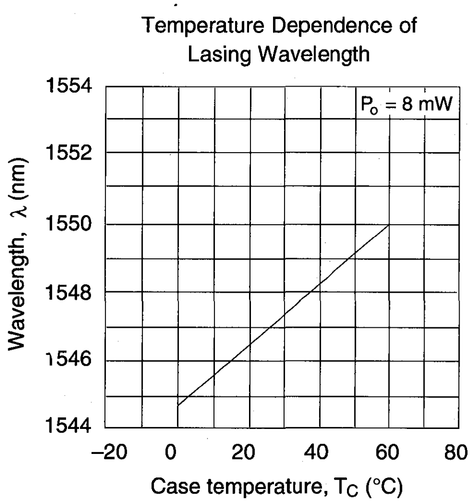
Typical Characteristic Curves (cont.)







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Infrared Emitting Diodes

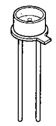
Description

The HE7601SG is a 770 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. It is suitable as a light source for optical control devices and sensors.

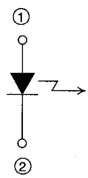
Features

- High efficiency and high output power

Package Type
- HE7601SG: SG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

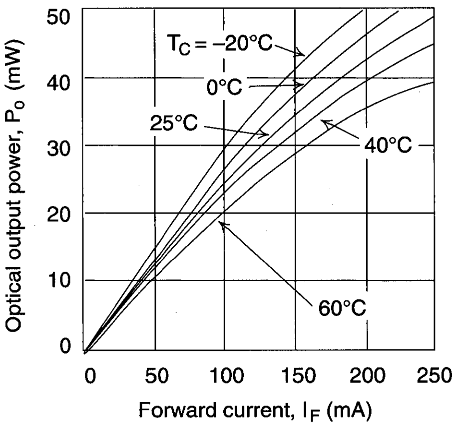
Item	Symbol	Rated Value	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

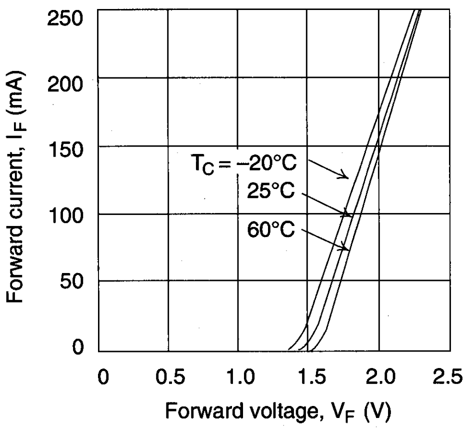
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O	30	—	—	mW	I_F = 200 mA
Peak wavelength	λ_p	740	770	800	nm	I_F = 200 mA
Spectral width	$\Delta\lambda$	—	50	—	nm	I_F = 200 mA
Forward voltage	V_F	—	—	2.5	V	I_F = 200 mA
Reverse current	I_R	—	—	100	μA	V_R = 3 V
Capacitance	C_t	—	30	—	pF	V_R = 0 V, f = 1 MHz
Rise and fall time	t_r, t_f	—	10	—	ns	I_F = 50 mA

Typical Characteristic Curves

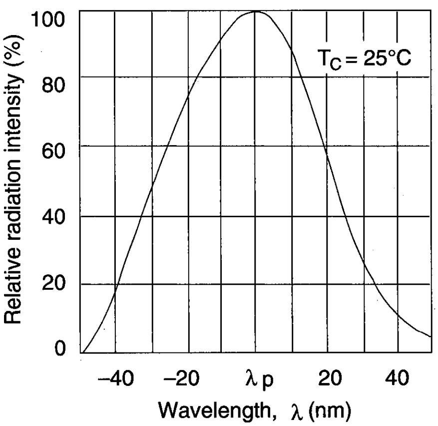
Optical Output Power vs. Forward Current



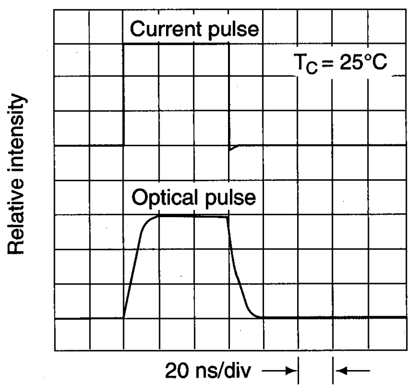
Forward Current vs. Forward Voltage



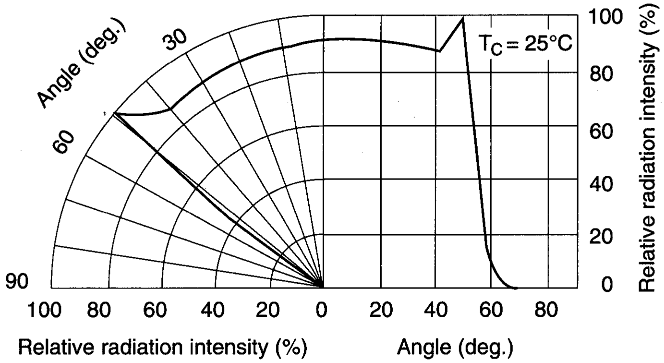
Spectral Distribution



Pulse Response



Typical Characteristic Curves (cont.)



HE8403SG/ML — GaAlAs IRED

Description

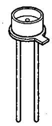
The HE8403SG/ML are 840 nm band GaAlAs infrared light emitting diodes with a double heterojunction structure. They are suitable as light sources for optical fiber communication systems.

Features

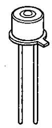
- High efficiency, high luminance
- High speed pulse output
- Excellent linearity in their optical output power - forward current characteristics

Package Type

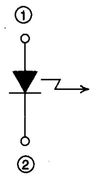
- HE8403SG: SG



- HE8403ML: ML1



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	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

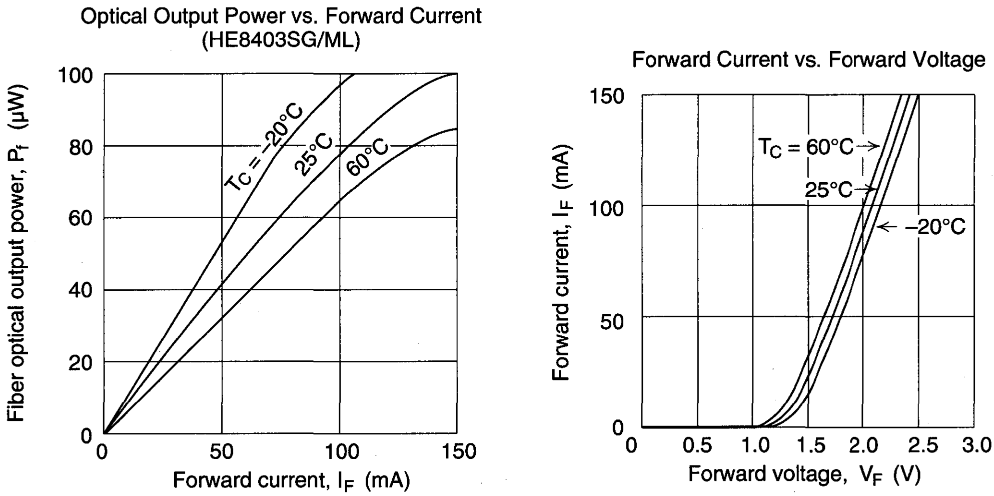
Optical and Electrical Characteristics (T_C = 25°C)

Item		Symbol	Min	Typ	Max	Units	Test Conditions
Fiber optical output power	HE8403SG	P_f*1	40	80	—	μW	I_F = 100 mA
	HE8403ML		50	80	—		
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 = 3V
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

Note: 1. These outputs are measured at the G150/125 fiber in the HE8403ML and at the G150/125 fiber after passing through a collimating rod lens in the HE8403SG.

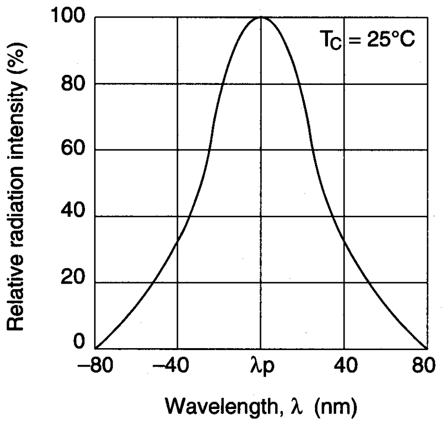
1

Typical Characteristic Curves

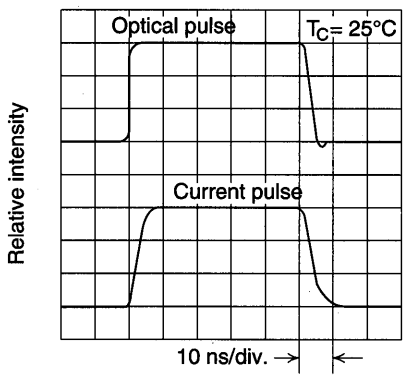


Typical Characteristic Curves (cont.)

Wavelength Distribution Characteristics

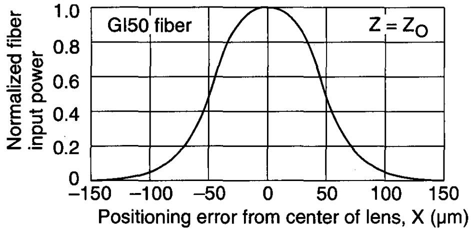


Pulse Response Characteristics



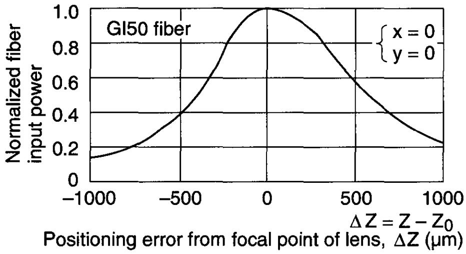
Typical Characteristic Curves (cont.)

Coupling Characteristics (HE8403ML)

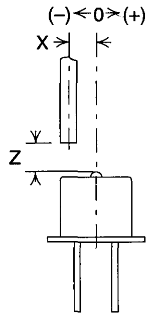


Fiber input deviation due to lateral fiber positioning error

Z_0 = Focal point of lens



Fiber input deviation due to horizontal fiber positioning error



HE8404SG   GaAlAs IRED

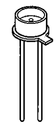
Description

The HE8404SG is a 820 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. It is suitable as a light source for a wide range of optical control and sensing equipment.

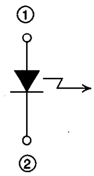
Features

- High efficiency, high output

Package Type
- HE8404SG: SG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

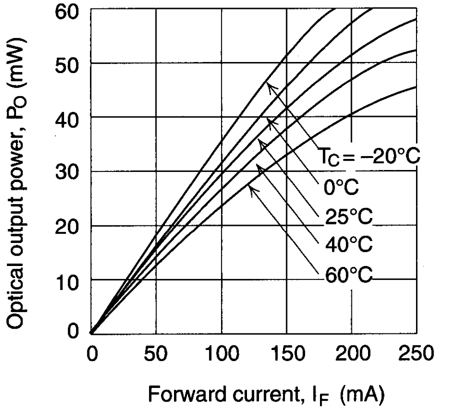
Item	Symbol	Rated Value	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

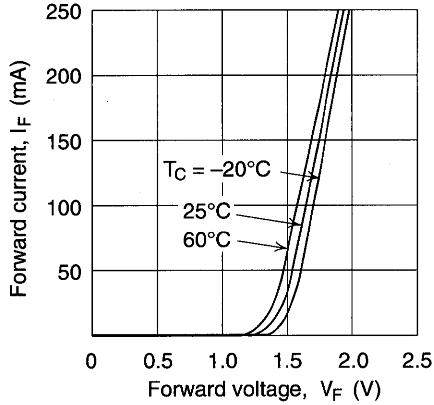
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O	40	—	—	mW	I_F = 200 mA
Peak wavelength	λ_p	790	820	850	nm	I_F = 200 mA
Spectral width	$\Delta\lambda$	—	50	—	nm	I_F = 200 mA
Forward voltage	V_F	—	—	2.5	V	I_F = 200 mA
Reverse current	I_R	—	—	100	μA	V_R = 3 V
Capacitance	C_t	—	30	—	pF	V_R = 0 V, f = 1 MHz
Rise and fall time	t_r, t_f	—	10	—	ns	I_F = 50 mA

Typical Characteristic Curves

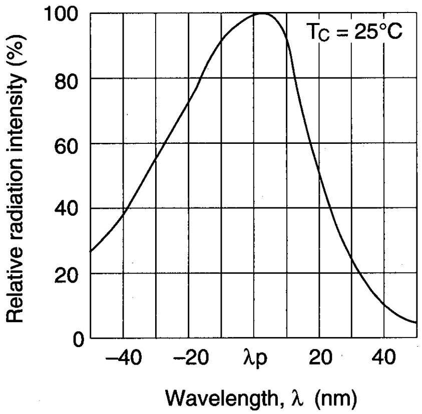
Optical Output Power vs. Forward Current



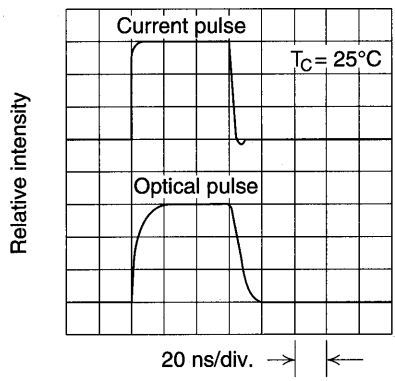
Forward Current vs. Forward Voltage



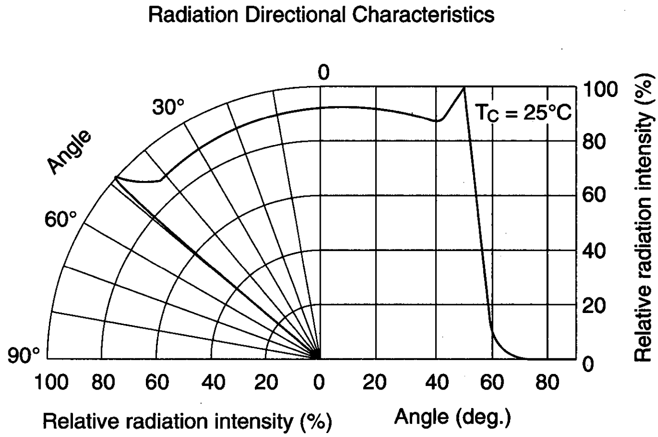
Wavelength Distribution Characteristics



Pulse Response Characteristics



Typical Characteristic Curves (cont.)



HE8807SG/SL/CL/FL — GaAlAs IRED

Description

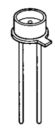
The HE8807SG/SL/CL/FL are 880 nm band GaAlAs infrared light emitting diodes with a single hetero-junction structure.

Features

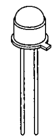
- High output, high efficiency
- Narrow spectral width
- Sharp radiation directivity (HE8807SL/CL/FL)
- Wide radiation directivity (HE8807SG)
- High reliability

Package Type

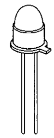
• HE8807SG: SG



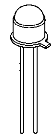
• HE8807SL: SL



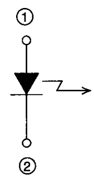
• HE8807CL: CL



• HE8807FL: FL



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

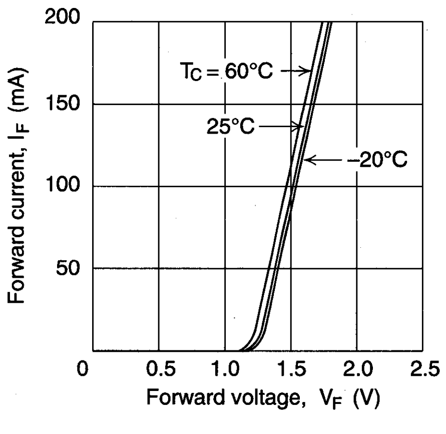
Item	Symbol	Rated Value	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	–20 to +85	°C
Storage temperature	T_{stg}	–40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

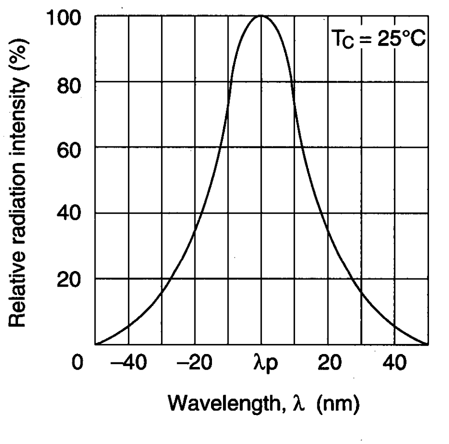
Item		Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	HE8807SG	P_O	10	20	—	mW	I_F = 150 mA
	HE8807SL		5	17	—		
	HE8807CL		5	15	—		
	HE8807FL		5	15	—		
Peak wavelength		λ_p	800	880	900	nm	I_F = 150 mA
Spectral width		$\Delta\lambda$	—	30	—	nm	I_F = 150 mA
Forward voltage		V_F	—	1.7	2.3	V	I_F = 150 mA
Reverse current		I_R	—	—	100	µA	V_R = 3V
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

Typical Characteristic Curves

Forward Current vs. Forward Current



Wavelength Distribution Characteristics



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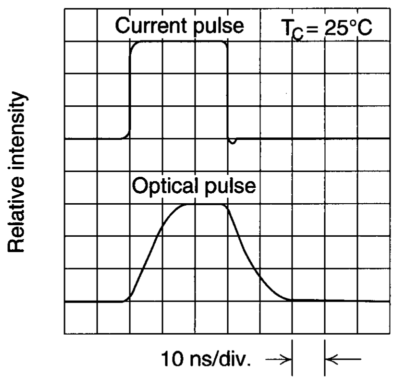
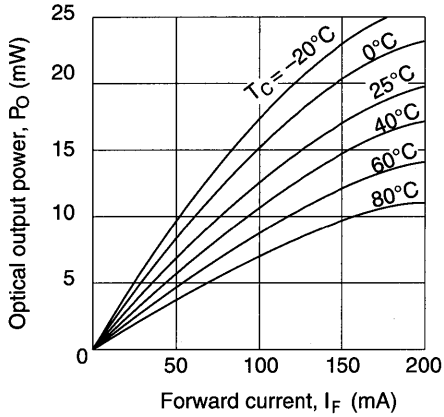
Typical Characteristic Curves (cont.)

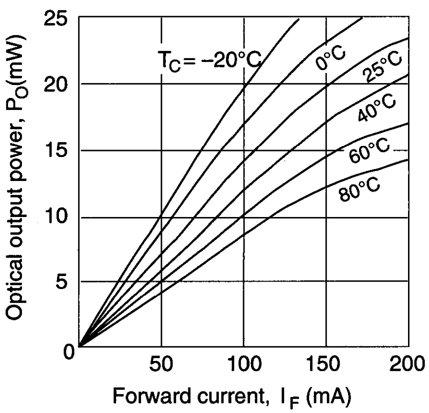
Pulse Response Characteristics



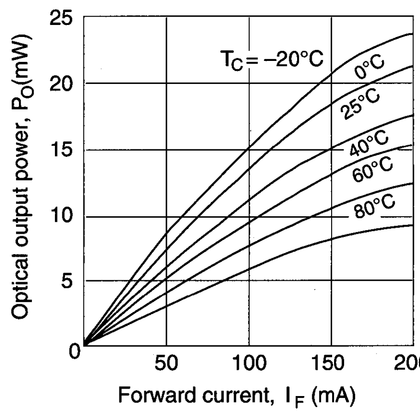
Optical Output Power vs. Forward Current (HE8807SL)



Optical Output Power vs. Forward Current (HE8807SG)

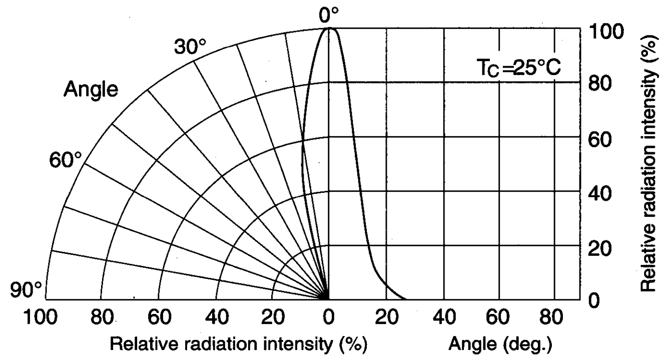


Optical Output Power vs. Forward Current (HE8807CL/FL)

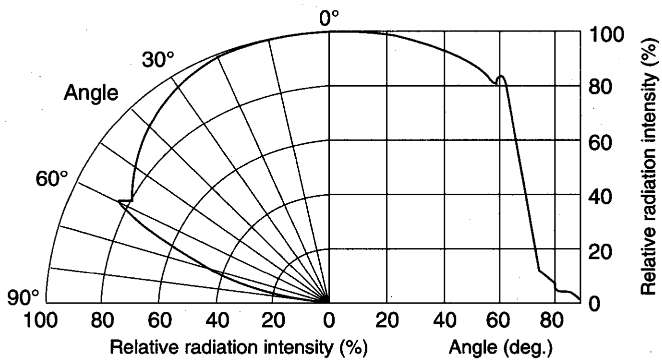


Typical Characteristic Curves (cont.)

Radiation Directional Characteristics (HE8807SL)

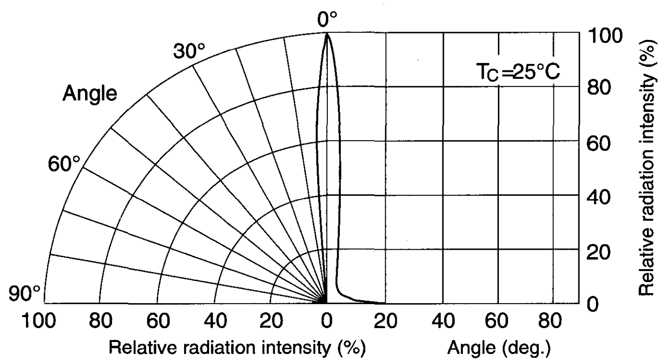


Radiation Directional Characteristics (HE8807SG)

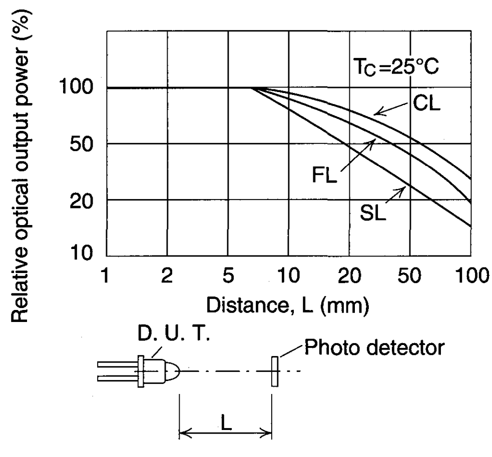


Typical Characteristic Curves (cont.)

Radiation Directional Characteristics (HE8807CL/FL)



Relative Optical Output Power vs. Distance



HE8811 GaAlAs IRED

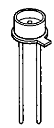
Description

The HE8811 is a 820 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. Its high brightness, high output power and fast response make it suitable as a light source for measuring instruments and infrared-beam communication equipment.

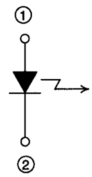
Features

- High-frequency response
- High efficiency and high output power
- Broad radiation pattern

Package Type
- HE8811: SG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

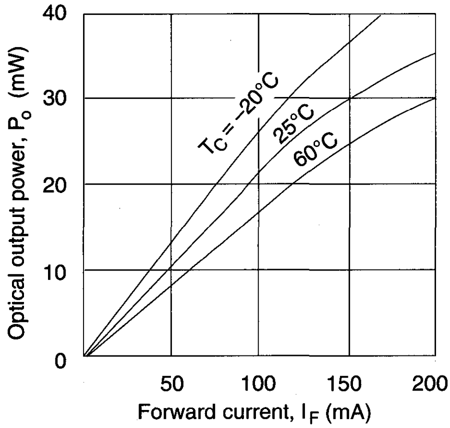
Item	Symbol	Rated Value	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

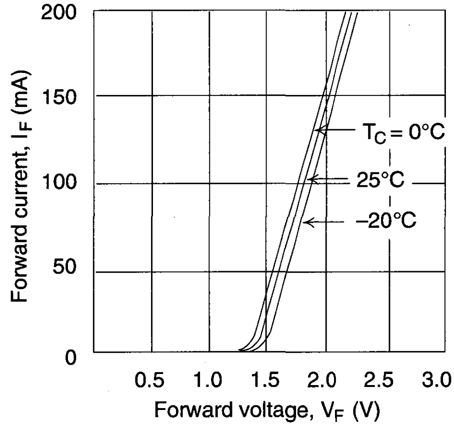
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O	20	30	—	mW	I_F = 150 mA
Peak wavelength	λ_p	780	820	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$	—	50	—	nm	I_F = 150 mA
Forward voltage	V_F	—	—	2.5	V	I_F = 150 mA
Reverse current	I_R	—	—	100	µA	V_R = 3 V
Capacitance	C_t	—	10	—	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

Typical Characteristic Curves

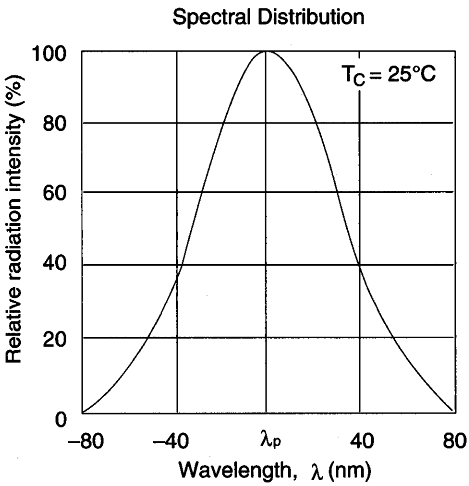
Optical Output Power vs. Forward Current

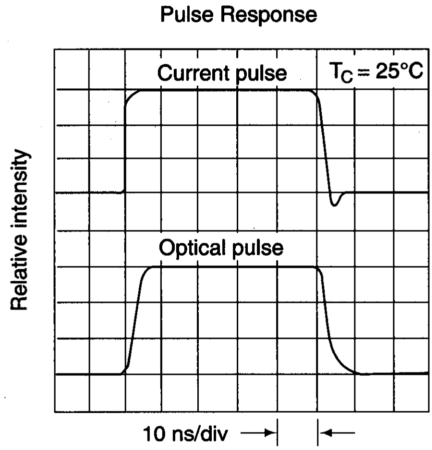


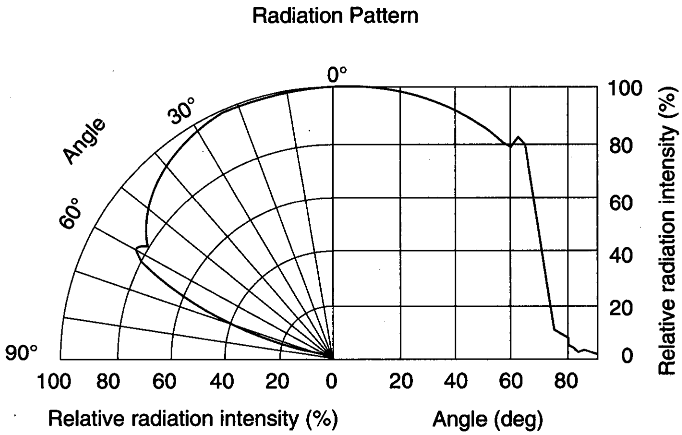
Forward Current vs. Forward Voltage



Typical Characteristic Curves (cont.)







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HE8812SG — GaAlAs IRED

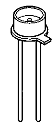
Description

The HE8812SG is a 870 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. It is suitable as a light source for a wide range of optical control and sensing equipment.

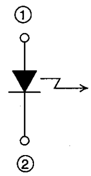
Features

- High efficiency, high output

Package Type
- HE8812SG: SG



Internal Circuit



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Absolute Maximum Ratings (T_C = 25°C)

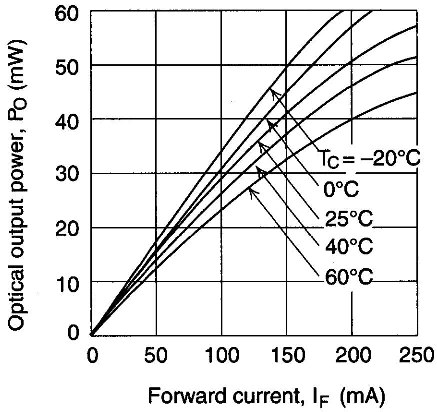
Item	Symbol	Rated Value	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

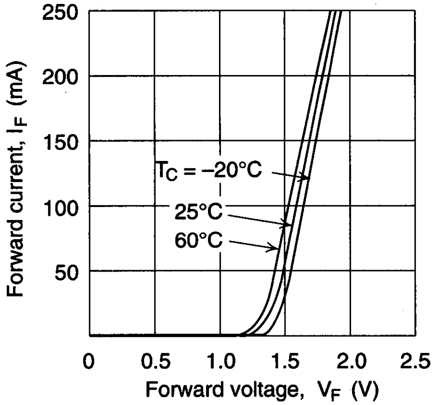
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O	40	—	—	mW	I_F = 200 mA
Peak wavelength	λ_p	840	870	900	nm	I_F = 200 mA
Spectral width	$\Delta\lambda$	—	50	60	nm	I_F = 200 mA
Forward voltage	V_F	—	—	2.5	V	I_F = 200 mA
Reverse current	I_R	—	—	100	μA	V_R = 3 V
Capacitance	C_t	—	30	—	pF	V_R = 0 V, f = 1 MHz
Rise and fall time	t_r, t_f	—	10	—	ns	I_F = 50 mA

Typical Characteristic Curves

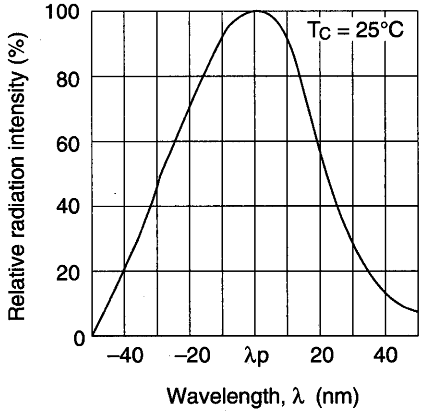
Optical Output Power vs. Forward Current



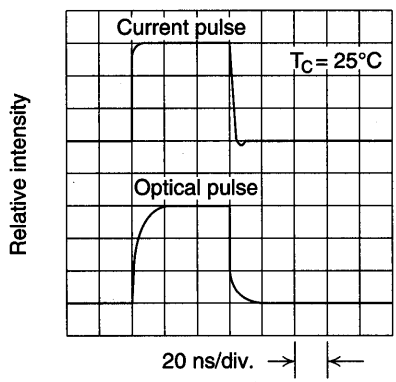
Forward Current vs. Forward Voltage



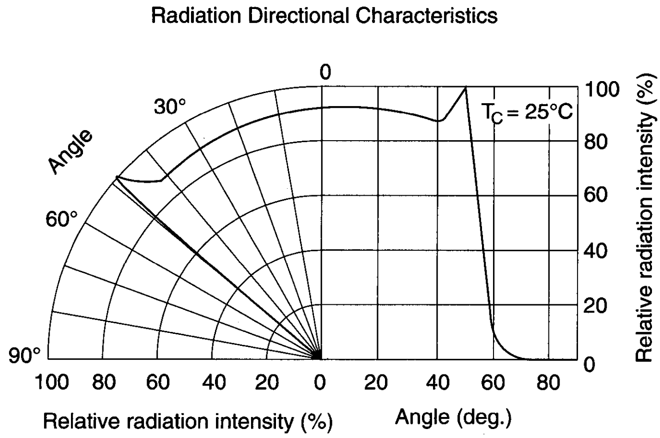
Wavelength Distribution Characteristics



Pulse Response Characteristics



Typical Characteristic Curves (cont.)



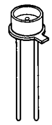
Description

The HE8813VG is a 880 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. It is suitable as a light source for still camera autofocus mechanisms.

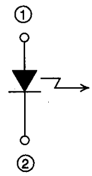
Features

- High efficiency and high power output

Package Type
- HE8813VG: VG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

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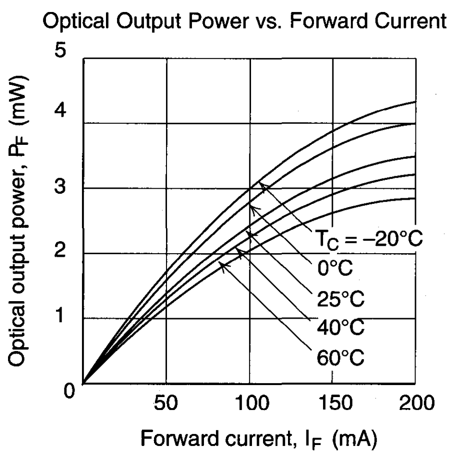
Optical and Electrical Characteristics (T_C = 25°C)

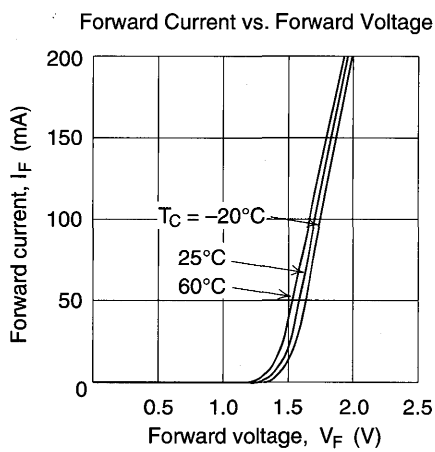
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_f*1	2.2	—	—	mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$	—	50	60	nm	I_F = 150 mA
Forward voltage	V_F	—	—	2.3	V	I_F = 150 mA
Reverse current	I_R	—	—	100	μA	V_R = 3 V
Capacitance	C_t	—	10	—	pF	V_R = 0 V, f = 1 MHz
Rise and fall times	t_r , t_f	—	10	—	ns	I_F = 50 mA

Note: 1. P_f specification: The optical output within 14 degrees of the acceptance angle.

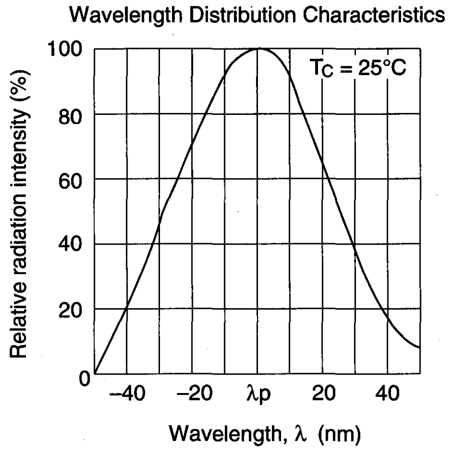
1

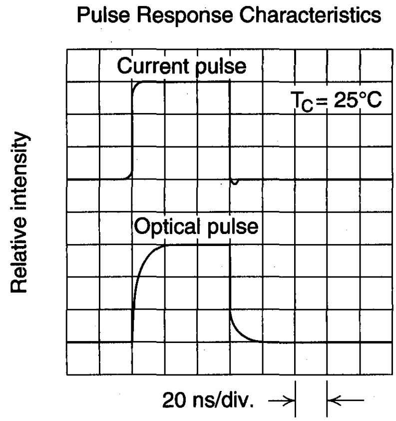
Typical Characteristic Curves

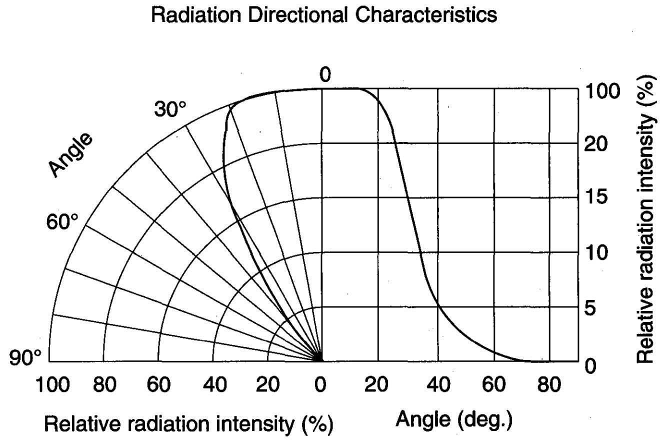




Typical Characteristic Curves (cont.)







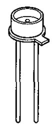
Description

The HE8815VG is a 880 nm band GaAlAs infrared light emitting diode with a double heterojunction structure. It is suitable as a light source for VCR camera autofocus mechanisms.

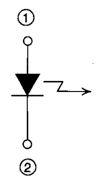
Features

- High efficiency and high power output

Package Type
- HE8815VG: VG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

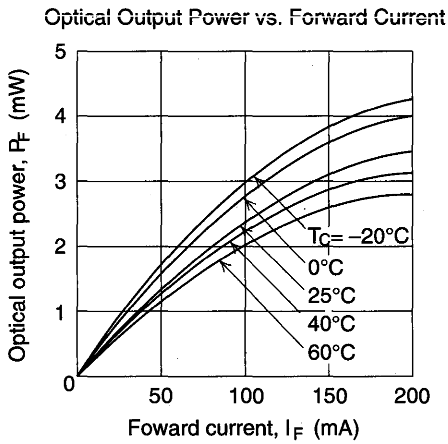
Item	Symbol	Rated Value	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	–20 to +60	°C
Storage temperature	T_{stg}	–40 to +90	°C

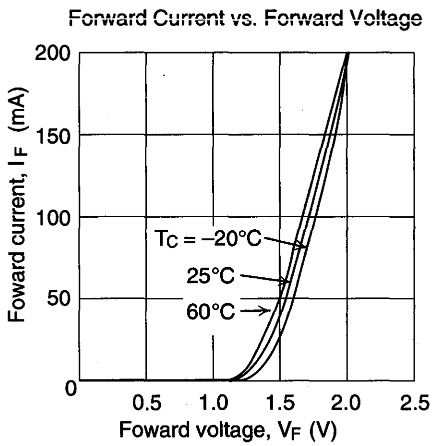
Optical and Electrical Characteristics ($T_C = 25°C$)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_f*1	2.2	—	—	mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$	—	50	60	nm	I_F = 150 mA
Forward voltage	V_F	—	—	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 and fall times	t_r, t_f	—	10	—	ns	I_F = 50 mA

Note: 1. P_f specification: The optical output within 14 degrees of the acceptance angle.

Typical Characteristic Curves





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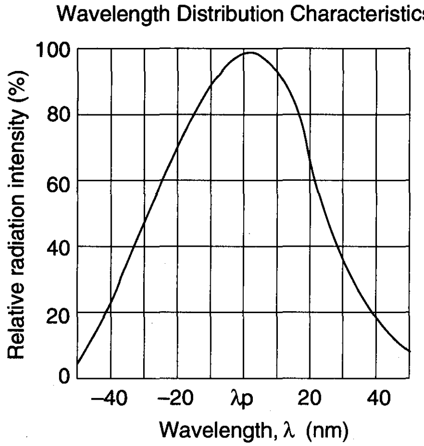
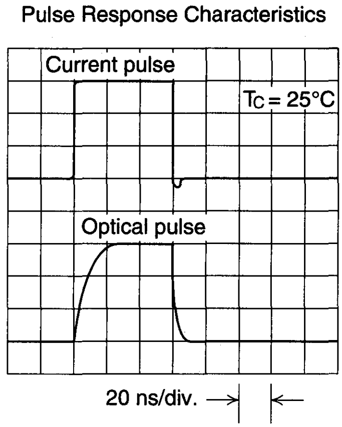
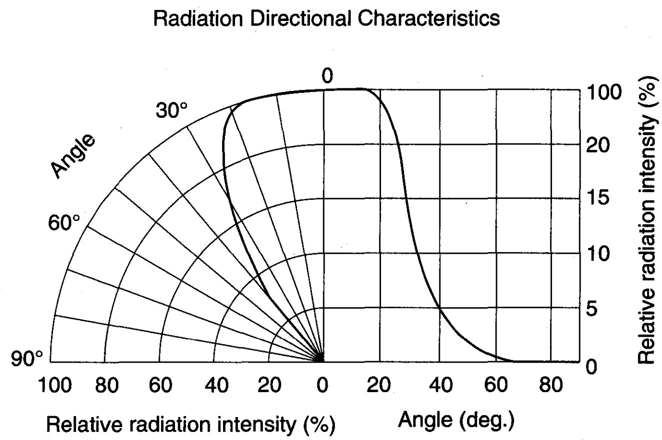
Typical Characteristic Curves (cont.)







HE1303SG/ML   InGaAsP IRED

Description

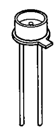
The HE1303SG/ML are 1.3 μm band InGaAsP infrared light emitting diodes with a double heterojunction structure. They are suitable as light sources for optical fiber communication systems.

Features

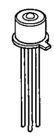
- High efficiency, high luminance
- High speed pulse output
- High output power

Package Type

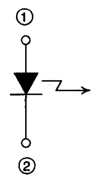
- HE1303SG: SG



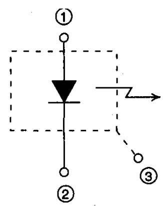
- HE1303ML: ML3



Internal Circuit



HE1303SG



HE1303ML

Absolute Maximum Ratings (T_C = 25°C)

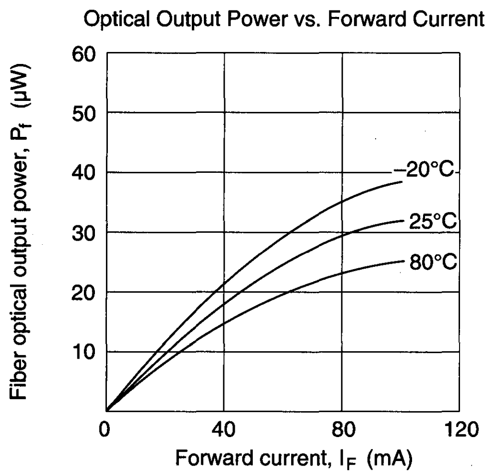
Item	Symbol	Rated Value	Units
Forward current	I_F	100	mA
Reverse voltage	V_R	1	V
Tolerable power dissipation	P_d	200	mW
Operating temperature	T_{opr}	–20 to +85	°C
Storage temperature	T_{stg}	–40 to +100	°C

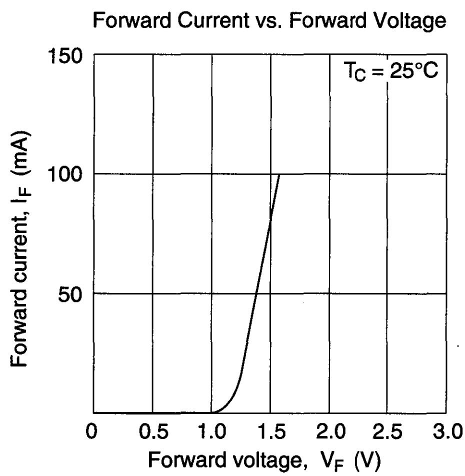
Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Fiber optical output power	P_f*1	25	—	—	μW	I_F = 80 mA
Peak wavelength	λ_p	1280	—	1360	nm	I_F = 80 mA
Spectral width	$\Delta\lambda$	—	—	180	nm	I_F = 80 mA
Forward voltage	V_F	—	1.5	2.0	V	I_F = 80 mA
Capacitance	C_t	—	10	—	pF	V_R = 0 V, f = 1 MHz
Rise time	t_r	—	1.0	—	ns	I_F = 60 mA
Fall time	t_f	—	1.5	—	ns	I_F = 60 mA

Note: 1. These outputs are measured at the G150/125 fiber in the HE1303ML and at the G150/125 fiber after passing through a collimating rod lens in the HE1303SG.

Typical Characteristic Curves





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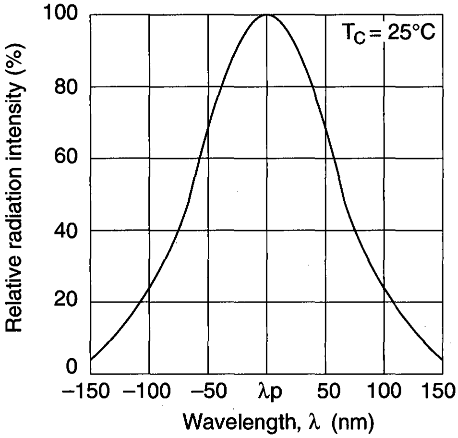
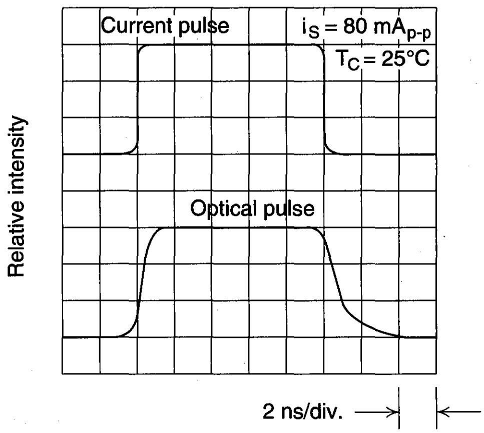
Typical Characteristic Curves (cont.)

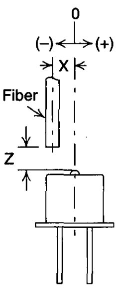
Spectral Distribution

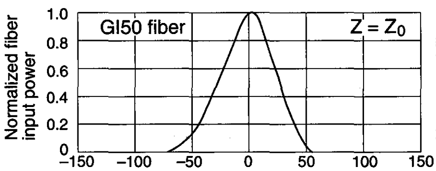


Pulse Response



Coupling Characteristics (HE1303ML)

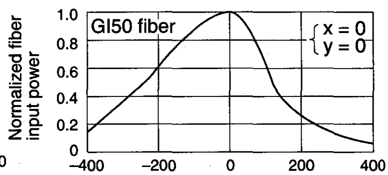




Positioning error from center of lens, X (μm)

Fiber input deviation due to lateral fiber positioning error

Z_0 = Focal point of lens



Positioning error from focal point of lens, Δ Z (μm) $\Delta Z = Z - Z_0$

Fiber input deviation due to horizontal fiber positioning error

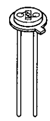
Description

The HLP20R/30R/40R are GaAlAs infrared light emitting diodes with a single heterojunction structure. They are suitable as light sources for a variety of applied optical instruments.

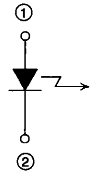
Features

- High efficiency
- Wide selection of wavelength and output power
- Narrow spectral width

Package Type
- HLP20R: R
- HLP30R: R
- HLP40R: R



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Forward current	I_F	250	mA
		230*1	
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	–20 to +40*2	°C
Storage temperature	T_{stg}	–40 to +60*2	°C

Note: 1. Value for devices with λ_p from 735 nm to 785 nm.
2. Value for conditions without condensation.

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O		*3		mW	I_F = 200 mA
Peak wavelength	λ_p		*3		nm	I_F = 200 mA
Spectral width	$\Delta\lambda$	—	30	—	nm	I_F = 200 mA
Beam divergence	$\theta_{//}$	—	180	—	deg.	I_F = 200 mA
Forward voltage	V_F	—	1.7	2.3	V	I_F = 200 mA
		—	2.0*1	2.6*1		
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*1	—		
Fall time	t_f	—	12	—	ns	I_F = 50 mA
		—	20*1			

Note: 1. Value for devices with λp from 735 nm to 785 nm.
3. HLP20R – HLP40R are graded according to λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)		
Grade	**Min**	**Typ**	**Max**	**15 (Min)**	**25 (Min)**	**35 (Min)**
A	735	760	785	HLP20R	HLP30R	
B	775	800	825		HLP30R	HLP40R
C	815	840	865		HLP30R	HLP40R
D	855	880	905		HLP30R	HLP40R

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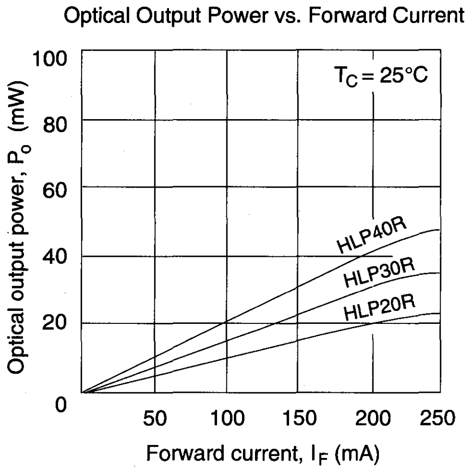
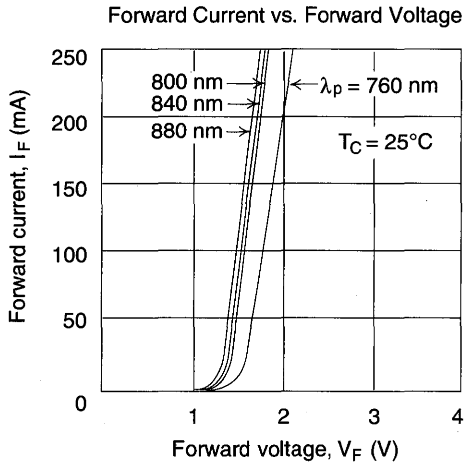
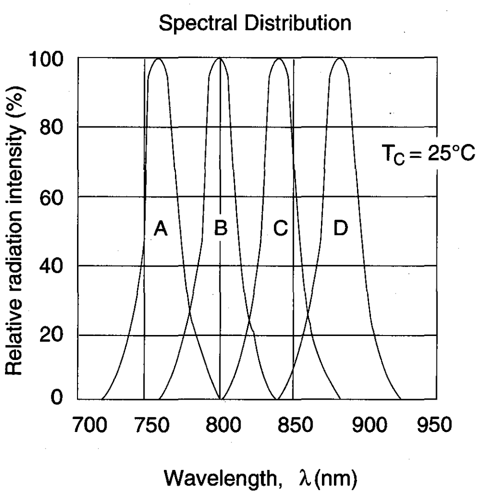
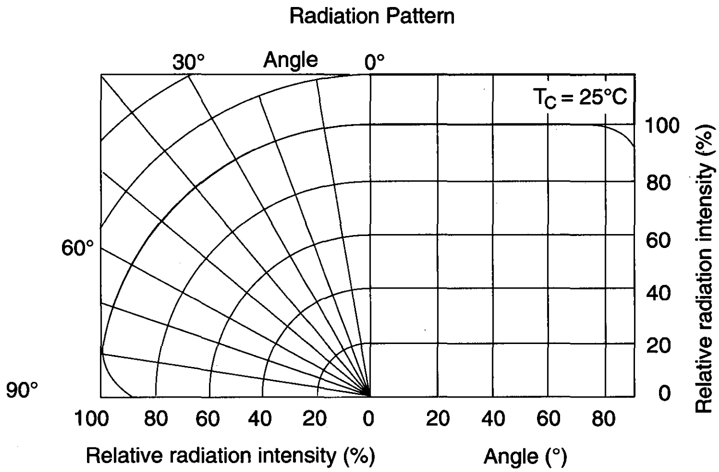
Typical Characteristic Curves







Typical Characteristic Curves (cont.)



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HLP20RG/30RG/40RG **GaAlAs IRED**

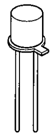
Description

The HLP20RG/30RG/40RG are GaAlAs infrared light emitting diodes with a single heterojunction structure. They are suitable as light sources for a variety of applied optical instruments.

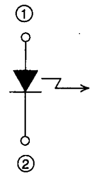
Features

- High efficiency
- Wide selection of wavelength and output power
- Narrow spectral width

Package Type
- HLP20RG: RG
- HLP30RG: RG
- HLP40RG: RG



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Forward current	I_F	250	mA
		230*1	
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

Note: 1. Value for devices with λ_p from 735 nm to 785 nm.

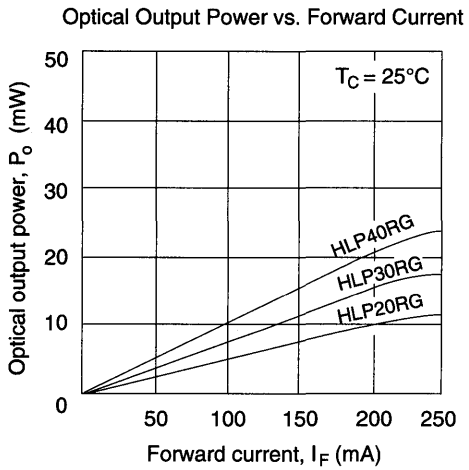
Optical and Electrical Characteristics ($T_C = 25°C$)

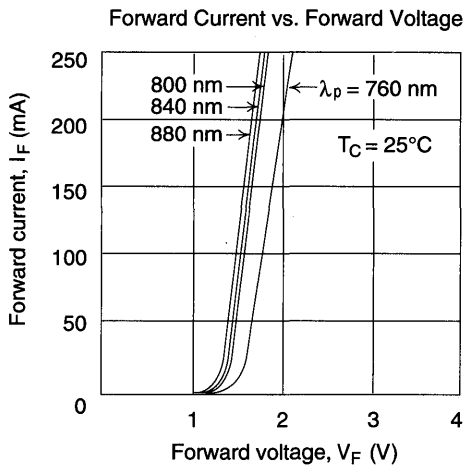
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	P_O		*2		mW	$I_F = 200$ mA
Peak wavelength	λ_p		*2		nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$	—	30	—	nm	$I_F = 200$ mA
Beam divergence	$\theta_{//}$	—	120	—	deg.	$I_F = 200$ mA
Forward voltage	V_F	—	1.7	2.3	V	$I_F = 200$ mA
		—	2.0*1	2.6*1		
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*1	—		
Fall time	t_f	—	12	—	ns	$I_F = 50$ mA
		—	20*1			

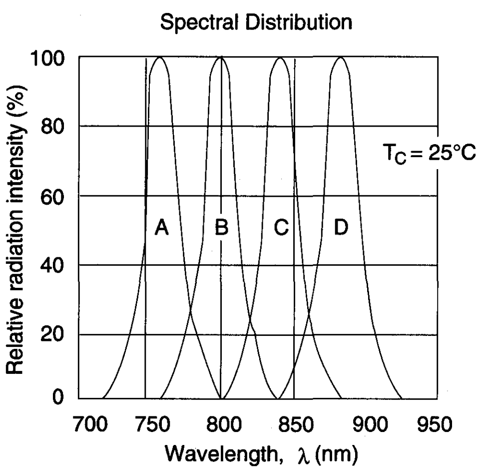
Note: 1. Value for devices with λp from 735 nm to 785 nm.
2. HLP20RG – HLP40RG are graded according to λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)		
Grade	**Min**	**Typ**	**Max**	**7 (Min)**	**12 (Min)**	**17 (Min)**
A	735	760	785	HLP20RG	HLP30RG	
B	775	800	825		HLP30RG	HLP40RG
C	815	840	865		HLP30RG	HLP40RG
D	855	880	905		HLP30RG	HLP40RG

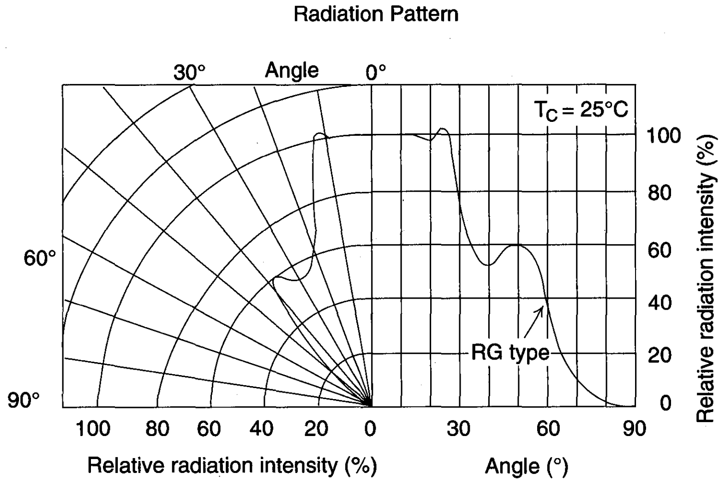
Typical Characteristic Curves







Typical Characteristic Curves (cont.)



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Photodiodes

HR8101 — Si PIN PD

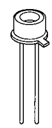
Description

The HR8101 is a Si PIN photodiode which responds to a 0.6 to 0.9 μm band. It is suitable as an optical detector for all types of optical application equipment, including measurement and communications.

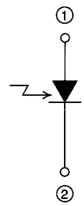
Features

- High speed pulse response: t_r, t_f = 30 ns, typ.
- Effective reception area: 0.8 by 0.8 mm.

Package Type
- HR8101: QG



Internal Circuit



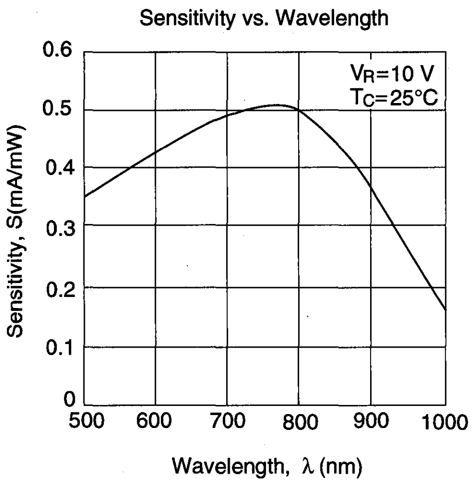
Absolute Maximum Ratings (T_C = 25°C)

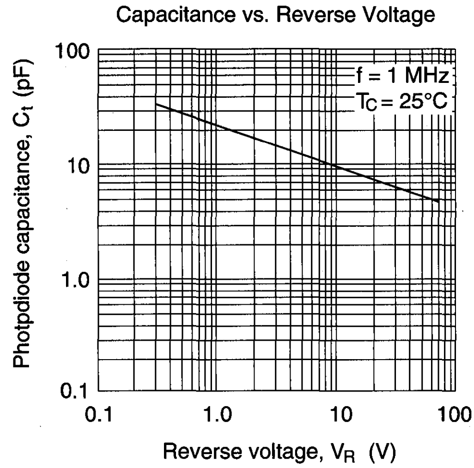
Item	Symbol	Rated Value	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	–40 to +80	°C
Storage temperature	T_{stg}	–45 to +100	°C

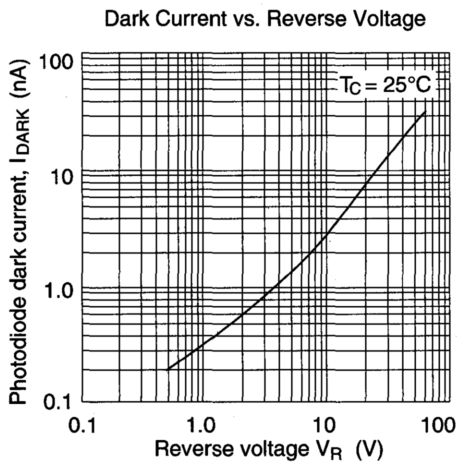
Optical and Electrical Characteristics (T_C = 25°C)

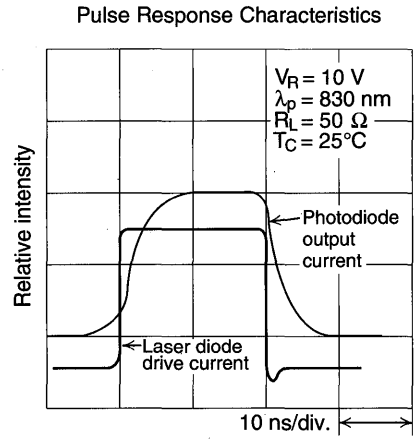
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	I_{DARK}	—	2	10	nA	V_R = 10 V
Capacitance	C_t	—	10	15	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4	—	—	mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r	—	30	—	ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f	—	30	—	ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

Typical Characteristic Curves









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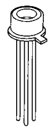
Description

The HR8102 is a Si PIN photodiode which responds to a 0.6 to 0.9 μm band. Its fast pulse response time makes it suitable as an optical detector for high capacity optical communication systems.

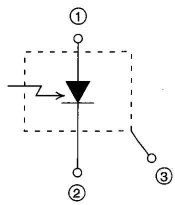
Features

- High sensitivity, wide bandwidth
- High speed pulse response: t_r, t_f = 1 ns, typ.
- 5V of low voltage operation possible
- Effective reception area: 300μm dia.

Package Type
- HR8102: TG1



Internal Circuit



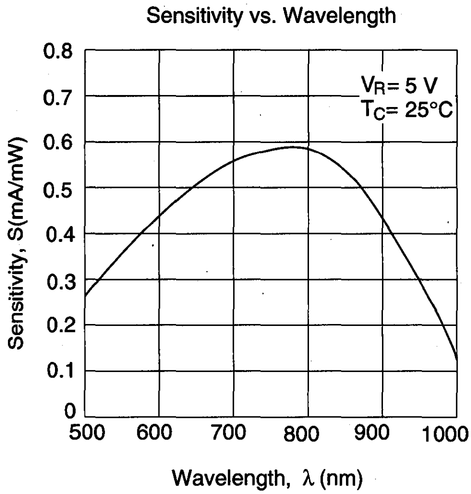
Absolute Maximum Ratings (T_C = 25°C)

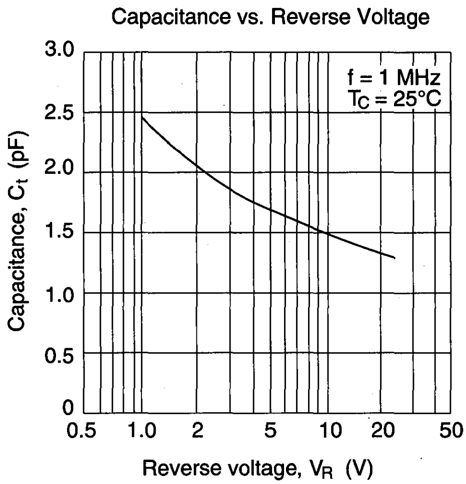
Item	Symbol	Rated Value	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	–40 to +80	°C
Storage temperature	T_{stg}	–45 to +100	°C

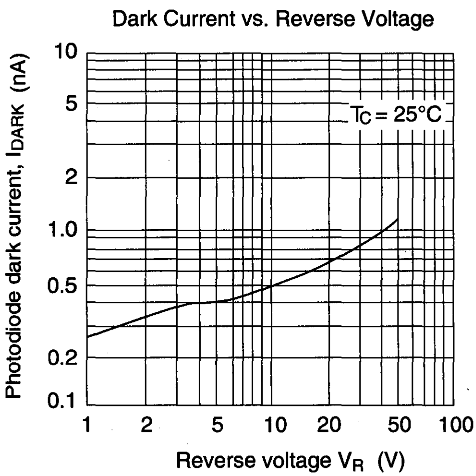
Optical and Electrical Characteristics (T_C = 25°C)

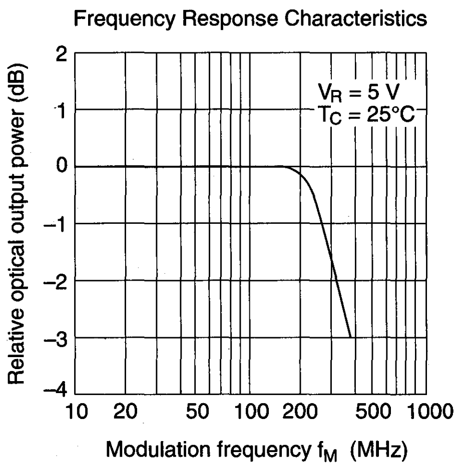
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	I_{DARK}	—	0.5	3	nA	V_R = 10 V
Capacitance	C_t	—	1.5	3	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4	—	—	mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r	—	1.0	—	ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f	—	1.0	—	ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

Typical Characteristic Curves









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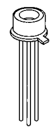
Description

The HR8202TG is a Si avalanche photodiode which responds to a 0.6 to 0.9 μm band. Its high frequency characteristics make it suitable as an optical detector especially for analog optical transmission systems.

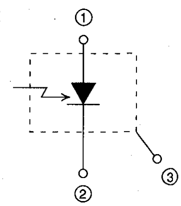
Features

- High quantum efficiency: 70%
- High speed response: 300 MHz
- Low dark current: 3 nA
- Low operating voltage: 200 V
- Effective reception area: 300 μm dia.

Package Type
- HR8202TG: TG1



Internal Circuit



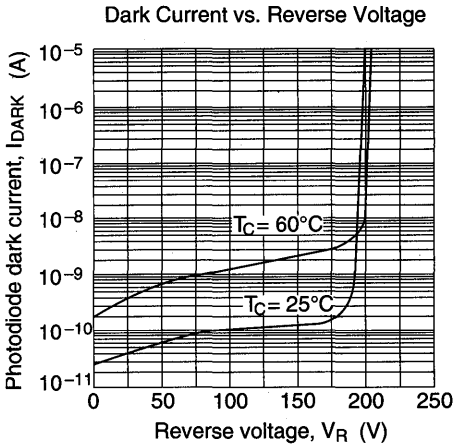
Absolute Maximum Ratings (T_C = 25°C)

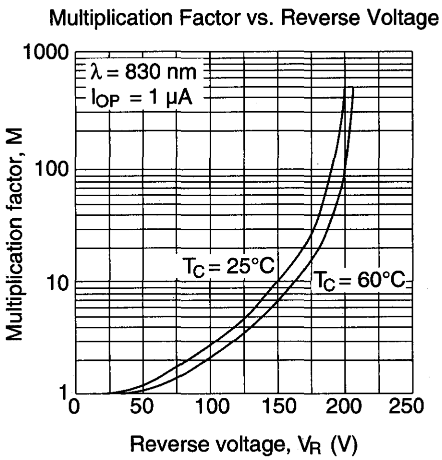
Item	Symbol	Rated Value	Units
Forward current	I_F	100	mA
Reverse current	I_R	200	μA
Operating temperature	T_{opr}	–40 to +80	°C
Storage temperature	T_{stg}	–45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

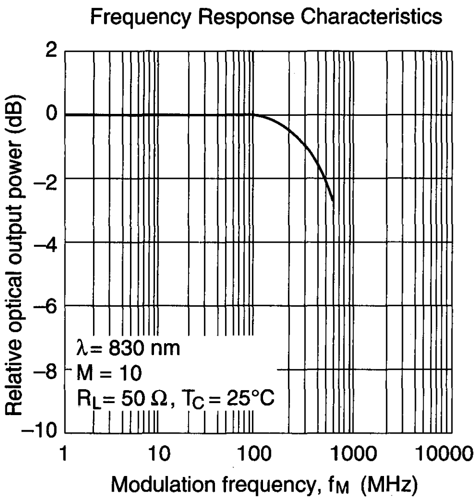
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	I_{DARK}	—	0.5	3	nA	$V_R = 0.9\ V_B$
Inter-pin capacitance	C_t	—	1.5	—	pF	V_R = 100 V, f = 1 MHz
Sensitivity	S	0.46	0.52	—	mA/mW	λ_p = 830 nm, M =1
Quantum efficiency	η	70	78	—	%	λ_p = 830 nm, M = 1
Breakdown voltage	V_B	150	180	220	V	I_{DARK} = 100 µA
Cut-off frequency	f_c	—	600	—	MHz	λ_p = 830 nm
						R_L = 50 Ω, M = 10
Excessive noise factor	F	—	2	—	—	λ_p = 830 nm, M = 10
	x	—	0.3	—	—	f = 10 MHz, B = 300 kHz
Multiplication factor	M	30	—	—	—	V_R = 0.9 VB, λ_p = 830 nm

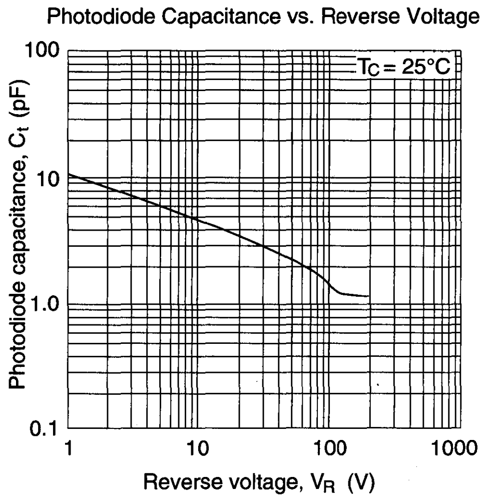
Typical Characteristic Curves

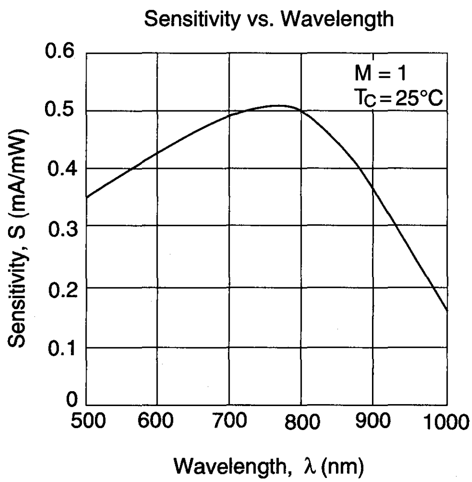




Typical Characteristic Curves (cont.)







HR8203KG (Preliminary) **Si APD**

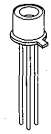
Description

The HR8203KG is a Si avalanche photodiode which responds to a 0.6 to 0.9 µm band. It is suitable as an optical detector for optical fiber communication systems.

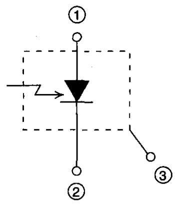
Features

- Low operation voltage: 80 V at I_{DARK} = 100 µA
- High quantum efficiency: 65% at M = 1
- Low dark current: 3 nA at 0.9 V_B
- Effective reception area: ϕ800 µm

Package Type
- HR8203KG: KG



Internal Circuit



Absolute Maximum Ratings (T_C = 25 ±3°C)

Item	Symbol	Rated Value	Unit
Forward current	I_F	100	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 ±3°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Quantum efficiency	η	65	—	—	%	λ_p = 830 nm, M = 1
Breakdown voltage	V_B	60	80	100	V	I_{DARK} = 100 µA
Temperature coefficient of breakdown voltage	γ	—	0.5	—	V/°C	
Dark current	I_{DARK}	—	10	50	nA	V_R = 0.9 V_B
Capacitance	C_t	—	—	6	pF	V_R = 0.9 V_B
Cut-off frequency	f_C	—	100	—	MHz	M = 50
Maximum multiplication ratio	M_{max}	50	—	—	—	I_{p0} = 2 µA
Excess noise factor	x	—	0.3	—	—	λ_p = 830 nm, M = 50 f = 10 MHz, B = 300 kHz

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Description

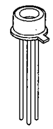
The HR1103TG/CX are InGaAs PIN photodiodes which respond to a 1.0 to 1.65 µm band. Their fast pulse response make them suitable as optical detectors for high capacity optical fiber communication systems.

Features

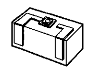
- Fast pulse response: t_r, t_f = 0.5 ns typ.
- High sensitivity: S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current: I_{DARK} = 1 nA typ.
- Effective reception area: 100 µm dia.
- Low capacitance: C_t = 1.0 pF typ. (HR1103TG)
  C_t = 1.2 pF typ. (HR1103CX)

Package Type

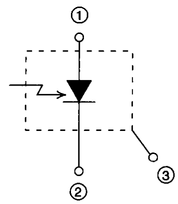
• HR1103TG: TG2

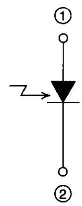


• HR1103CX: CX



Internal Circuit





Absolute Maximum Ratings (T_C = 25 ±3°C)

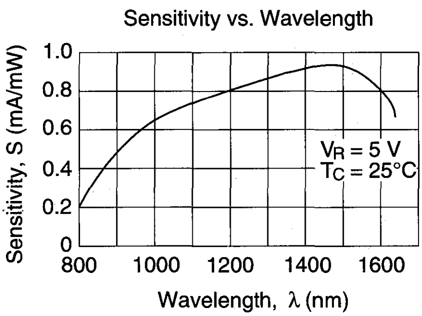
Item	Symbol	Rated Value	Unit
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	–40 to +80	°C
Storage temperature	T_{stg}	–45 to +100	°C

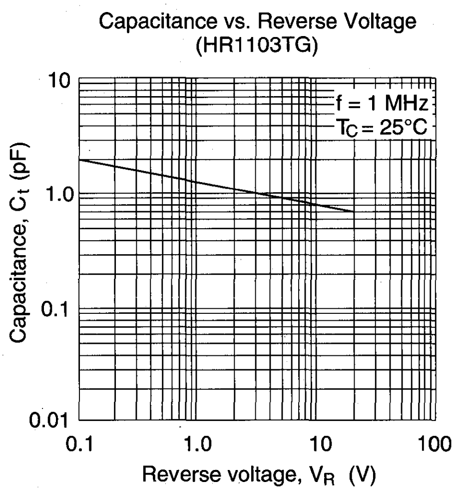
Note: The HR1103CX is intended for use in hermetically sealed packages. When using this product, please consult the "Handling Instructions" section in this book for more information.

Optical and Electrical Characteristics (T_C = 25°C)

Item		Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	HR1103TG	I_{DARK}	—	1	20	nA	V_R = 5 V
	HR1103CX		—	1	50		
Capacitance	HR1103TG	C_t	—	1.0	1.5	pF	V_R = 5 V, f = 1 MHz
	HR1103CX		—	1.2	2.0		
Sensitivity		S_1	0.73	0.85	—	mA/mW	V_R = 5 V, λ_p = 1300 nm
		S_2	—	0.9	—		V_R = 5 V, λ_p = 1550 nm
Sensitivity saturation bias 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

Typical Characteristic Curves





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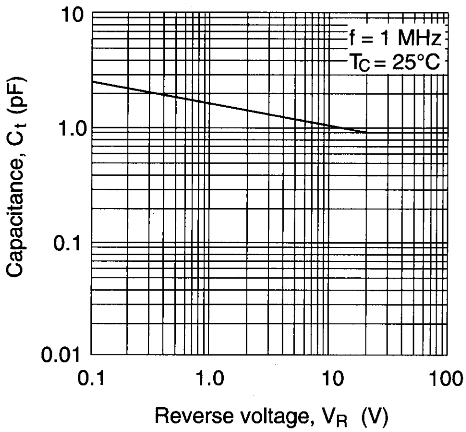
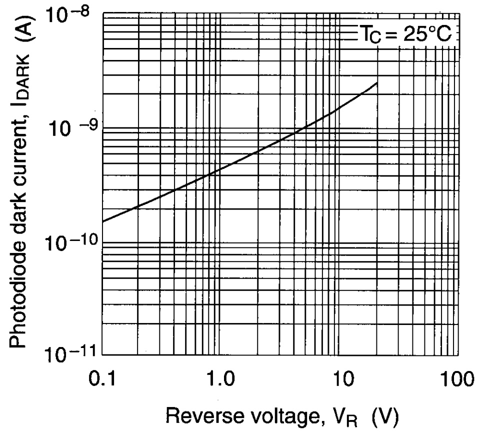
Typical Characteristic Curves (cont.)

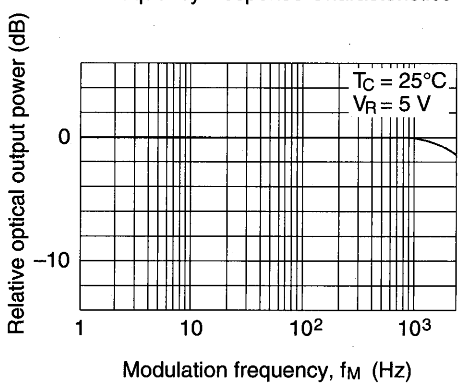
Capacitance vs. Reverse Voltage (HR1103CX)



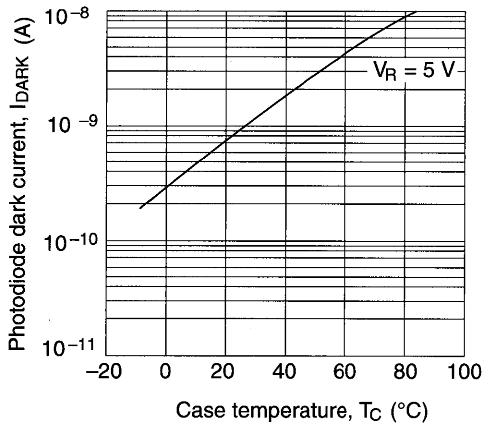
Dark Current vs. Reverse Voltage



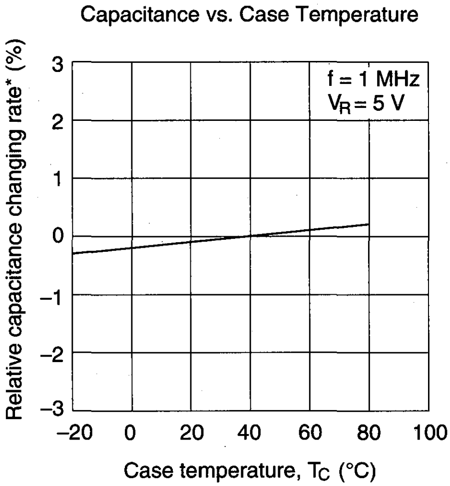
Frequency Response Characteristics



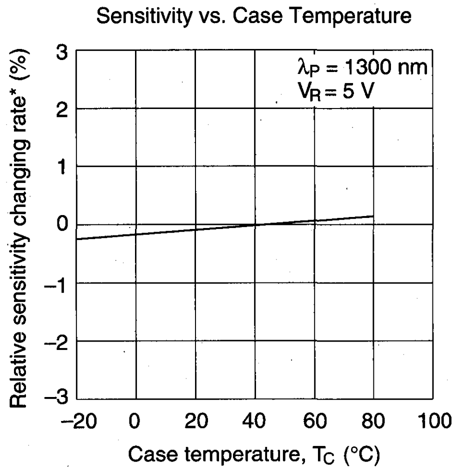
Dark Current vs. Case Temperature



Typical Characteristic Curves (cont.)



(*Between terminal pins at T_C = 25°C)



(*At T_C = 25°C)

HR1104TG/CX/MH

Description

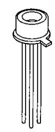
The HR1104TG/CX/MH are InGaAs PIN photodiodes which respond to a 1.0 to 1.65 μm band. They are suitable as optical detectors for high capacity optical fiber communication systems.

Features

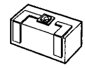
- Fast pulse response: t_r, t_f = 1.0 ns typ.
- High sensitivity: S = 0.9 mA/mW typ. (λ_p=1550 nm)
- Low dark current: I_{DARK} = 1 nA typ.
- Low capacitance: C_t = 5 pF typ.
- Effective reception area: 300 μm dia.

Package Type

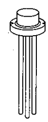
- HR1104TG: TG2



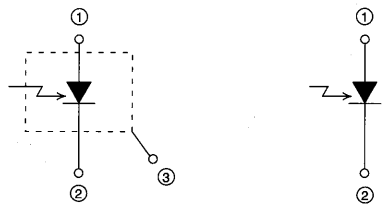
- HR1104CX: CX



- HR1104MH: MH



Internal Circuit



HR1104TG
HR1104MH

HR1104CX

Note: The HR1104CX is intended for use in hermetically sealed packages. When using this product, please consult the “Handling Instructions” section in this book for more information.

Absolute Maximum Ratings (T_C = 25 ±3°C)

Item	Symbol	Rated Value	Unit
Reverse voltage	V_R	20	V
Forward current	I_F	4	mA
Reverse current	I_R	2	mA
Operating temperature	T_{opr}	–40 to +85	°C
Storage temperature	T_{stg}	–45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	I_{DARK}	—	1	30	nA	V_R = 5 V
Capacitance G	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	—		V_R = 5 V, λ_p = 1550 nm
Sensitivity saturation bias 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

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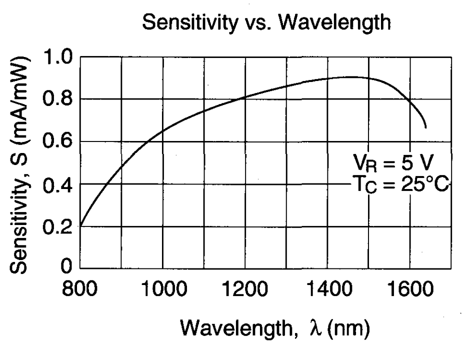
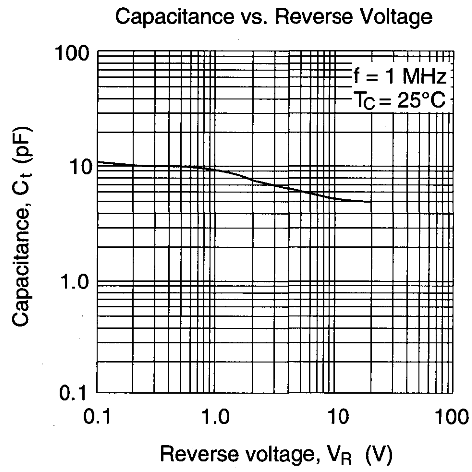
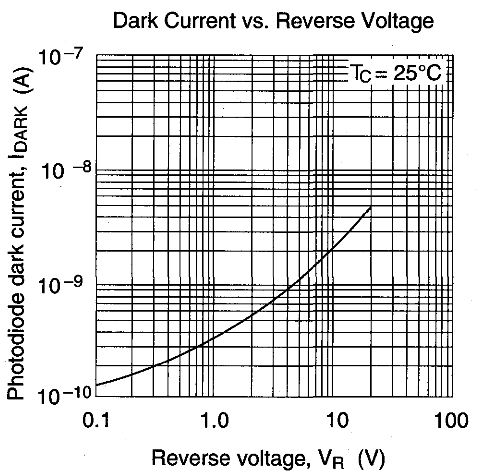
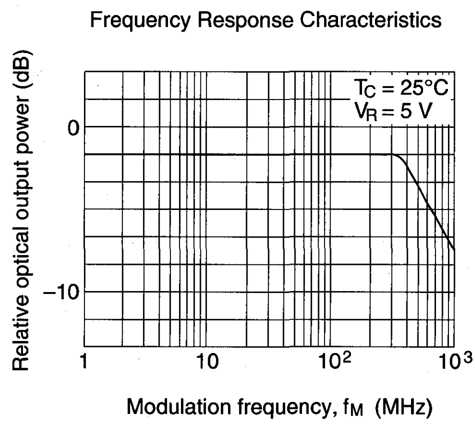
Typical Characteristic Curves

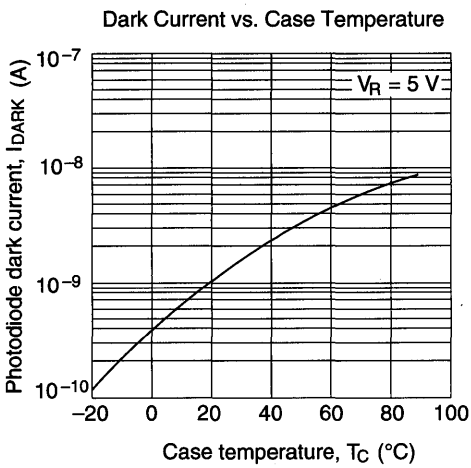


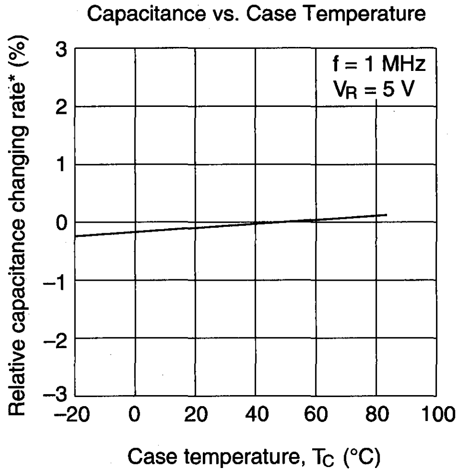




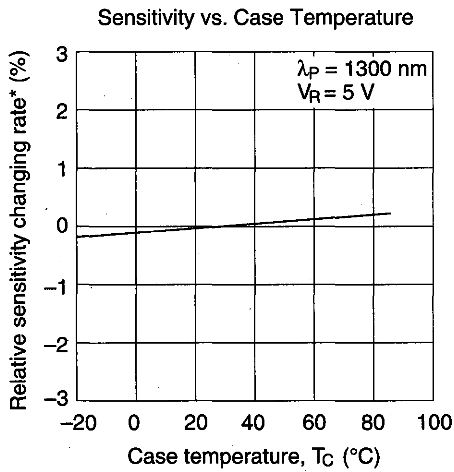


Typical Characteristic Curves (cont.)





(*Between terminal pins at $T_C = 25°C$)



(*At $T_C = 25°C$)

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HR1105TG/MR/CR — InGaAs PIN PD

Description

The HR1105TG/MR/CR are InGaAs PIN photodiodes which respond to a 1.0 μm to 1.65 μm band. Their fast pulse response makes them suitable as optical detectors for high-bit-rate optical fiber communication systems.

Features

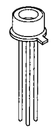
- Fast pulse response: t_r, t_f = 0.3 ns Typ.
- High sensitivity:
  S = 0.9 mA/mW Typ. (λ_p = 1550 nm,TG/MR)
  S = 0.8 mA/mW Typ. (λ_p = 1550 nm,CR)
- Low dark current: I_{DARK} = 1 nA Typ.
- Low capacitance:
  C_t = 0.8 pF Typ. (TG/MR)
  C_t = 0.9 pF Typ. (CR)
- Photodetectable area: 80 μm Dia.

Fiber Specifications (HR1105CR)

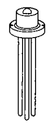
Numerical aperture: 0.2
Core diameter: 50 μm
Outer diameter: 125 μm
Jacket diameter: 900 μm
Refractive index profile: GI
Fiber length: More than 500 mm

Package Type

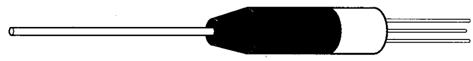
- HR1105TG: TG2



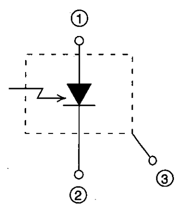
- HR1105MR: MR



- HR1105CR: CR



Internal Circuit



Absolute Maximum Ratings (T_C = 25 ±3°C)

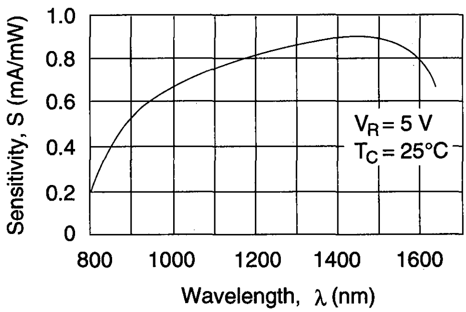
Item		Symbol	Rated Value	Unit
Reverse voltage		V_R	20	V
Forward current		I_F	5.0	mA
Reverse current		I_R	500	μA
Operating temperature	TG/MR	T_{opr}	–40 to +80	°C
	CR		–20 to +75	
Storage temperature	TG/MR	T_{stg}	–45 to +100	°C
	CR		–45 to +80	

Optical and Electrical Characteristics (T_C = 25°C)

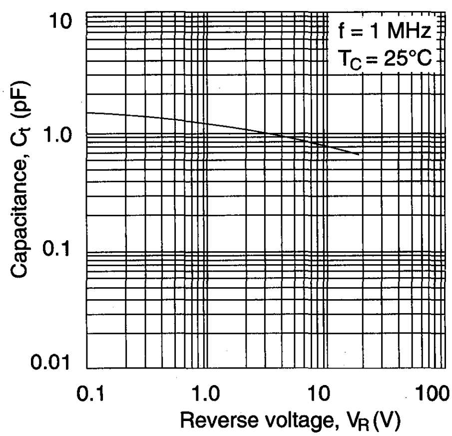
Item		Symbol	Min	Typ	Max	Units	Test Conditions
Dark current	HR1105TG/MR	I_{DARK}	—	1	10	nA	V_R = 5 V
	HR1105CX		—	1	5		
Capacitance	HR1105TG/MR	C_t	—	0.8	1.2	pF	V_R = 5 V, f = 1 MHz
	HR1105CR		—	0.9	1.3		
Sensitivity	HR1105TG/MR	S_1	0.73	0.85	—	mA/mW	V_R = 5 V, λ_p = 1300 nm
	HR1105CR		0.63	0.78	—		
	HR1105TG/MR	S_2	—	0.9	—	mA/mW	V_R = 5 V, λ_p = 1550 nm
	HR1105CR		—	0.8			
Sensitivity saturation bias voltage		$V_{R(S)}$	—	—	2	V	—
Rise time		t_r	—	0.3	—	ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω
Fall time		t_f	—	0.3	—	ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω

Typical Characteristic Curves

Sensitivity vs. Wavelength



Capacitance vs. Reverse Voltage



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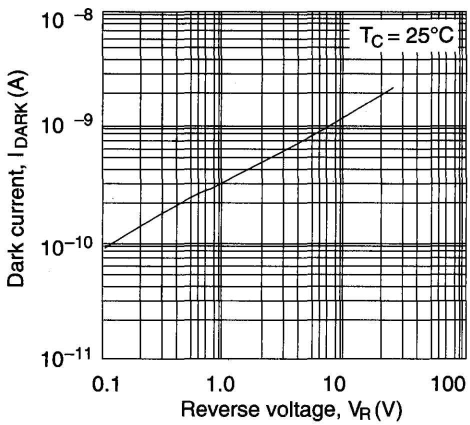
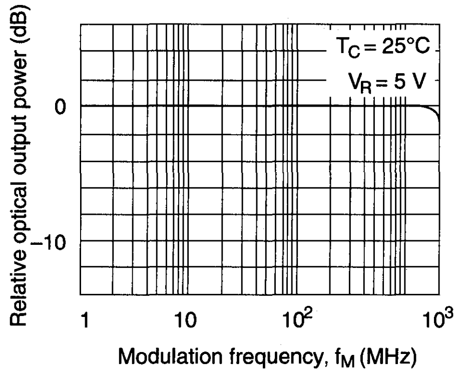
Typical Characteristic Curves (cont.)

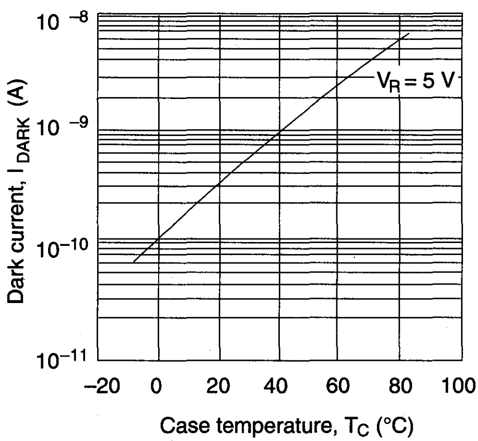
Dark Current vs. Reverse Voltage



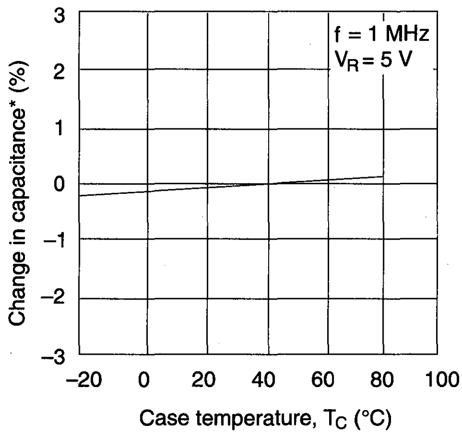
Frequency Response



Dark Current Temperature Dependence

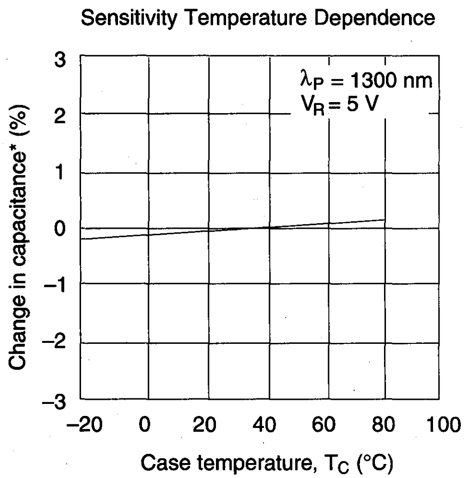


Capacitance Temperature Dependence



(* Across terminal pins, relative to T_C = 25°C)

Typical Characteristic Curves (cont.)



(* Across terminal pins, relative to T_C = 25°C)

HR1201TG/CX/FR

Description

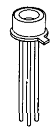
The HR1201TG/CX/FR are InGaAs avalanche photodiodes which respond to a 1.0 μm to 1.65 μm. Their fast pulse response makes them suitable as optical detectors for high-bit-rate optical fiber communication systems.

Features

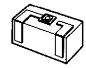
- High sensitivity:
  S = 0.9 mA/mW (TG/CX)
  S = 0.8 mA/mW (FR) at λ_p = 1550 nm Typ.
- Low dark current: I_{DARK} = 2 nA Typ.
- Small capacitance:
  C_t = 0.5 pF (TG)
  C_t = 0.7 pF (CX/FR)
- Photodetectable area: 50 μm Dia.
- High multiplication ratio: M = 40 Typ.
- Excellent frequency characteristics:
  G.B. = 30 (TG/CX)
  G.B. = 20 (FR) (G.B. product Typ.)
- Slim package with multi mode fiber (FR)

Package Type

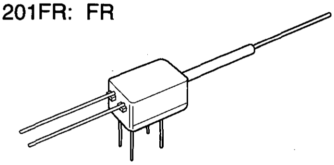
- HR1201TG: TG



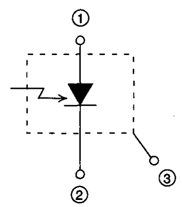
- HR1201CX: CX



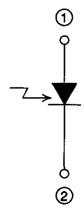
- HR1201FR: FR



Internal Circuit



HR1201TG2



HR1201CX/FR

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Fiber Specifications (HR1201FR)

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

Absolute Maximum Ratings (T_C = 25 ±3°C)

Item		Symbol	Rated Value	Unit
Reverse voltage		V_R	10	V
Forward current		I_F	500	μA
Reverse current		I_R	500	μA
Operating temperature	TG/CX	T_{opr}	–40 to +80	°C
	FR		–20 to +75	
Storage temperature	TG/CX	T_{stg}	–45 to +100	°C
	FR		–40 to +85	

Note: The HR1201CX is intended for use in hermetically sealed packages. When using this product, please consult the "Handling Instructions" section in this book for more information.

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

Item		Symbol	Min	Typ	Max	Units	Test Conditions
Dark current		I_{DARK}	—	1	20	nA	$V_R = 0.9\ V_B$
Multiplied dark current		I_{DM}	—	0.5	5	nA	M = 1
Capacitance	(TG)	C_t	—	0.5	0.8	pF	$V_R = 0.9\ V_B$, f = 1 MHz
	(CX/FR)		—	0.7	1.0		
Sensitivity	(TG/CX)	S_1	0.73	0.85	—	mA/mW	$\lambda_p = 1300$ nm
	(FR)		0.7	0.75	—		
	(TG/CX)	S_2	—	0.9	—	mA/mW	$\lambda_p = 1550$ nm
	(FR)		—	0.8			
Breakdown voltage		V_B	60	80	100	V	$I_{DARK} = 100\ \mu A$
Cutoff frequency	(TG/CX/FR)	f_C	1	—	—	GHz	M = 5; $\lambda_p = 1300$ nm, $R_L = 50\ \Omega$, 500 kHz to – 3 dB
			1	—	—		M = 10
	(FR)		—	0.4	—		M = 30
	(TG/CX)		—	1	—		
Excess noise factor		F	—	5	—	—	$\lambda_p = 1300$ nm, M = 10, f = 30 MHz, B = 1 MHz, $I_{p0} = 2\ \mu A$
		x	—	0.7	—	—	
Maximum multiplication ratio		M	30	40	—	—	$\lambda_p = 1300$ nm, $I_{p0} = 2\ \mu A$

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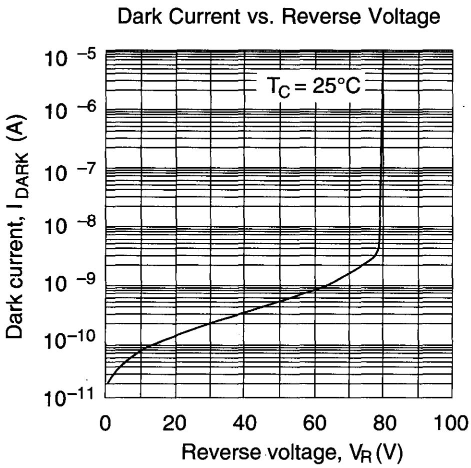
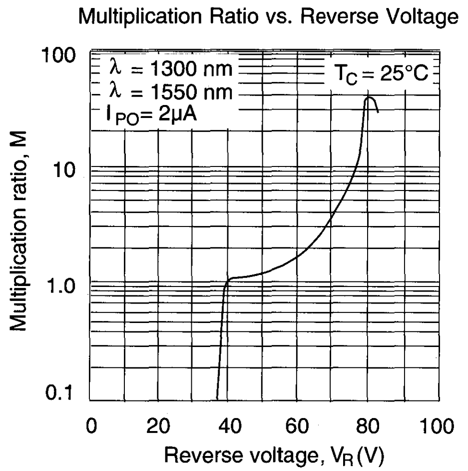
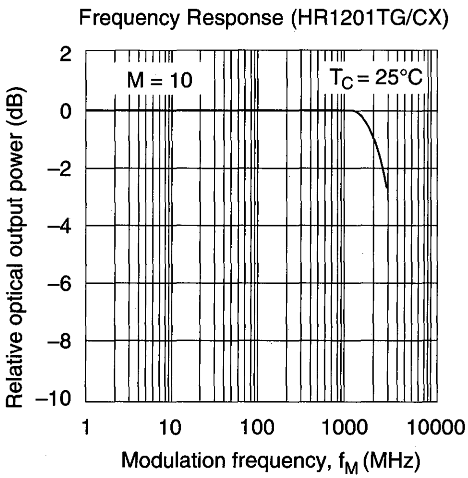
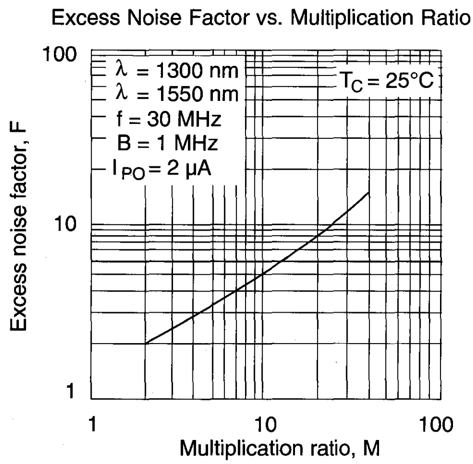
Typical Characteristic Curves



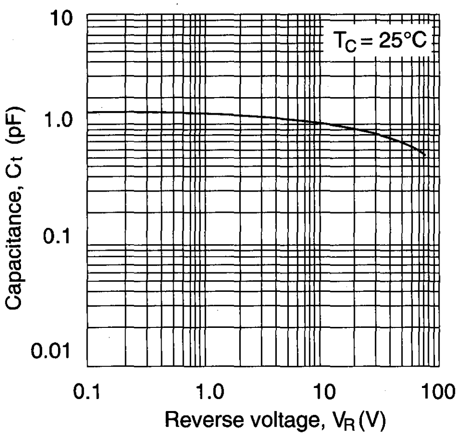




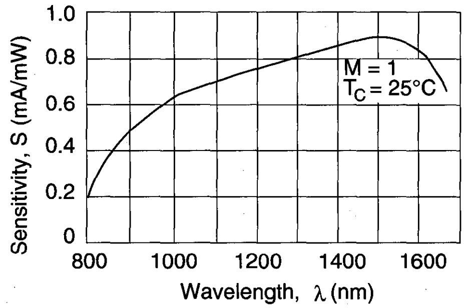


Typical Characteristic Curves (cont.)

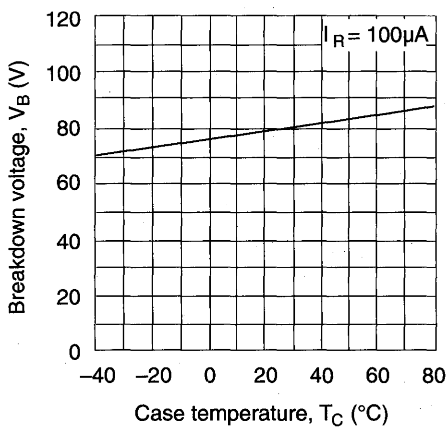
Capacitance vs. Reverse Voltage



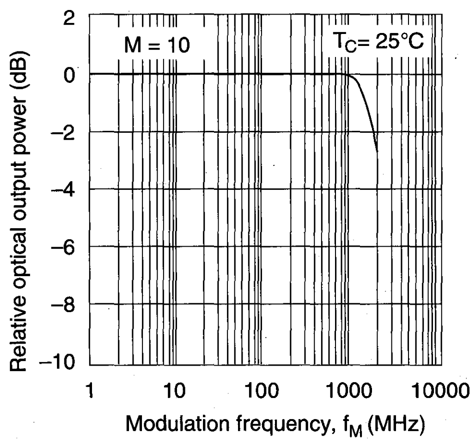
Sensitivity vs. Wavelength



Breakdown Voltage vs. Temperature Dependence



Frequency Response (HR1201FR)



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Product not Actively Promoted

HL6411G

Description

The HL6411G is a 0.63 μm band AlGaInP laser diode with a multi-quantum well (MQW) structure. It is suitable as a light source for laser pointers, laser levelers and various other types of optical equipment. Hermetic sealing of the package assures high reliability.

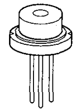
Application

- Laser pointer

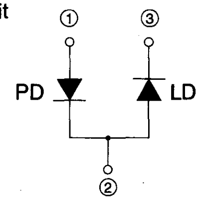
Features

- Visible light output at wavelengths up to 640 nm. (nearly equal to He-Ne gas laser)
- Optical output power: 3 mW CW
- Low operating voltage: 2.8 V Max.
- Single longitudinal mode
- Low astigmatism: 10 μm Typ.
- Built-in monitor photodiode

Package Type
- HL6411G: G2



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

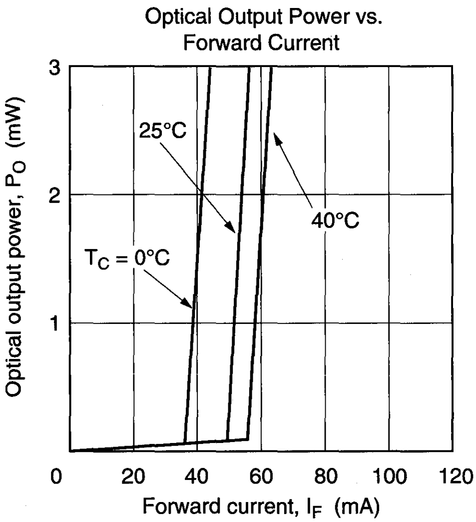
Item	Symbol	Rated Value	Unit
Optical output power	P_O	3	mW
Pulsed optical output power	$P_{O\ (pulse)}$	5*1	mW
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	30	V
Operating temperature	T_{opr}	–10 to +40	°C
Storage temperature	T_{stg}	–40 to +85	°C

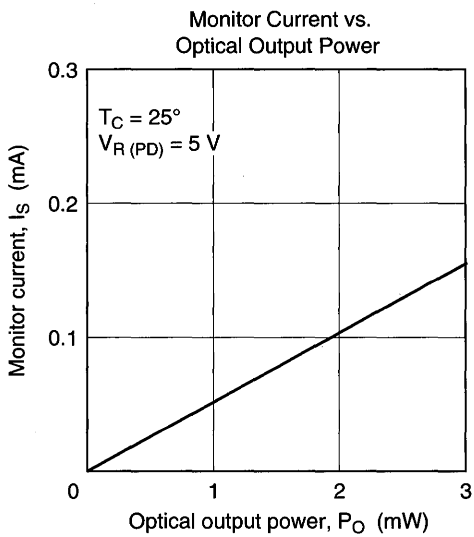
Note: 1. Maximum 50% duty cycle, maximum 1 μs pulse width

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Threshold current	I_{th}	20	55	70	mA	
Optical output power	P_O	3	—	—	mW	Kink free
Operating voltage	V_{op}	—	—	2.8	V	P_O = 3 mW
Operating current	I_{op}	—	65	85	mA	
Lasing wavelength	λ_p	625	633	640	nm	P_O = 3 mW
Beam divergence (parallel)	$\theta_{//}$	5	8	11	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)	$\theta_{\perp}$	25	31	37	deg.	P_O = 3 mW, FWHM
Monitor current	I_S	0.08	—	0.4	mA	P_O = 3 mW, $V_{R(PD)}$ = 5 V
Astigmatism	A_S	—	10	—	µm	P_O = 3 mW, NA = 0.4

Typical Characteristic Curves





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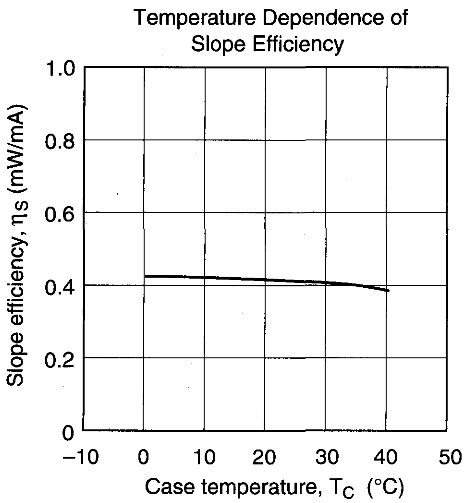
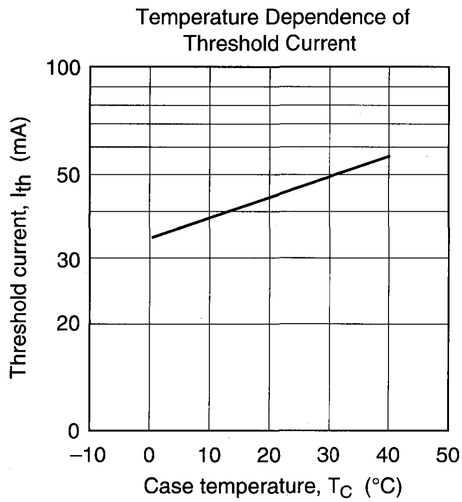
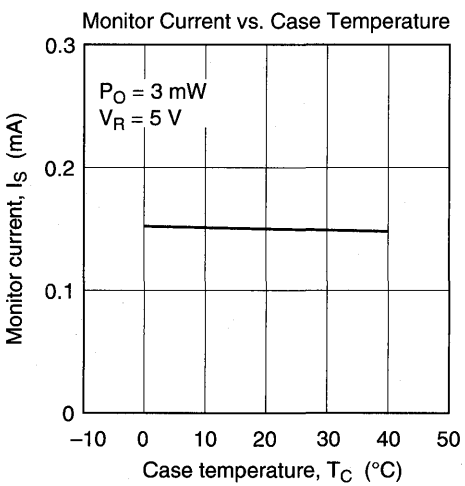
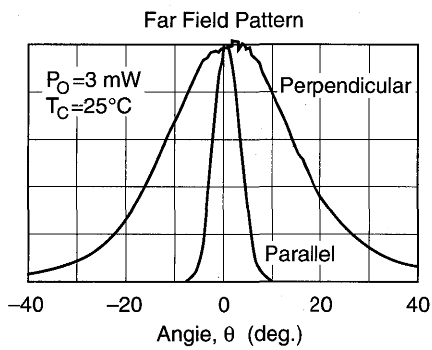
Typical Characteristic Curves (cont.)

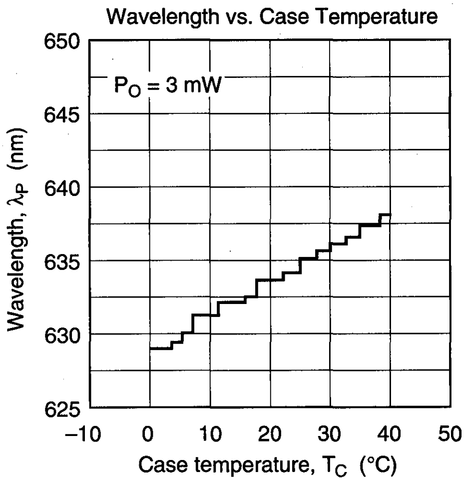








Typical Characteristic Curves (cont.)



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Part 2

2

Fiberoptics Components

Product Lineup

2

Product Lineup

Data Rate	Transmitter	Receiver	Distance ‡
OC-1 52Mb/s	Transceiver TRV5366 * FP-LD, 1.3μm InGaAs PIN-PD		≤ 400m
	TRV5367 * FP-LD, 1.3μm Ge APD		≥ 40km
OC-3 156Mb/s	TRM5612 series FP-LD, 1.3μm	RCV5602 series InGaAs PIN-PD	≥ 15km
	Transceiver TRV5466 * FP-LD, 1.3μm InGaAs PIN-PD		≤ 400m
	TRV5467 * FP-LD, 1.3μm Ge APD		≥ 40km
	† TRM5467 FP-LD, 1.3μm	† RCV5467 * InGaAs APD	≥ 80km
OC-12 622Mb/s	TRM5714AN FP-LD, 1.3μm	RCV5703AN * InGaAs PIN-PD	≥ 2km
	TRM5712AN FP-LD, 1.3μm, TEC	RCV5707AH * InGaAs APD	≥ 40km
	TRM5732AN DFB-LD, 1.3μm, TEC	RCV5737AH * InGaAs APD	≥ 60km
	TRM7732AN DFB-LD, 1.55μm, TEC		≥ 80km
OC-48 2488Mb/s	TRM5934AN DFB-LD, 1.3μm, TEC	RCV5931AN * InGaAs APD	≥ 40km
	TRM7934AN MQW-LD, 1.55μm, TEC		≥ 80km
	Laser Diode Module LB5374 DFB-LD, 1.3μm, TEC	Front-end Receiver PS5931 InGaAs APD, Pre-Amp	≥ 40km
	LB7374 MQW-LD, 1.55μm, TEC		≥ 80km
OC-3/12 156M/622Mb/s	LC5272 FP-LD, 1.3μm, TEC		≥ 20km

Note ‡ Depending upon the characteristics of fiber used in the system.
* Clock recovery is included.
† These products are under development.
▭ Products under second source agreement.

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Main Characteristics

Transmitters and Tranceivers (Transmitter Section)

Part No.	Data Rate	(Mb/s)	Absolute Maximun Ratings: Operating Temperature (°C)	Absolute Maximun Ratings: Storage Temperature (°C)	Optical and Electrical Characteristics: Output Power Typ(dBm)	Optical and Electrical Characteristics: Laser Temperature Control	Reference Page
TRV5366 *	OC-1	52	+10 to +60	–40 to +80	–11	n/a	382
TRV5367 *		52	+10 to +60	–40 to +80	0	n/a	384
TRV5466 *	OC-3	156	+10 to +60	–40 to +80	–11	n/a	386
TRM5612FN/GN/HN		1 to 200	0 to +65	–40 to +85	–11	n/a	352
TRM5612FH/GH/HH		1 to 200	–40 to +85	–40 to +85	–11	n/a	352
TRV5467 *		156	+10 to +60	–40 to +80	0	n/a	388
TRM5467 †		156	0 to +65	–20 to +70	+3	n/a	350
TRM5714AN	OC-12	1 to 622	0 to +65	–20 to +75	–11.5	n/a	356
TRM5712AN		1 to 622	–40 to +75	–40 to +85	0	included	354
TRM5732AN		1 to 622	–40 to +75	–40 to +85	0	included	358
TRM7732AN		1 to 622	–40 to +75	–40 to +85	0	included	360
TRM5934AN	OC-48	52 to 2,488	0 to +65	–20 to +75	–3	included	362
TRM7934AN		52 to 2,488	0 to +65	–20 to +75	–2	included	364

†: Under development
*: Tranceiver

Receivers and Tranceivers (Receiver section)

Part No.	Data Rate	(Mb/s)	Absolute Maximun Ratings: Operating Temperature (°C)	Absolute Maximun Ratings: Storage Temperature (°C)	Optical and Electrical Characteristics: Min.Received Power Typ(dBm)	Optical and Electrical Characteristics: Clock Recovery Circuit	Reference Page
TRV5366 *	OC-1	52	+10 to +60	–40 to +80	–25	included	382
TRV5367 *		52	+10 to +60	–40 to +80	–36	included	384
TRV5466 *	OC-3	156	+10 to +60	–40 to +80	–25	included	386
RCV5602FN/GN/HN		156	0 to +65	–40 to +85	–38	n/a	370
RCV5602FH/GH/HH		156	–40 to +85	–40 to +85	–38	n/a	370
TRV5467 *		156	+10 to +60	–40 to +80	–36	included	388
RCV5467 †		156	0 to +65	–20 to +70	–45	included	368
RCV5703AN	OC-12	622	0 to +65	–20 to +75	–28	included	372
RCV5707AH		622	–20 to +85	–40 to +85	–34	included	374
RCV5737AH		622	–20 to +85	–40 to +85	–38	included	376
RCV5931AN	OC-48	2,488	0 to +65	–40 to +70	–32	included	378

†: Under development
*: Tranceiver

2

Main Characteristics

Laser Diode Modules

Part No.	Data Rate	(Mb/s)	Absolute Maximun Ratings Operating Temperature (°C)	Storage Temperature (°C)	Optical and Electrical Characteristics Fiber output Power Typ(mW)	Test Condition I_F (mA)	Reference Page
LC5272	OC-12	≤622	–20 to +60	–40 to +70	1.5	Ith+20	392
LB5374	OC-48	≤2,488	–20 to +65	–40 to +70	1.5	Ith+20	394
LB7374		≤2,488	–20 to +65	–40 to +70	1.0	Ith+20	396

Front-end Receiver

Part No.	Data Rate	(Mb/s)	Absolute Maximun Ratings Operating Temperature (°C)	Storage Temperature (°C)	Optical and Electrical Characteristics Min.Received Power Typ(dBm)	Trans-impedance Typ(Ω)	Reference Page
PS5931	OC-48	2,488	–10 to +70	–40 to +70	–32	800	400

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Specification Sheets

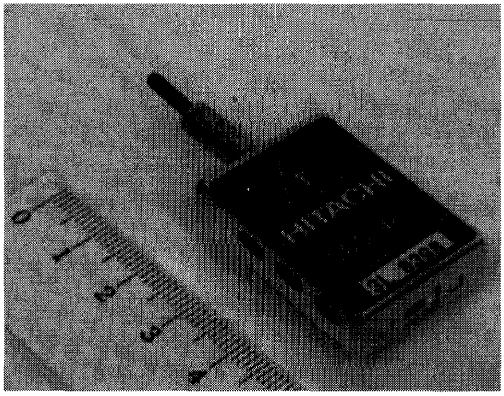
Transmitters

2

Description

The TRM5467 is a lightwave transmitter for OC-3.

Features



- Fabry-Perot laser diode
- High optical output power: +1dBm min.
- Operation at 155.52 Mb/s (Scrambled NRZ) at 1.3 μm wavelength
- Uncooled laser with automatic optical power control for constant output power over temperature range
- ECL10K interface
- Low-power alarm and shutdown

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Supply voltage	V	–6.2	V
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 70	°C
Humidity (long-term)	—	55	%
Lead soldering temperature	T_s	260	°C
Lead soldering time	—	10	sec

Optical Characteristics (T_C = 0 to 65°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	1	—	7	dBm	Single-mode fiber
Center wavelength	λ_c	1280	1310	1330	nm	
RMS spectral width	$\Delta\lambda$	—	—	4	nm	
Extinction ratio	—	13	—	—	dB	P_{OH} / P_{OL}
Optical Eye Pattern Mask	—	—	—	—	—	ITU-TSS(CCITT G957)

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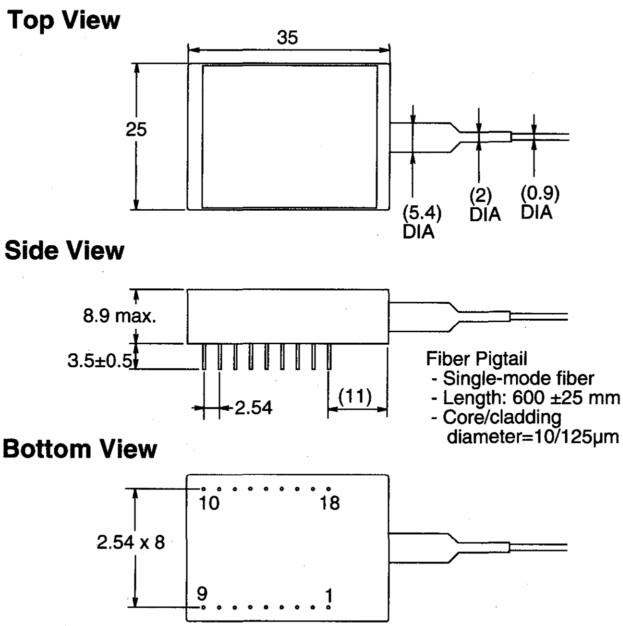
Electrical Characteristics (T_C = 0 to 65°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V	–4.94	–5.2	–5.46	V	
DC power supply current	I	—	—	180	mA	V_{EE} = –5.2 V

Outline Drawings and Pin Descriptions



Pin	Description
1:	Ground
2:	Ground
3:	Ground
4:	V_{EE}
5:	V_{EE}
6:	Ground
7:	Data In
8:	Clock In
9:	Ground
10:	Ground
11:	Shutdown In
12:	Ground
13:	Alarm Out
14:	Ground
15:	V_{EE}
16:	V_{EE}
17:	V_{EE}
18:	Ground

Dimension: mm

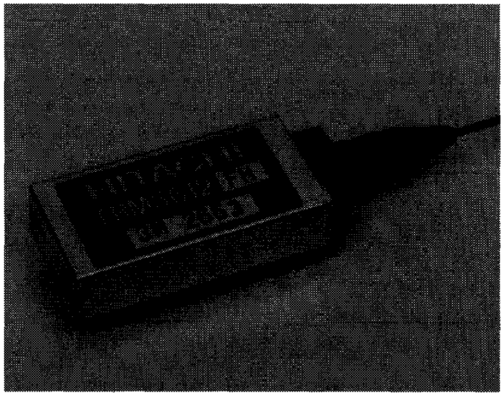
2

Description

The TRM5612 is a lightwave transmitter for OC-1 and OC-3.

Features

- Complied with SONET/SDH standard
- Fabry-Perot laser diode
- Operation at the rates of up to 200 Mb/s at 1.3 μm wavelength
- Uncooled laser with automatic optical power control for constant output power over temperature range
- Hermetically sealed, 20-pin DIP
- Performance monitors



Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Supply voltage	V	5.5	V
Operating case temperature	T_{opr}	–40 to 85 (0 to 65) *	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Humidity (long-term)	—	85	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

* Specification depends upon the part number.

Optical Characteristics (Over operating temperature range)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output **	$\overline{P_O}$	–15	–11	–8	dBm	Single-mode fiber
Center wavelength	λ_c	1260	1308	1360	nm	
RMS spectral width	$\Delta\lambda$	—	—	4	nm	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical rise and fall times	t_r, t_f	—	—	T/3	ns	10 to 90% (50% duty cycle) T: bit-period

** Other output power options are available.

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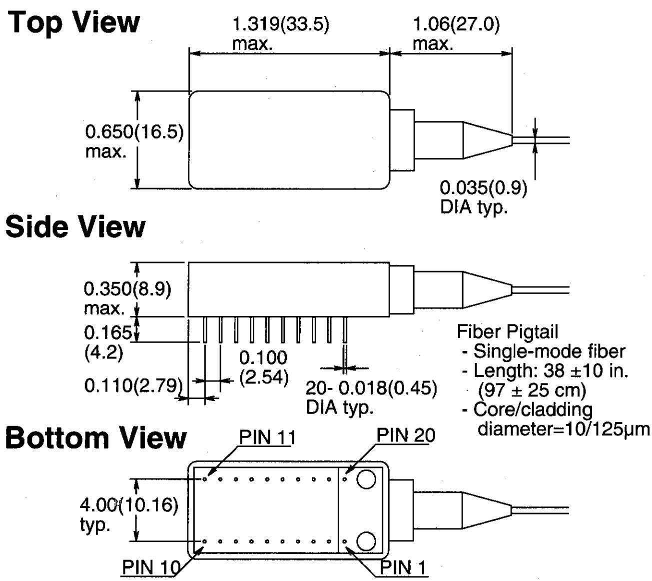
Electrical Characteristics (Over operating temperature range)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V	4.75	5.0	5.50	V	V_{CC}–V_{EE}
DC power supply current	I	—	—	130	mA	V_{CC} = 5.0 V
Input data voltage						V_{CC} = 5.0 V
Low	V_{IL}	—	V_{CC} – 1.8	—	V	50Ω load to (V_{CC}–2) V
High	V_{IH}	—	V_{CC} – 0.8	—		
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period
Disable voltage	V_D	V_{CC} – 2.0	—	V_{CC}	V	
Enable voltage	V_{EN}	V_{EE}	—	V_{EE} + 0.8	V	

Outline Drawings and Pin Descriptions

Tolerance: ±0.005 in. (±0.127 mm)
Dimension: inch (mm)



Pin	Description
1:	No user connection
2:	Laser-bias monitor (+)*
3:	No user connection
4:	Laser-bias monitor (–)*
5:	V_{EE}
6:	V_{CC}
7:	Transmitter disable
8:	V_{CC}
9:	V_{CC}
10:	No user connection
11:	Case ground
12:	V_{CC}
13:	Case ground
14:	V_{EE}
15:	$\overline{\text{DATA}}$
16:	DATA
17:	Laser-backface monitor (–)*
18:	V_{CC}
19:	Laser-backface monitor (+)*
20:	No user connection

* Laser backface and bias monitor functions are customer-use options that are used during manufacture and for diagnostics and are not required for normal operation of the transmitter.

Ordering Information

Operating case temperature (°C)	Connector	Part Number
0 to 65	FC-PC	TRM5612FN
0 to 65	ST *	TRM5612GN
0 to 65	SC	TRM5612HN
–40 to 85	FC-PC	TRM5612FH
–40 to 85	ST *	TRM5612GH
–40 to 85	SC	TRM5612HH

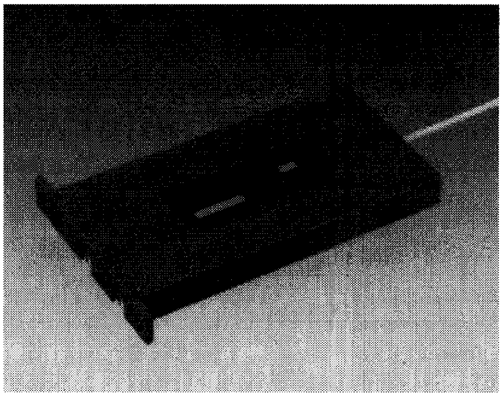
* ST is a registered trademark of AT&T.

2

Description

The TRM5712AN is a lightwave transmitter for OC-12.

Features



- Complied with SONET/SDH standard
- Fabry-Perot laser diode
- Operation from 1Mb/s to 622.08Mb/s at 1.3 µm wavelength
- 50Ω, AC-coupled interface
- Low-power-alarm and performance monitors

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–40 to 75	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Humidity (long-term)	—	55	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–1.25	0	1.25	dBm	622Mb/s, T_C = 0 to 65°C
		–1.50	0	1.50		156Mb/s, T_C = –40 to 75°C
Center wavelength	λ_c	1300	—	1320	nm	622Mb/s, T_C = 0 to 65°C
		1280	—	1335		156Mb/s, T_C = –40 to 75°C
RMS spectral width	$\Delta\lambda$	—	—	2.5	nm	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical rise and fall times	t_r, t_f	—	—	0.5	ns	10 to 90% (50% duty cycle)
Optical path penalty	—	—	—	1	dB	max. 110 ps/nm (1.3 µm) at 4% optical reflection

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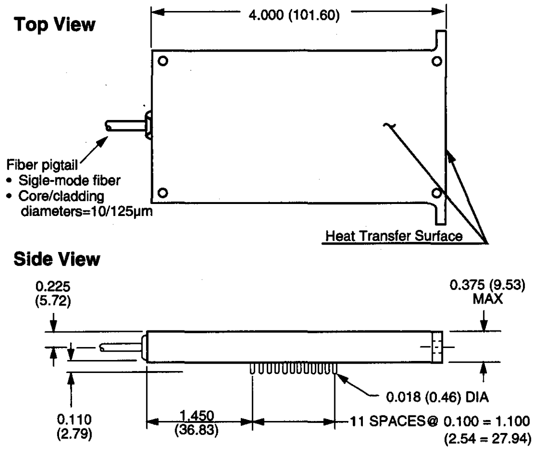
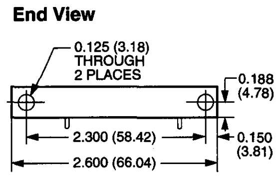
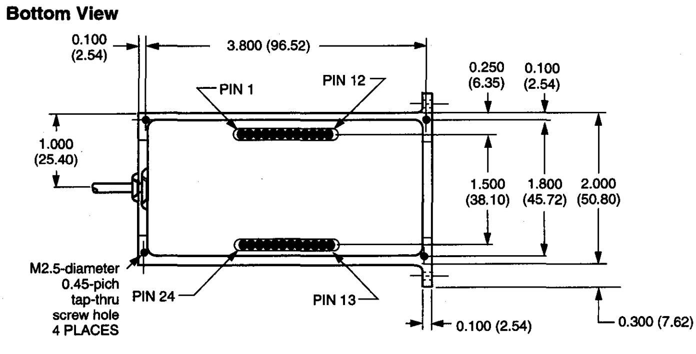
Electrical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE1}	–4.95	–5.2	–5.45		
	V_{EE2}	–2.1	–2.2	–2.3		
DC power supply current	I_{CC}	—	—	800	mA	V_{CC} = 5.0 V ±5%
	I_{EE1}	—	—	200		V_{EE1} = –5.2 V ± 5%
	I_{EE2}	—	—	1000		V_{EE2} = –2.2 V ± 5%
Input data voltage	V_{IN}	0.6	0.8	1.0	V_{pp}	
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period

Outline Drawings and Pin Descriptions







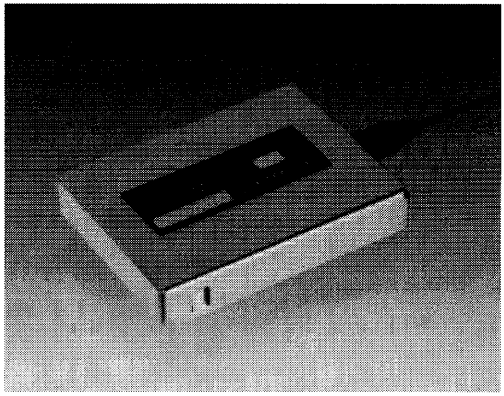
Tolerance: ±0.005 in. (±0.127 mm)
Dimension: inch (mm)

Pin	Description
1:	Case Ground (RF ground)
2:	Case Ground (RF ground)
3:	V_{EE1}
4:	V_{EE2}
5:	V_{CC}
6:	Case Ground (RF ground)
7:	DATA (50Ω, AC-coupled)
8:	Case Ground (RF ground)
9:	Case Ground (RF ground)
10:	Case Ground (RF ground)
11:	Case Ground (RF ground)
12:	No User Connection
13:	No User Connection
14:	Laser Bias Monitor (+)
15:	Laser Bias Monitor (–)
16:	Laser Backface Monitor (+)
17:	Laser Backface Monitor (–)
18:	Disable
19:	Case Ground (RF ground)
20:	Alarm Output
21:	Temperature Monitor (+)
22:	Temperature Monitor (–)
23:	Case Ground (RF ground)
24:	Case Ground (RF ground)

Description

The TRM5714AN is a lightwave transmitter for OC-12.

Features



- Complied with SONET/SDH standard
- Fabry-Perot laser diode
- Operation from 1Mb/s to 622.08Mb/s at 1.3 µm wavelength
- ECL 10k interface
- Low-power-alarm and performance monitors
- Low power dissipation ≤ 2 W

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 75	°C
Humidity (long-term)	—	55	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

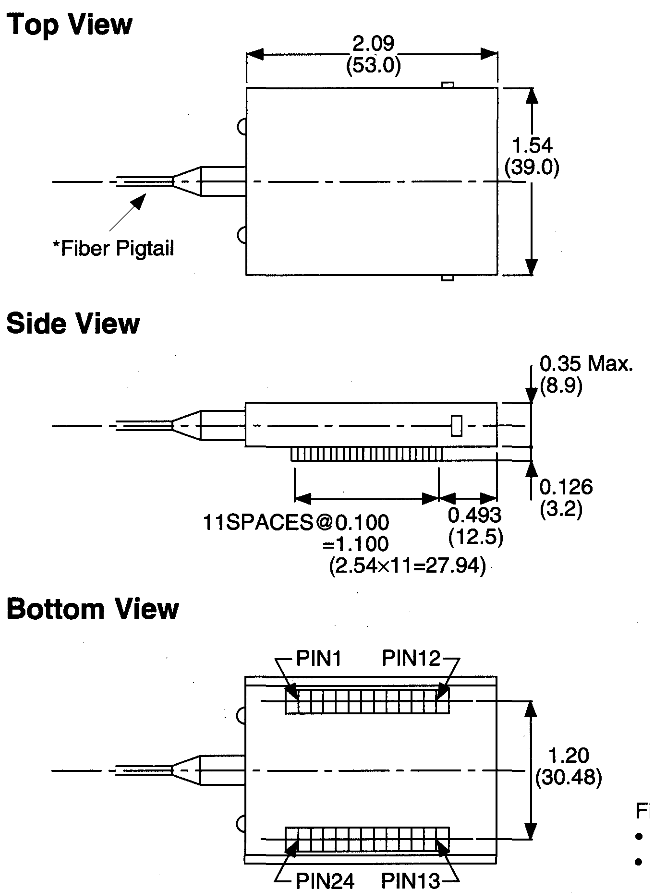
Optical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–14.0	–11.5	–9.0	dBm	156Mb/s, 622Mb/s T_C = 0 to 65°C
Center wavelength	λ_c	1260	1310	1360	nm	156Mb/s, 622Mb/s T_C = 0 to 65°C
RMS spectral width	$\Delta\lambda$	—	2.0	8.0	nm	
Extinction ratio	—	8.2	—	—	dB	P_{OH} / P_{OL}
Optical rise and fall times	t_r, t_f	—	—	0.5	ns	10 to 90% (50% duty cycle)

Electrical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.95	–5.2	–5.45		
DC power supply current	I_{CC}	—	—	100	mA	V_{CC} = 5.0 V ±5%
	I_{EE}	—	—	250		V_{EE} = –5.2 V ±5%

Outline Drawings and Pin Descriptions



Pin	Description
1:	Case Ground (RF ground)
2:	Case Ground (RF ground)
3:	V_{EE}
4:	Case Ground (RF ground)
5:	V_{CC}
6:	Case Ground (RF ground)
7:	$\overline{\text{DATA}}$ (ECL 10K Level)
8:	DATA (ECL 10K Level)
9:	Case Ground (RF ground)
10:	Case Ground (RF ground)
11:	Case Ground (RF ground)
12:	Case Ground (RF ground)
13:	Case Ground (RF ground)
14:	Laser Bias Monitor (+)
15:	Laser Bias Monitor (–)
16:	Laser Backface Monitor (+)
17:	Laser Backface Monitor (–)
18:	Disable
19:	Case Ground (RF ground)
20:	Alarm Output
21:	Case Ground (RF ground)
22:	Case Ground (RF ground)
23:	Case Ground (RF ground)
24:	Case Ground (RF ground)

Fiber pigtail
- Single-mode fiber
- Core/cladding diameters = 10/125 μm

Dimension: inch (mm)

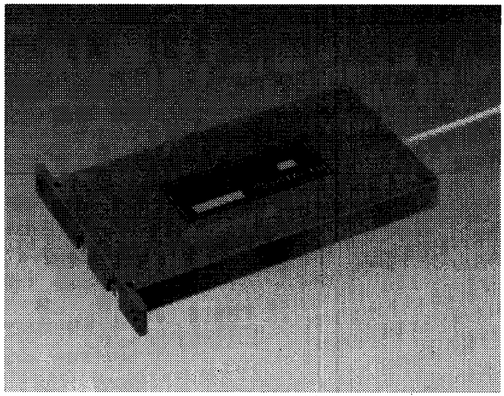
2

Description

The TRM5732AN is a lightwave transmitter for OC-12.

Features

- Complied with SONET/SDH standard
- DFB laser diode
- Operation from 1Mb/s to 622.08Mb/s at 1.3 μm wavelength
- 50Ω, AC-coupled interface
- Low-power-alarm and performance monitors



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–40 to 75	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Humidity (long-term)	—	55	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–1.75	0	1.75	dBm	622Mb/s, T_C = 0 to 65°C
		–2.0	0	2.0		156Mb/s, T_C = –40 to 75°C
Center wavelength	λ_c	1280	1310	1335	nm	622Mb/s, T_C = 0 to 65°C
						156Mb/s, T_C = –40 to 75°C
Spectral width	$\Delta\lambda_{(-20dB)}$	—	—	1	nm	20 dB down
Side mode suppression ratio	S_r	30	—	—	dB	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical rise and fall times	t_r, t_f	—	—	0.5	ns	10 to 90% (50% duty cycle)
Optical path penalty	—	—	—	1	dB	max. 110 ps/nm (1.3 μm) at 4% optical reflection

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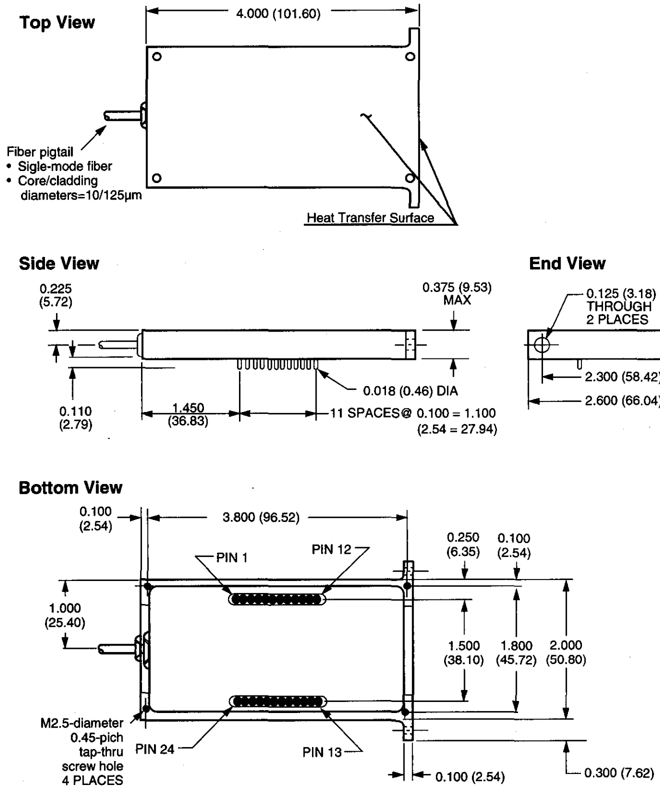
Electrical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE1}	–4.95	–5.2	–5.45		
	V_{EE2}	–2.1	–2.2	–2.3		
DC power supply current	I_{CC}	—	—	800	mA	V_{CC} = 5.0 V ±5%
	I_{EE1}	—	—	200		V_{EE1} = –5.2 V ±5%
	I_{EE2}	—	—	1000		V_{EE2} = –2.2 V ±5%
Input data voltage	V_{IN}	0.6	0.8	1.0	V_{pp}	
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period

Outline Drawings and Pin Descriptions



Tolerance: ±0.005 in. (±0.127 mm)
Dimension: inch (mm)

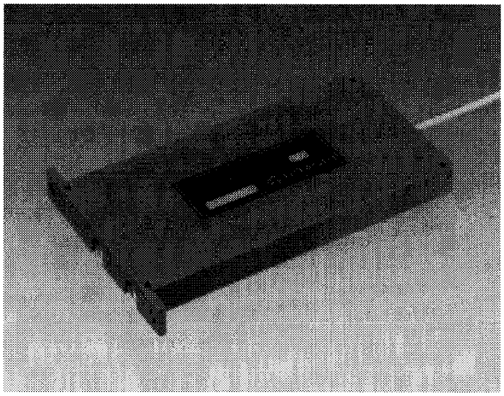
Pin	Description
1:	Case Ground (RF ground)
2:	Case Ground (RF ground)
3:	V_{EE1}
4:	V_{EE2}
5:	V_{CC}
6:	Case Ground (RF ground)
7:	DATA (50Ω, AC-coupled)
8:	Case Ground (RF ground)
9:	Case Ground (RF ground)
10:	Case Ground (RF ground)
11:	Case Ground (RF ground)
12:	No User Connection
13:	No User Connection
14:	Laser Bias Monitor (+)
15:	Laser Bias Monitor (–)
16:	Laser Backface Monitor (+)
17:	Laser Backface Monitor (–)
18:	Disable
19:	Case Ground (RF ground)
20:	Alarm Output
21:	Temperature Monitor (+)
22:	Temperature Monitor (–)
23:	Case Ground (RF ground)
24:	Case Ground (RF ground)

Description

The TRM7732AN is a lightwave transmitter for OC-12.

Features

- Complied with SONET/SDH standard
- DFB laser diode
- Operation from 1Mb/s to 622.08Mb/s at 1.55 μm wavelength
- 50Ω, AC-coupled interface
- Low-power-alarm and performance monitors



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–40 to 75	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Humidity (long-term)	—	55	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

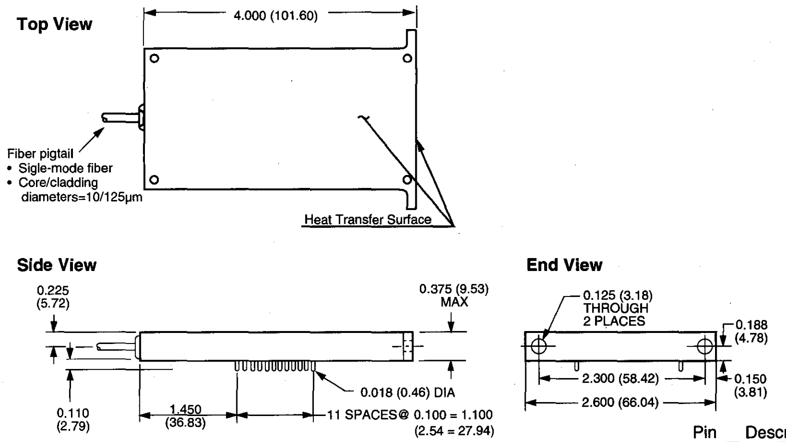
Optical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

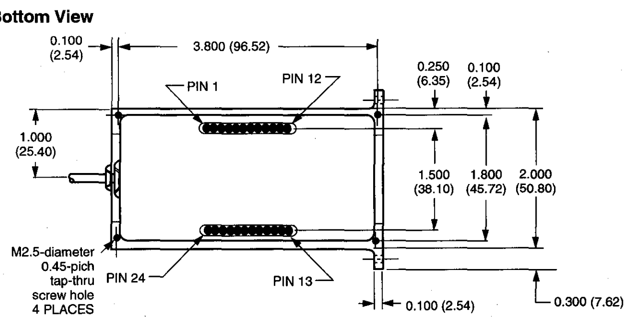
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–1.75	0	1.75	dBm	622Mb/s, T_C = 0 to 65°C
		–2.0	0	2.0		156Mb/s, T_C = –40 to 75°C
Center wavelength	λ_c	1530	1550	1570	nm	622Mb/s, T_C = 0 to 65°C
		1500	1550	1580		156Mb/s, T_C = –40 to 75°C
Spectral width	$\Delta\lambda_{(-20dB)}$	—	—	1	nm	20 dB down
Side-mode suppresion ratio	S_r	30	—	—	dB	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical rise and fall times	t_r, t_f	—	—	0.5	ns	10 to 90% (50% duty cycle)
Optical path penalty	—	—	—	1	dB	max. 1220 ps/nm (1.55 μm) at 4% optical reflection

Electrical Characteristics (Unless otherwise indicated, measurement conditions are T_C = 25°C, 50% duty-cycle data signal)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE1}	–4.95	–5.2	–5.45		
	V_{EE2}	–2.1	–2.2	–2.3		
DC power supply current	I_{CC}	—	—	800	mA	V_{CC} = 5.0 V ±5%
	I_{EE1}	—	—	200		V_{EE1} = –5.2 V ±5%
	I_{EE2}	—	—	1000		V_{EE2} = –2.2 V ±5%
Input data voltage	V_{IN}	0.6	0.8	1.0	V_{pp}	
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period

Outline Drawings and Pin Descriptions





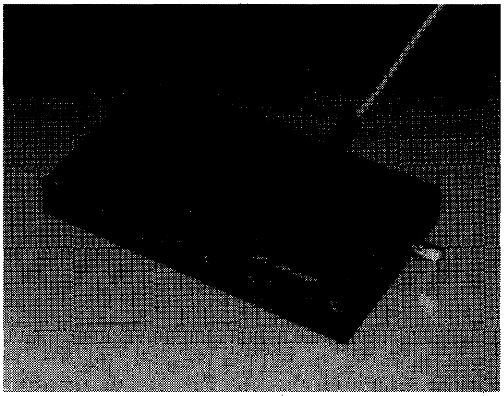
Pin	Description
1:	Case Ground (RF ground)
2:	Case Ground (RF ground)
3:	V_{EE1}
4:	V_{EE2}
5:	V_{CC}
6:	Case Ground (RF ground)
7:	DATA (50Ω, AC-coupled)
8:	Case Ground (RF ground)
9:	Case Ground (RF ground)
10:	Case Ground (RF ground)
11:	Case Ground (RF ground)
12:	No User Connection
13:	No User Connection
14:	Laser Bias Monitor (+)
15:	Laser Bias Monitor (–)
16:	Laser Backface Monitor (+)
17:	Laser Backface Monitor (–)
18:	Disable
19:	Case Ground (RF ground)
20:	Alarm Output
21:	Temperature Monitor (+)
22:	Temperature Monitor (–)
23:	Case Ground (RF ground)
24:	Case Ground (RF ground)

Tolerance: ±0.005 in. (±0.127 mm)
Dimension: inch (mm)

Description

The TRM5934AN is a lightwave transmitter for OC-48.

Features



- Complied with SONET/SDH standard
- DFB laser diode
- Operation from 52Mb/s to 2488.32Mb/s at 1.3 μm wavelength
- 50Ω, AC-coupled interface
- Low-power-alarm and performance monitors

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 75	°C
Humidity (long-term)	—	55 to 90	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

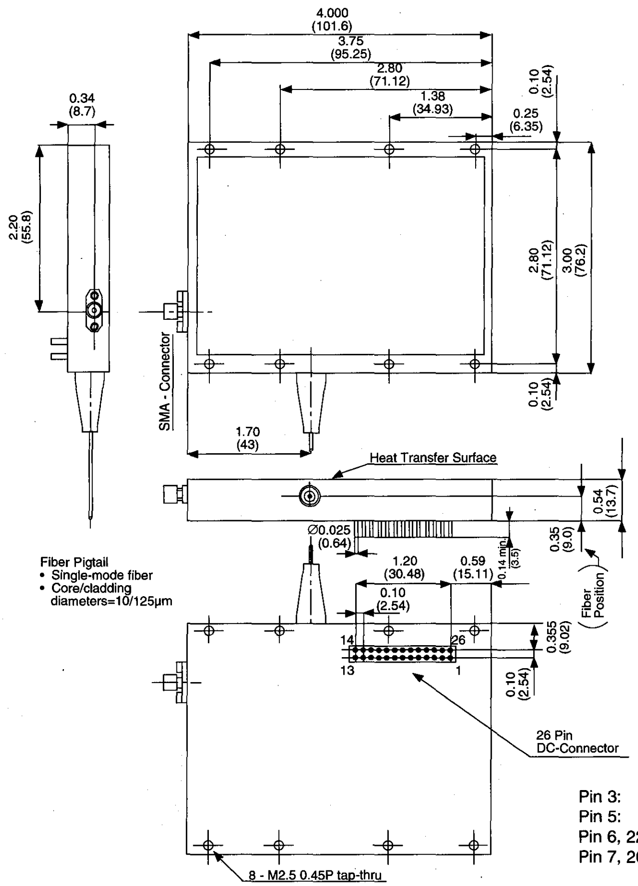
Optical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–5.0	–3.0	0	dBm	T_C = 0 to 65°C
Center wavelength	λ_c	1280	1310	1335	nm	2.5Gb/s, T_C = 0 to 65°C
Spectral width	$\Delta\lambda_{(-20dB)}$	—	—	1	nm	20 dB down
Side-mode suppression Ratio	S_r	30	—	—	dB	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical Waveform	—	Satisfying the Mask			—	CCITT G.957
Optical path penalty	—	—	—	1	dB	max. 110 ps/nm (1.3 μm) at 4% optical reflection

Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE1}	–4.95	–5.2	–5.45		
	V_{EE2}	–1.9	–2.0	–2.1		
DC power supply current	I_{CC}	—	—	700	mA	V_{CC} = 5.0 V ±5%
	I_{EE1}	—	—	250		V_{EE1} = –5.2 V ±5%
	I_{EE2}	—	—	1000		V_{EE2} = –2.0 V ±5%
Input data voltage	V_{IN}	0.8	—	1.0	V_{pp}	
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period

Outline Drawings and Pin Descriptions



Tolerance: ±0.0075 in. (±0.20 mm)
Dimension: inch (mm)

Pin	Description
1:	GND
2:	GND
3:	Wavelength logic output
4:	GND
5:	Shut-down logic input
6:	Normalized backface monitor
7:	Temperature monitor
8:	V_{CC} = +5.0V
9:	V_{EE1} = –5.2V
10:	V_{EE2} = –2.0V
11:	V_{EE2} = –2.0V
12:	GND
13:	GND
14:	GND
15:	GND
16:	V_{EE2} = –2.0V
17:	V_{EE2} = –2.0V
18:	V_{EE1} = –5.2V
19:	V_{CC} = +5.0V
20:	–5.2V temp. mon. reference
21:	GND
22:	Normalized bias monitor
23:	GND
24:	Alarm output
25:	GND
26:	GND

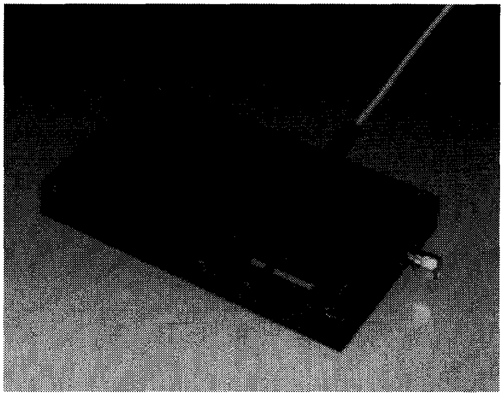
* Metal case is at GND.

Pin 3:	Open for 1.3 µm, short to GND for 1.5 µm
Pin 5:	C-MOS level logic "1" input disables transmitter
Pin 6, 22:	Output normalized to 0.5V
Pin 7, 20:	Laser temperature monitor: T_{LD} (K)
	T_{LD} (K) = 100 × (V_{pin7} (V) – V_{pin20} (V))
Pin 24:	C-MOS level logic "1" output for 3 dB optical power drop

Description

The TRM7934AN is a lightwave transmitter for OC-48.

Features



- Complied with SONET/SDH standard
- MQW-DFB laser diode
- Operation from 52Mb/s to 2488.32Mb/s at 1.55 μm wavelength
- 50Ω, AC-coupled interface
- Low-power-alarm and performance monitors

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 75	°C
Humidity (long-term)	—	55 to 90	%
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–4.0	–2.0	1.0	dBm	T_C = 0 to 65°C
Center wavelength	λ_c	1480	1550	1580	nm	2.5Gb/s, T_C = 0 to 65°C
Spectral width	$\Delta\lambda$ (–20dB)	—	—	1	nm	20 dB down
Side-mode suppression Ratio	S_r	30	—	—	dB	
Extinction ratio	—	10	—	—	dB	P_{OH} / P_{OL}
Optical Waveform	—	Satisfying the Mask			—	CCITT G.957
Optical path penalty	—	—	—	1	dB	max. 400 ps/nm (1.55 μm) at 4% optical reflection

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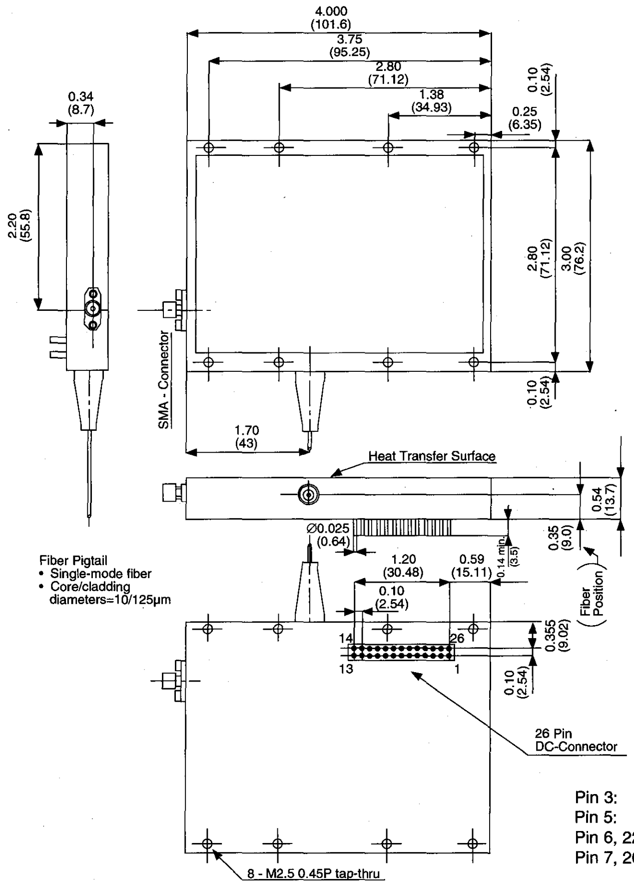
Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE1}	–4.95	–5.2	–5.45		
	V_{EE2}	–1.9	–2.0	–2.1		
DC power supply current	I_{CC}	—	—	700	mA	V_{CC} = 5.0 V ±5%
	I_{EE1}	—	—	250		V_{EE1} = –5.2 V ±5%
	I_{EE2}	—	—	1000		V_{EE2} = –2.0 V ±5%
Input data voltage	V_{IN}	0.8	—	1.0	V_{pp}	
Input transition time	T_{IN}	—	—	T/4	ns	10 to 90% (50% duty cycle) T: bit-period

Outline Drawings and Pin Descriptions



Tolerance: ±0.0075 in. (±0.20 mm)
Dimension: inch (mm)

Pin	Description
1:	GND
2:	GND
3:	Wavelength logic output
4:	GND
5:	Shut-down logic input
6:	Normalized backface monitor
7:	Temperature monitor
8:	V_{CC} = +5.0V
9:	V_{EE1} = –5.2V
10:	V_{EE2} = –2.0V
11:	V_{EE2} = –2.0V
12:	GND
13:	GND
14:	GND
15:	GND
16:	V_{EE2} = –2.0V
17:	V_{EE2} = –2.0V
18:	V_{EE1} = –5.2V
19:	V_{CC} = +5.0V
20:	–5.2V temp. mon. reference
21:	GND
22:	Normalized bias monitor
23:	GND
24:	Alarm output
25:	GND
26:	GND

* Metal case is at GND.

Pin 3: Open for 1.3 μm, short to GND for 1.5 μm
Pin 5: C-MOS level logic "1" input disables transmitter
Pin 6, 22: Output normalized to 0.5V
Pin 7, 20: Laser temperature monitor: T_{LD} (K)
T_{LD} (K) = 100 × (V_{pin7} (V) – V_{pin20} (V))
Pin 24: C-MOS level logic "1" output for 3 dB optical power drop

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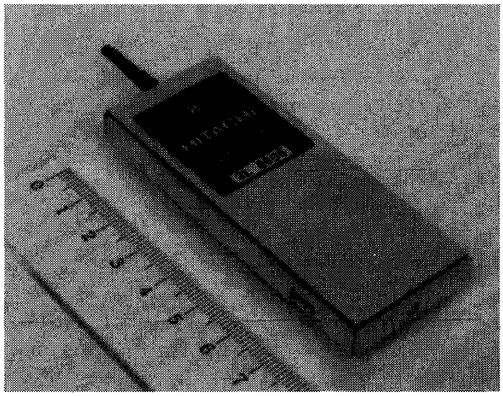
Receivers

2

Description

The RCV5667 is a lightwave receiver for OC-3.

Features



- InGaAs APD
- High sensitivity: -45dBm
- Operation at 155.52Mb/s (scrambled NRZ) at 1.3 μm or 1.55 μm wavelength
- ECL10K interface
- Clock recovery using SAW filter
- Loss-of-signal (LOS) indicator

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 70	°C
Supply voltages	V_{EE}	–6.2	V
Lead soldering temperature	T_s	260	°C
Lead soldering time	—	10	sec

Optical Characteristics (T_a = 0 to 65°C, λ = 1.3 μm)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–45	–44	dBm	156Mb/s, $2^{23} - 1$ NRZ, 10^{-11} BER
Maximum received power	P_{inmax}	–24	–23	—	dBm	156Mb/s, $2^{23} - 1$ NRZ, 10^{-11} BER

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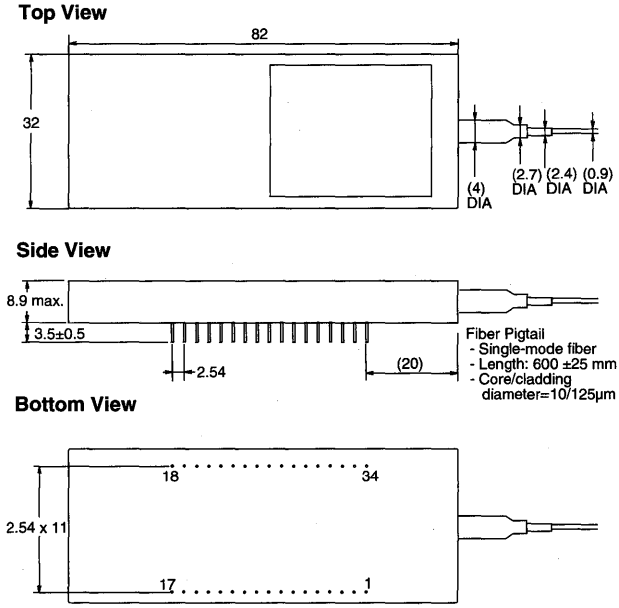
Electrical Characteristics (T_C = 0 to 65°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{EE}	–4.94	–5.2	–5.46	V	
DC power supply current	I_{EE}	—	—	350	mA	V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.9	ns	20 to 80% (peak)
Timing jitter (RMS)	—	—	—	2	deg	2^{23} – 1 NRZ

Outline Drawings and Pin Descriptions



Dimension: mm

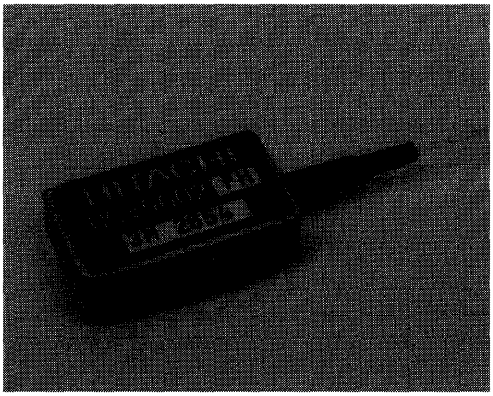
Pin:	Description
1:	Ground
2:	V_{EE}
3:	V_{EE}
4:	Ground
5:	V_{EE}
6:	Ground
7:	Ground
8:	Ground
9:	Ground
10:	Ground
11:	Ground
12:	Ground
13:	V_{EE}
14:	Clock Out
15:	Clock Out
16:	Ground
17:	V_{EE}
18:	Ground
19:	V_{EE}
20:	Data Out
21:	Data Out
22:	Alarm Out
23:	Ground
24:	Ground
25:	Ground
26:	Ground
27:	V_{EE}
28:	V_{EE}
29:	Ground
30:	Ground
31:	Ground
32:	V_{EE}
33:	V_{EE}
34:	Ground

2

Description

The RCV5602 is a lightwave receiver for OC-1 and OC-3.

Features



- Complied with SONET/SDH standard
- InGaAs PIN-PD
- Operation from 20Mb/s to200Mb/s at 1.3 μm or 1.55 μm wavelength
- Wide dynamic range: 27 dB
- ECL level
- Hermetically sealed, 20-pin DIP
- Loss-of-signal (LOS) indicator

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–40 to 85 (0 to 65) *	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Operating wavelength range	λ	1.1 to 1.57	μm
Supply voltages	V_{CC}	5.5	V
	V_{EE}	–15	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

* Specification depends upon the part number.

Optical Characteristics (λ = 1.3 μm, Over operating temperature range)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–38	–34	dBm	156Mb/s, 2^{23} – 1 NRZ, 10^{-10} BER
Maximum received power	P_{inmax}	–7	—	—	dBm	2^{23} – 1 NRZ, 10^{-10} BER
Flag switching level					dBm	156Mb/s, 2^{23} – 1 NRZ
Decreasing light input	—	–53	–40	–36		
Increasing light input	—	–52	–38.7	–35.2		

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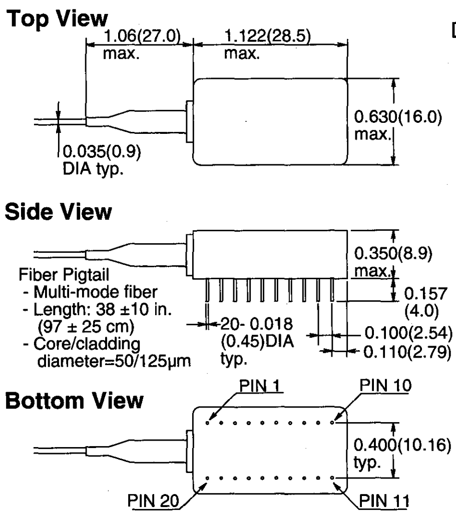
Electrical Characteristics (Over operating temperature range)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.5	V	
	V_{EE}	–4.75	–5.2	–5.5		
DC power supply current	I_{CC}	—	—	95	mA	V_{CC} = 5.0 V , without output drive current
	I_{EE}	—	—	1		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.4	ns	20 to 80% (peak)
Output data voltage					V	50Ω load to (V_{CC} – 2) V
Low	V_{OL}	V_{CC}–1.810	—	V_{CC}–1.620		
High	V_{OH}	V_{CC}–1.025	—	V_{CC}–0.880		
Output flag voltage					V	50Ω load to (V_{CC} – 2) V
Low	V_{FL}	V_{CC}–1.810	—	V_{CC}–1.620		
High	V_{FH}	V_{CC}–1.025	—	V_{CC}–0.880		

Outline Drawings and Pin Descriptions



Tolerance: ±0.005 in. (±0.127 mm)
Dimension: inch (mm)

Pin:	Description
1:	No user connection
2:	No user connection
3:	No user connection
4:	No user connection
5:	No user connection
6:	Ground
7:	Data
8:	Ground
9:	$\overline{\text{Data}}$
10:	–5.2V
11:	+5V
12:	Flag *
13:	Ground
14:	$\overline{\text{Flag}}$ *
15:	Ground
16:	No user connection
17:	No user connection
18:	No user connection
19:	No user connection
20:	No user connection

* Flag goes to P-ECL high level at the presence of optical signal input.

Ordering Information

Operating case temperature (°C)	Connector	Part Number
0 to 65	FC-PC	RCV5602FN
0 to 65	ST *	RCV5602GN
0 to 65	SC	RCV5602HN
–40 to 85	FC-PC	RCV5602FH
–40 to 85	ST *	RCV5602GH
–40 to 85	SC	RCV5602HH

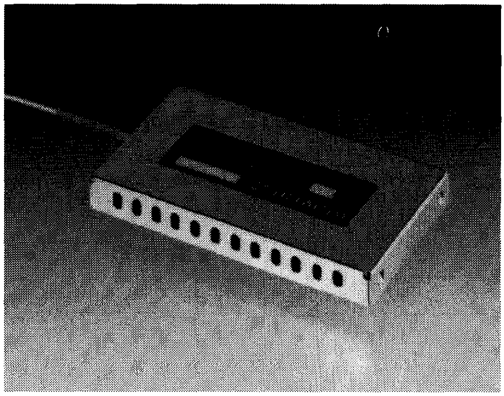
* ST is a registered trademarks of AT&T.

2

Description

The RCV5703AN is a lightwave receiver for OC-12.

Features



- Complied with SONET/SDH standard
- InGaAs PIN-PD
- Operation at 622.08Mb/s for 1.3 µm or 1.55 µm wavelength
- Wide dynamic range: 18 dB
- ECL 10k interface
- Clock recovery using SAW filter
- Loss-of-signal (LOS) indicator and photo-current monitors

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–20 to 75	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–6.0	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

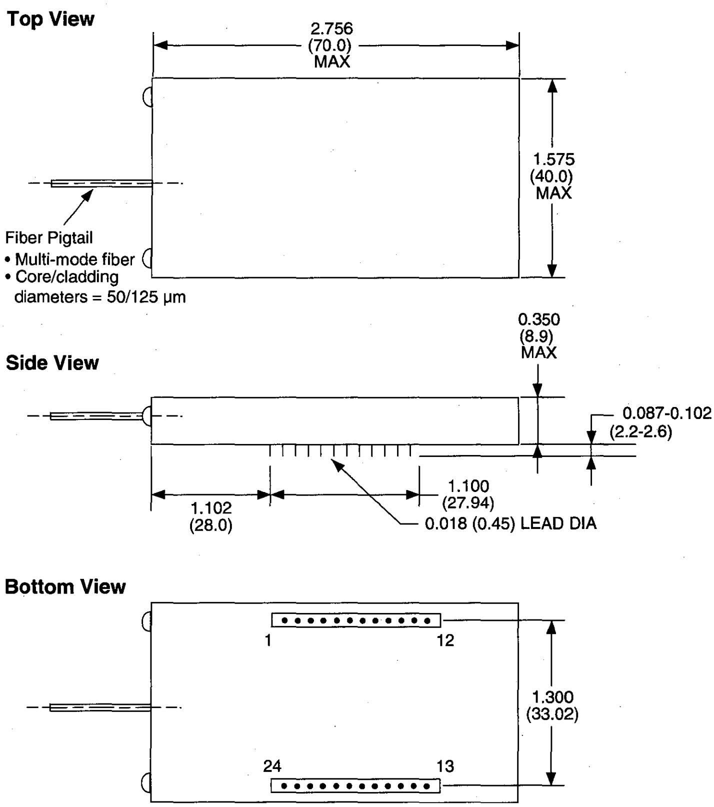
Optical Characteristics (T_a = 25°C, λ = 1.3 µm)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–28	–27	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER
Maximum received power	P_{inmax}	–6	–5	—	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER

Electrical Characteristics (T_a = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	50	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	250		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	500	ps	10 to 90%
Timing jitter (RMS)	—	—	—	2	deg	$2^{23} - 1$ NRZ

Outline Drawings and Pin Descriptions



Pin	Description
1:	Photocurrent Monitor (+)
2:	Photocurrent Monitor (–)
3:	LOS Indicator *
4:	Ground
5:	No User Connection
6:	Ground
7:	Data out
8:	$\overline{\text{Data out}}$
9:	Ground
10:	Clock out
11:	$\overline{\text{Clock out}}$
12:	Ground
13:	Ground
14:	No Connection
15:	Ground
16:	–5.2V
17:	Ground
18:	No User Connection
19:	Ground
20:	+5V
21:	Ground
22:	Ground
23:	No Connection
24:	Ground

* LOS Indicator goes to CMOS high level at the absence of optical signal input.

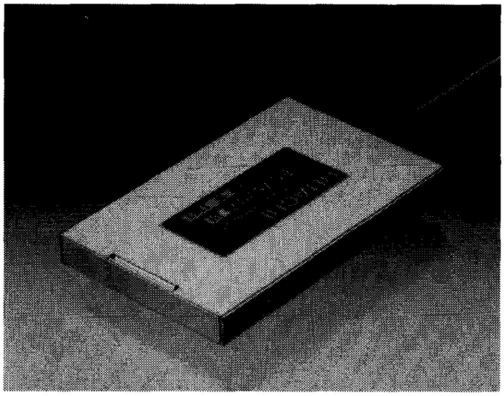
Tolerance: ±0.012 in. (±0.3 mm)
Dimension: inch (mm)

2

Description

The RCV5707AH is a lightwave receiver for OC-12.

Features



- Complied with SONET/SDH standard
- InGaAs APD
- Operation at 622.08Mb/s for 1.3 µm or 1.55 µm wavelength
- Wide dynamic range: 25 dB
- 50Ω, AC-coupled interface
- Clock recovery using SAW filter
- Loss-of-signal (LOS) indicator and photo-current monitors

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–20 to 85	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–6.0	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (T_a = –20 to 85°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–34	–33	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER
Maximum received power	P_{inmax}	–8	–7	—	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER

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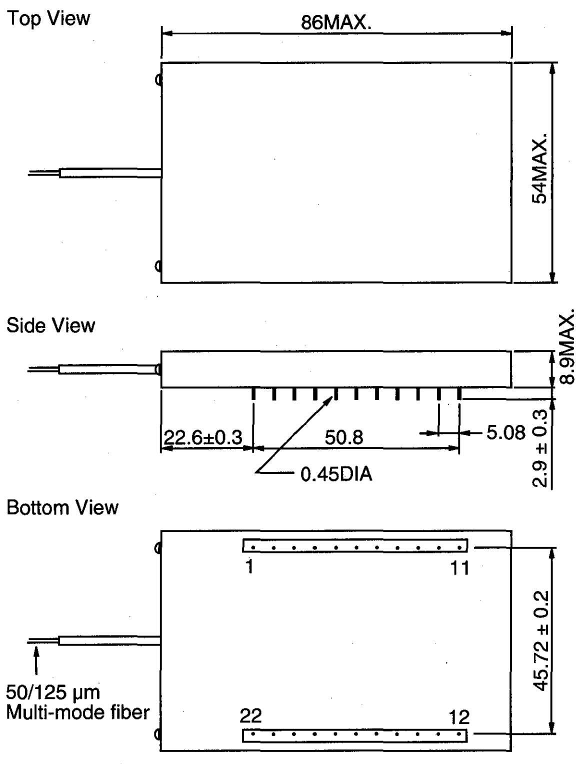
Electrical Characteristics (T_a = –20 to 85°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	200	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	360		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	700	ps	10 to 90%
Clock and data amplitude	—	600	—	1000	mVpp	50Ω load
Timing jitter (RMS)	—	—	—	2	deg	$2^{23} - 1$ NRZ

Outline Drawings and Pin Descriptions



Pin	Description
1:	Ground
2:	LOS Indicator *
3:	Ground
4:	Photocurrent Monitor
5:	Ground
6:	Data Out
7:	Ground
8:	No User Connection
9:	Ground
10:	Clock Out
11:	Ground
12:	Ground
13:	No User Connection
14:	Ground
15:	–5.2V
16:	Ground
17:	No User Connection
18:	Ground
19:	+5.0V
20:	Ground
21:	No User Connection
22:	No User Connection

* LOS Indicator goes to CMOS high level at the absence of optical signal input.

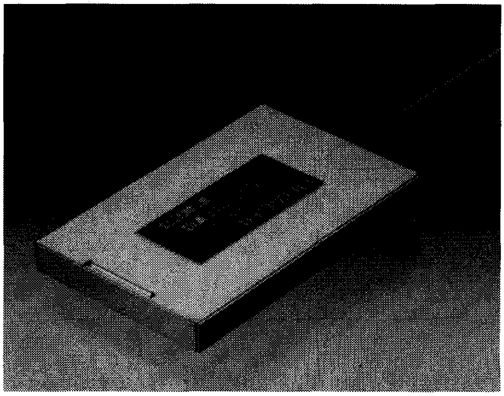
Tolerance: ±0.2 mm
Dimension: mm

2

Description

The RCV5737AH is a lightwave receiver for OC-12.

Features



- Complied with SONET/SDH standard
- InGaAs APD
- Operation at 622.08Mb/s for 1.3 μm or 1.55 μm wavelength
- Wide dynamic range: 23 dB
- 50Ω, AC-coupled interface
- Clock recovery using SAW filter
- Loss-of-signal (LOS) indicator and photo-current monitors

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–20 to 85	°C
Storage case temperature	T_{stg}	–40 to 85	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–6.0	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (T$_a$ = –20 to 85°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–38	–36	dBm	$2^{23} – 1$ NRZ, 10^{-10} BER
Maximum received power	P_{inmax}	–13	–10	—	dBm	$2^{23} – 1$ NRZ, 10^{-10} BER

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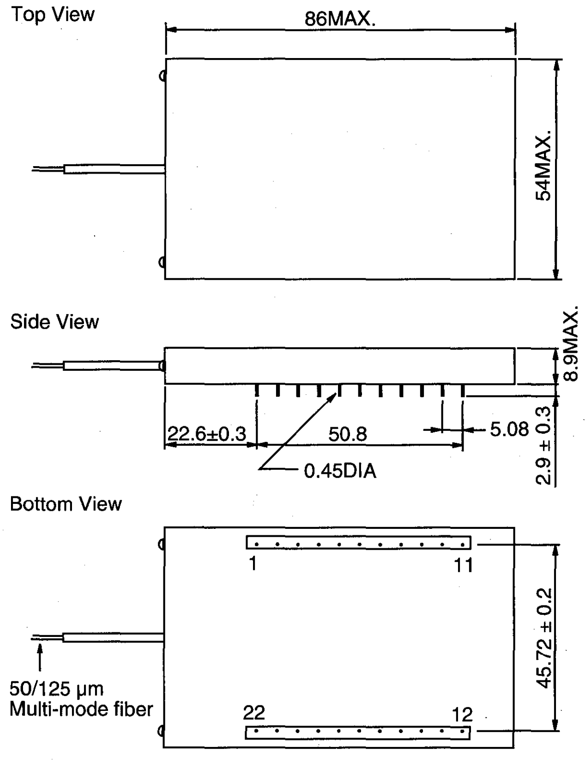
Electrical Characteristics (T_a = –20 to 85°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	200	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	360		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	700	ps	10 to 90%
Clock and data amplitude	—	600	—	1000	mV_{pp}	50Ω load
Timing jitter (RMS)	—	—	—	2	deg	2^{23} – 1 NRZ

Outline Drawings and Pin Descriptions



Pin	Description
1:	Ground
2:	LOS Indicator *
3:	Ground
4:	Photocurrent Monitor
5:	Ground
6:	Data Out
7:	Ground
8:	No User Connection
9:	Ground
10:	Clock Out
11:	Ground
12:	Ground
13:	No User Connection
14:	Ground
15:	–5.2V
16:	Ground
17:	No User Connection
18:	Ground
19:	+5.0V
20:	Ground
21:	No User Connection
22:	No User Connection

* LOS Indicator goes to CMOS high level at the absence of optical signal input.

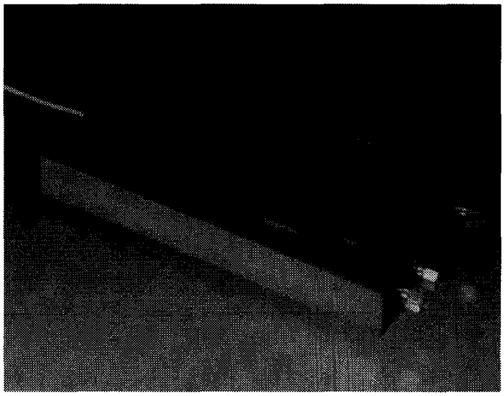
Tolerance: ±0.2 mm
Dimension: mm

2

Description

The RCV5931AN is a lightwave receiver for OC-48.

Features



- Complied with SONET/SDH standard
- InGaAs APD
- Operation at 2488.32Mb/s for 1.3 μm or 1.55 μm wavelength
- 50Ω, AC-coupled interface
- Clock recovery using SAW filter
- Loss-of-signal (LOS) indicator and photo-current monitors

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	0 to 65	°C
Storage case temperature	T_{stg}	–40 to 70	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–6.0	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical Characteristics (T$_a$ = 25°C, λ = 1.3 μm)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Minimum received power	P_{inmin}	—	–32	–29	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER
Maximum received power	P_{inmax}	–10	–9	—	dBm	$2^{23} - 1$ NRZ, 10^{-10} BER

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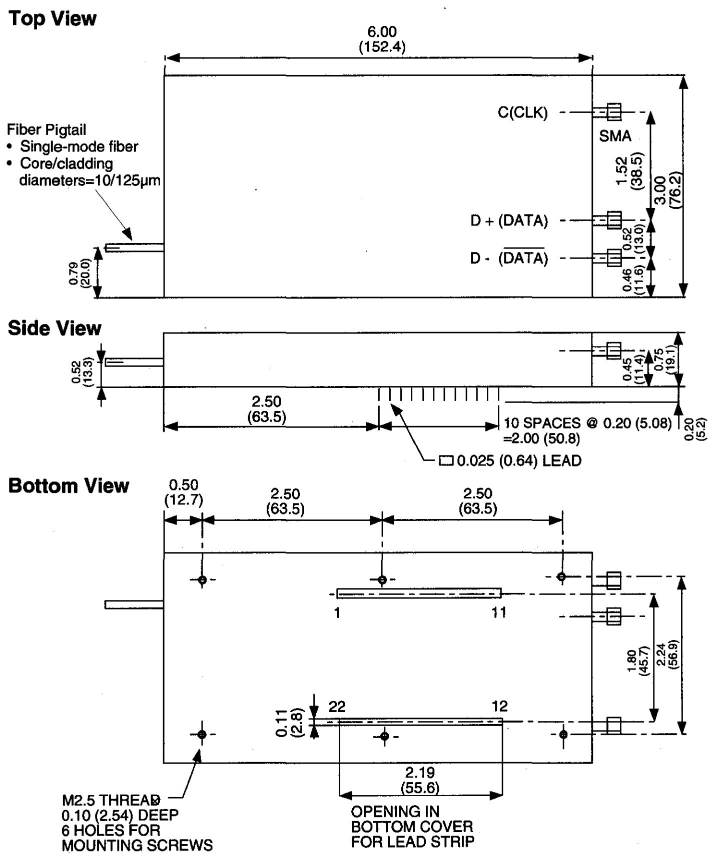
Electrical Characteristics (T_a = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	800	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	800		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	150	ps	20 to 80% (peak)
Clock and data amplitude	—	600	—	1000	mV_{pp}	50Ω load
Timing jitter (RMS)	—	—	—	3	deg	2^{23} – 1 NRZ, Pin=–26dBm

Outline Drawings and Pin Descriptions



Pin	Description
1:	Ground
2:	LOS Indicator *
3:	Ground
4:	Photocurrent Monitor
5:	Ground
6:	No User Connection
7:	Ground
8:	No User Connection
9:	Ground
10:	No User Connection
11:	Ground
12:	Ground
13:	–5.2V
14:	Ground
15:	–5.2V
16:	Ground
17:	+5.0V
18:	Ground
19:	+5.0V
20:	Ground
21:	No User Connection
22:	No User Connection

* LOS Indicator goes to CMOS high level at the absence of optical signal input.

2

Tolerance: ±0.012 in. (±0.3 mm)
Dimension: inch (mm)

Transceivers

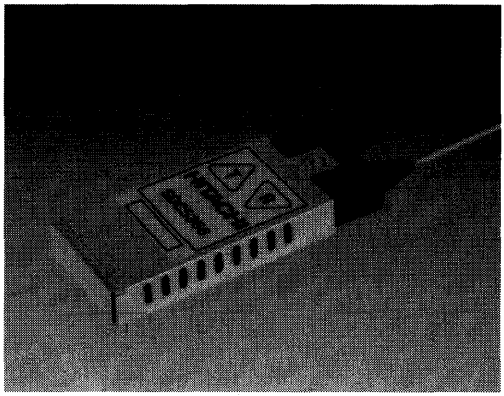
2

Description

The TRV5366 is a lightwave transceiver for OC-1.

Features

- Fabry-Perot laser/InGaAs PIN-PD
- Operation at 51.84Mb/s for 1.3 μm wavelength
- ECL 10k interface
- Clock recovery using SAW filter
- TX: Low-power alarm and shutdown
  RX: Loss-of-signal (LOS) indicator



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	10 to 60	°C
Storage case temperature	T_{stg}	–40 to 80	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–5.75	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–15	—	–8	dBm	T_C = 10 to 60°C
Center wavelength	λ_c	1270	1310	1360	nm	T_C = 10 to 60°C
Spectral width	$\Delta\lambda$	—	—	10	nm	FWHM
Extinction ratio	—	11	—	—	dB	P_{OH} / P_{OL}
Optical eye pattern mask	—	—	—	—	—	CCITT
Minimum received power	P_{inmin}	—	–25	–24	dBm	$2^{23} - 1$ NRZ, 10^{-11} BER
Maximum received power	P_{inmax}	–8	–7	—	dBm	$2^{23} - 1$ NRZ, 10^{-11} BER
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	30	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	350		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.9	ns	20 to 80%

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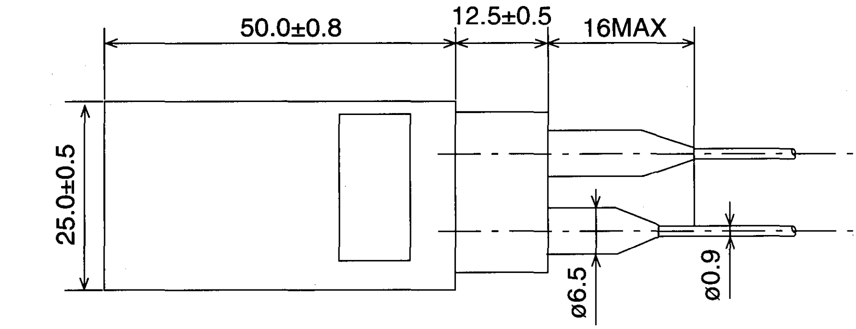
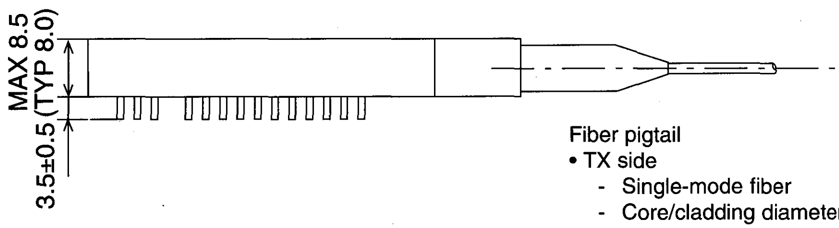
Outline Drawings and Pin Descriptions

Top View

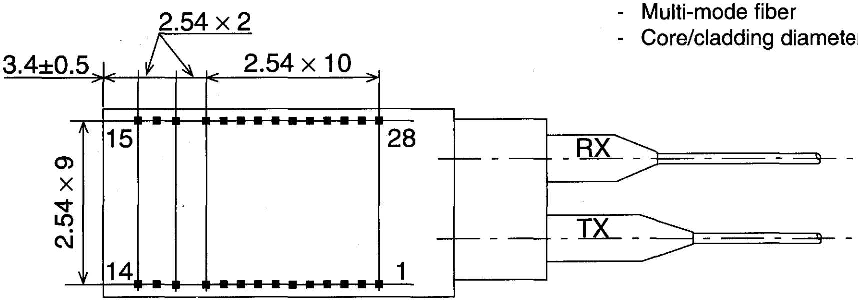


Side View



Fiber pigtail
- TX side
  - Single-mode fiber
  - Core/cladding diameter = 10/125 µm
- RX side
  - Multi-mode fiber
  - Core/cladding diameter = 50/125 µm

Bottom View



Dimension: mm

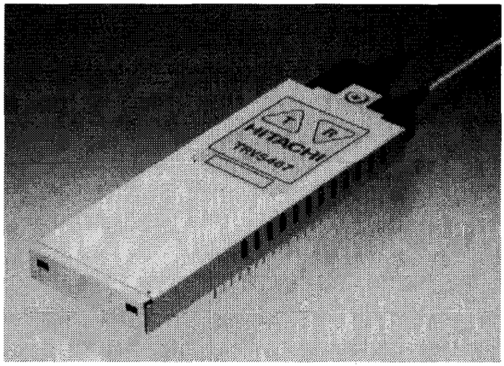
Pin	Description	Pin	Description
1:	TX Ground	15:	Data Out
2:	TX Ground	16:	Data Out
3:	TX V_{EE1}	17:	RX Ground
4:	TX Alarm Out	18:	RX Alarm Out
5:	Clock In	19:	RX V_{EE2}
6:	Data In	20:	RX V_{EE2}
7:	Shutdown In	21:	RX Ground
8:	RX V_{EE2}	22:	RX Ground
9:	RX Ground	23:	RX Ground
10:	RX Ground	24:	RX Ground
11:	RX V_{EE2}	25:	V_{CC}
12:	RX V_{EE2}	26:	RX Ground
13:	$\overline{\text{Clock Out}}$	27:	V_{EE3}
14:	Clock Out	28:	V_{EE3}

Description

The TRV5367 is a lightwave transceiver for OC-1.

Features

- Fabry-Perot laser/Ge APD
- Operation at 51.84Mb/s for 1.3 μm wavelength
- ECL 10k interface
- Clock recovery using SAW filter
- TX: Low-power alarm and shutdown
  RX: Loss-of-signal (LOS) indicator



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	10 to 60	°C
Storage case temperature	T_{stg}	–40 to 80	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–5.75	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–3	0	3	dBm	T_C = 10 to 60°C
Center wavelength	λ_c	1290	1310	1330	nm	T_C = 10 to 60°C
Spectral width	$\Delta\lambda$	—	—	10	nm	FWHM
Extinction ratio	—	13	—	—	dB	P_{OH} / P_{OL}
Optical eye pattern mask	—	—	—	—	—	CCITT
Minimum received power	P_{inmin}	—	–36	–35	dBm	2^{23} – 1 NRZ, 10^{-11} BER
Maximum received power	P_{inmax}	–17	–16	—	dBm	2^{23} – 1 NRZ, 10^{-11} BER
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	30	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	400		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.9	ns	20 to 80%
Timing jitter (RMS)	—	—	—	2	deg	2^{23} – 1 NRZ

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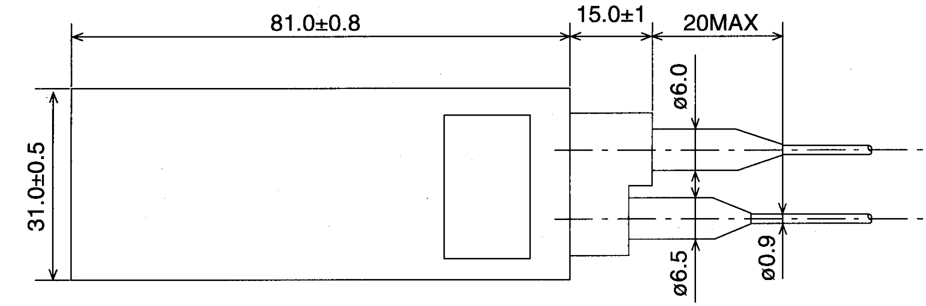
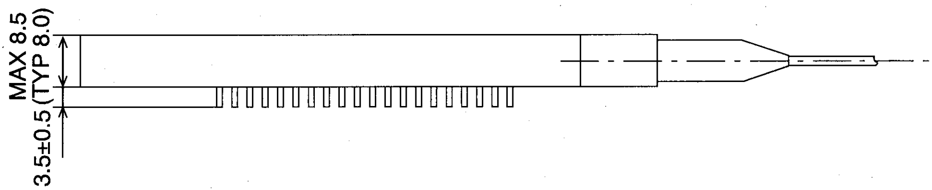
Outline Drawings and Pin Descriptions

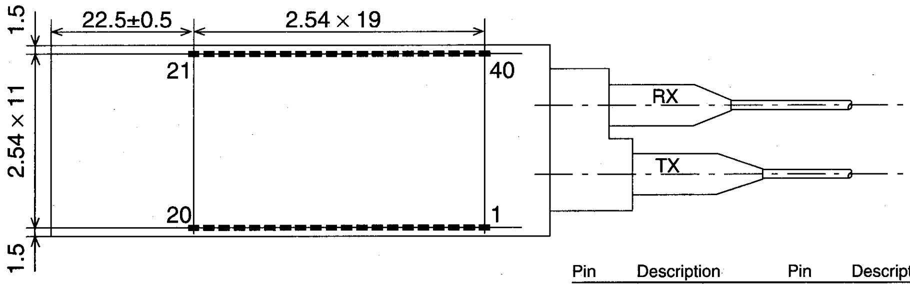
Top View



Side View



Bottom View



Fiber pigtail

- TX side
  - Single-mode fiber
  - Core/cladding diameter = 10/125 µm
- RX side
  - Multi-mode fiber
  - Core/cladding diameter = 50/125 µm

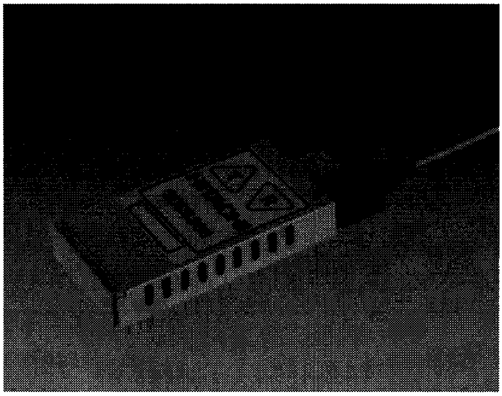
Dimension: mm

Pin	Description	Pin	Description
1:	TX Ground	21:	RX Ground
2:	TX Ground	22:	RX V_{EE2}
3:	TX V_{EE1}	23:	Data Out
4:	TX Alarm Out	24:	$\overline{\text{Data Out}}$
5:	Clock In	25:	RX Alarm Out
6:	Data In	26:	RX Ground
7:	Shutdown In	27:	RX Ground
8:	RX V_{EE2}	28:	RX Ground
9:	RX Ground	29:	RX Ground
10:	RX Ground	30:	RX V_{EE2}
11:	RX Ground	31:	RX V_{EE2}
12:	RX Ground	32:	RX Ground
13:	RX Ground	33:	RX Ground
14:	RX Ground	34:	RX Ground
15:	RX Ground	35:	RX Ground
16:	RX V_{EE2}	36:	RX Ground
17:	$\overline{\text{Clock Out}}$	37:	V_{CC}
18:	Clock Out	38:	RX Ground
19:	RX Ground	39:	V_{EE3}
20:	RX V_{EE2}	40:	V_{EE3}

Description

The TRV5466 is a lightwave transceiver for OC-3.

Features



- Complied with SDH standard
- Fabry-Perot laser/InGaAs PIN-PD
- Operation at 155.52Mb/s for 1.3 μm wavelength
- ECL 10k interface
- Clock recovery using SAW filter
- TX: Low-power alarm and shutdown
  RX: Loss-of-signal (LOS) indicator

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	10 to 60	°C
Storage case temperature	T_{stg}	–40 to 80	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–5.75	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical and Electrical Characteristics (T_C = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–15	—	–8	dBm	T_C = 10 to 60°C
Center wavelength	λ_c	1270	1310	1360	nm	T_C = 10 to 60°C
Spectral width	$\Delta\lambda$	—	—	10	nm	FWHM
Extinction ratio	—	11	—	—	dB	P_{OH} / P_{OL}
Optical eye pattern mask	—	—	—	—	—	CCITT
Minimum received power	P_{inmin}	—	–25	–24	dBm	2^{23} – 1 NRZ, 10^{-11} BER
Maximum received power	P_{inmax}	–8	–7	—	dBm	2^{23} – 1 NRZ, 10^{-11} BER
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	30	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	350		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.9	ns	20 to 80%

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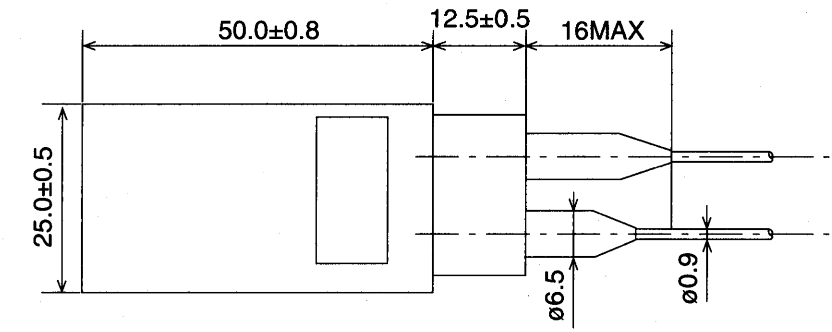
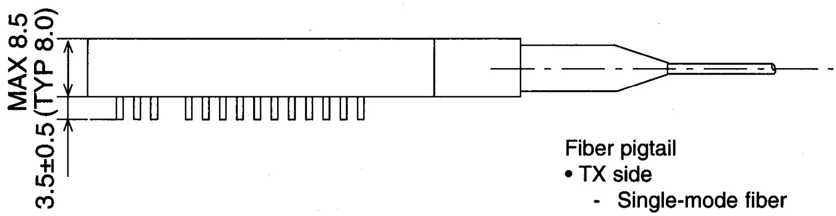
Outline Drawings and Pin Descriptions

Top View

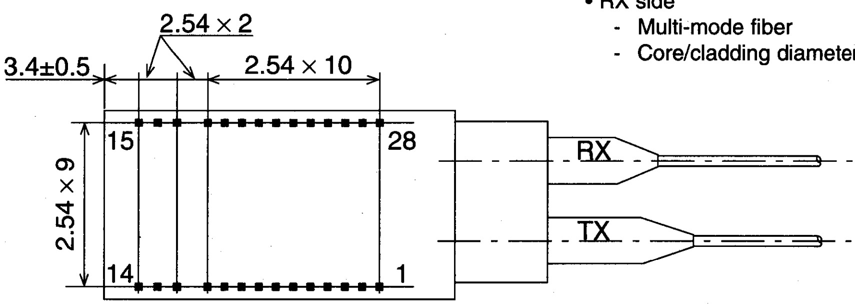


Side View



Fiber pigtail
- TX side
  - Single-mode fiber
  - Core/cladding diameter = 10/125 µm
- RX side
  - Multi-mode fiber
  - Core/cladding diameter = 50/125 µm

Bottom View



Dimension: mm

Pin	Description	Pin	Description
1:	TX Ground	15:	Data Out
2:	TX Ground	16:	$\overline{\text{Data}}$ Out
3:	TX V_{EE1}	17:	RX Ground
4:	TX Alarm Out	18:	RX Alarm Out
5:	Clock In	19:	RX V_{EE2}
6:	Data In	20:	RX V_{EE2}
7:	Shutdown In	21:	RX Ground
8:	RX V_{EE2}	22:	RX Ground
9:	RX Ground	23:	RX Ground
10:	RX Ground	24:	RX Ground
11:	RX V_{EE2}	25:	V_{CC}
12:	RX V_{EE2}	26:	RX Ground
13:	$\overline{\text{Clock}}$ Out	27:	V_{EE3}
14:	Clock Out	28:	V_{EE3}

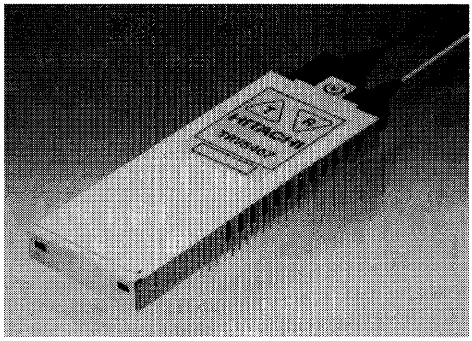
2

Description

The TRV5467 is a lightwave transceiver for OC-3.

Features

- Complied with SDH standard
- Fabry-Perot laser/Ge APD
- Operation at 155.52Mb/s for 1.3 μm wavelength
- ECL 10k interface
- Clock recovery using SAW filter
- TX: Low-power alarm and shutdown
  RX: Loss-of-signal (LOS) indicator



Absolute Maximum Ratings (T_C = 25°C)

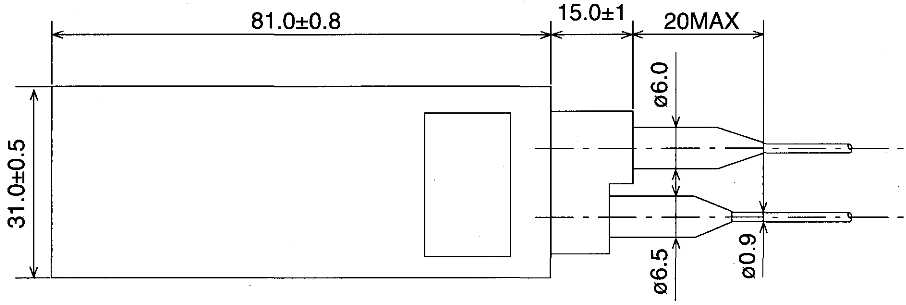
Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	10 to 60	°C
Storage case temperature	T_{stg}	–40 to 80	°C
Supply voltages	V_{CC}	6.0	V
	V_{EE}	–5.75	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Optical and Electrical Characteristics (T_C = 25°C)

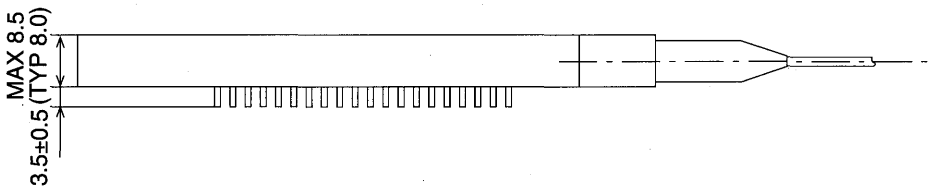
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Average power output	$\overline{P_O}$	–3	0	3	dBm	T_C = 10 to 60°C
Center wavelength	λ_c	1290	1310	1330	nm	T_C = 10 to 60°C
Spectral width	$\Delta\lambda$	—	—	10	nm	FWHM
Extinction ratio	—	13	—	—	dB	P_{OH} / P_{OL}
Optical eye pattern mask	—	—	—	—	—	CCITT
Minimum received power	P_{inmin}	—	–36	–35	dBm	2^{23} – 1 NRZ, 10^{-11} BER
Maximum received power	P_{inmax}	–17	–16	—	dBm	2^{23} – 1 NRZ, 10^{-11} BER
DC power supply voltage	V_{CC}	4.75	5.0	5.25	V	
	V_{EE}	–4.94	–5.2	–5.46		
DC power supply current	I_{CC}	—	—	30	mA	V_{CC} = 5.0 V
	I_{EE}	—	—	400		V_{EE} = –5.2 V
Output rise and fall times	t_r, t_f	—	—	1.9	ns	20 to 80%
Timing jitter (RMS)	—	—	—	2	deg	2^{23} – 1 NRZ

Outline Drawings and Pin Descriptions

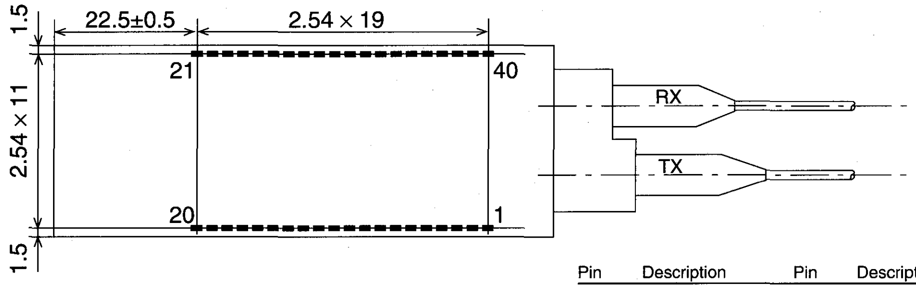
Top View



Side View



Bottom View



Fiber pigtail
- TX side
  - Single-mode fiber
  - Core/cladding diameter = 10/125 µm
- RX side
  - Multi-mode fiber
  - Core/cladding diameter = 50/125 µm

Dimension: mm

Pin	Description	Pin	Description
1:	TX Ground	21:	RX Ground
2:	TX Ground	22:	RX V_{EE2}
3:	TX V_{EE1}	23:	Data Out
4:	TX Alarm Out	24:	$\overline{\text{Data}}$ Out
5:	Clock In	25:	RX Alarm Out
6:	Data In	26:	RX Ground
7:	Shutdown In	27:	RX Ground
8:	RX V_{EE2}	28:	RX Ground
9:	RX Ground	29:	RX Ground
10:	RX Ground	30:	RX V_{EE2}
11:	RX Ground	31:	RX V_{EE2}
12:	RX Ground	32:	RX Ground
13:	RX Ground	33:	RX Ground
14:	RX Ground	34:	RX Ground
15:	RX Ground	35:	RX Ground
16:	RX V_{EE2}	36:	RX Ground
17:	$\overline{\text{Clock}}$ Out	37:	V_{CC}
18:	Clock Out	38:	RX Ground
19:	RX Ground	39:	V_{EE3}
20:	RX V_{EE2}	40:	V_{EE3}

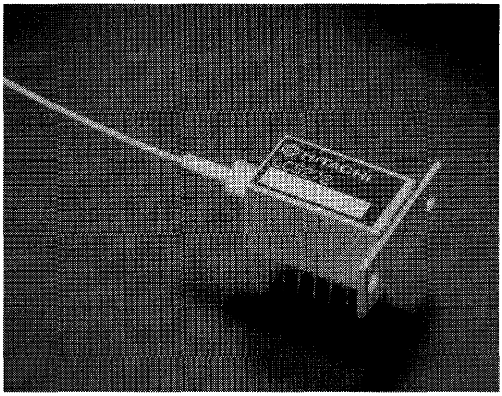
Laser Diode Modules

2

Description

The LC5272 is a multi longitudinal mode laser diode module..

Features



- 1.3 μm Fabry-Perot laser diode
- High speed operation (up to 622Mb/s)
- Internal monitor photodiode, thermistor and thermo-electric cooler
- Hermetically sealed, 14-pin dual-in line package
- High reliability

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–20 to 60	°C
Storage case temperature	T_{stg}	–40 to 70	°C
LD forward current (CW)	I_F	150	mA
LD reverse voltage	$V_{R\ (LD)}$	2	V
PD reverse voltage	$V_{R\ (PD)}$	15	V
Thermistor current	I_T	0.2	mA
Cooling current	I_C	1.4	A
Lead soldering temperature	T_s	260	°C
Lead soldering time	—	10	sec

Fiber Pigtail Specifications

Item	Rated Value	Units
Core diameter	10±1	μm
Cladding diameter	125±3	μm
Jacket diameter	0.9±0.1	mm
Cutoff wavelength	≤1270	nm
Fiber length	≥2000	mm

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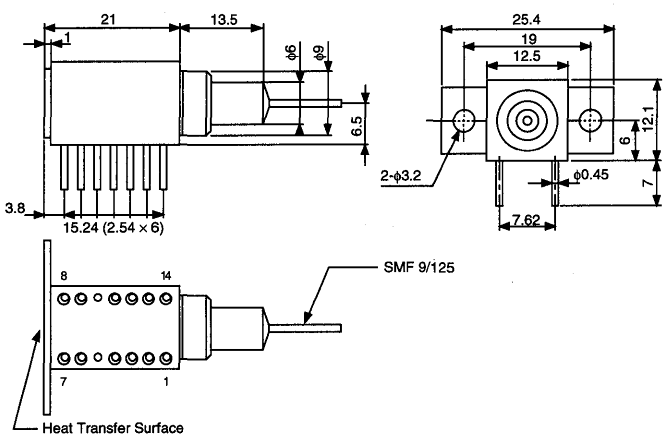
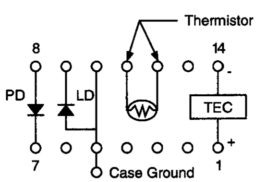
Optical Characteristics (T_{LD} = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	—	25	40	mA	CW
LD forward voltage	V_F	—	1.3	1.5	V	$I_F = I_{th}$ + 20 mA
Fiber output power	P_f	1.0	1.5	—	mW	$I_F = I_{th}$ + 20 mA
Optical rise time	t_r	—	0.3	0.5	ns	$I_B = I_{th}$, 10 to 90%
Optical fall time	t_f	—	0.3	0.5	ns	$I_B = I_{th}$, 10 to 90%
Peak wavelength	λ_p	1290	1310	1330	nm	$I_F = I_{th}$ + 20 mA
Spectral width	$\Delta\lambda$	—	2	5	nm	FWHM, $I_F = I_{th}$ + 20 mA
Monitor current	I_m	200	500	—	μA	$V_{R (PD)}$ = 10 V, $I_F = I_{th}$ + 20 mA
PD dark current	I_{DARK}	—	0.1	0.5	μA	$V_{R (PD)}$ = 10 V
Thermistor resistance	R_{th}	—	10	—	kΩ	T_{LD} = 25°C
Thermistor constant	R	—	—	3900	K	
Cooling current	I_C	—	—	1.0	A	ΔT = 40K, $I_F = I_{th}$ + 20 mA
Cooling voltage	V_C	—	1.3	1.6	V	ΔT = 40K, $I_F = I_{th}$ + 20 mA

Outline Drawings and Pin Descriptions



Dimension: mm



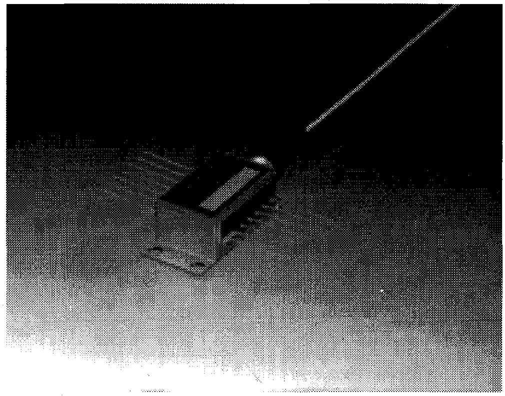
Pin	Description	Pin	Description
1:	TE Cooler (+)	8:	PD Anode
2:	NC	9:	LD Cathode
3:	NC	10:	LD Anode, Case Ground
4:	NC	11:	Thermistor
5:	LD Anode, Case Ground	12:	Thermistor
6:	NC	13:	NC
7:	PD Cathode	14:	TE Cooler (–)

Description

The LB5374 is a single longitudinal mode laser diode module..

Features

- 1.3 µm DFB laser diode
- High speed modulation (up to 2.5Gb/s)
- Built-in 30dB optical isolator
- Internal monitor photodiode, thermistor and thermo-electric cooler
- Hermetically sealed, 14-pin low profile butterfly package



Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–20 to 65	°C
Storage case temperature	T_{stg}	–40 to 70	°C
LD forward current (CW)	I_F	150	mA
LD reverse voltage	$V_{R (LD)}$	2	V
PD reverse voltage	$V_{R (PD)}$	15	V
Thermistor current	I_T	0.2	mA
Cooling current	I_C	1.4	A
Lead soldering temperature	T_s	260	°C
Lead soldering time	—	10	sec

Fiber Pigtail Specifications

Item	Rated Value	Units
Core diameter	10±1	µm
Cladding diameter	125±3	µm
Jacket diameter	0.9±0.1	mm
Cutoff wavelength	≤1270	nm
Fiber length	≥2000	mm

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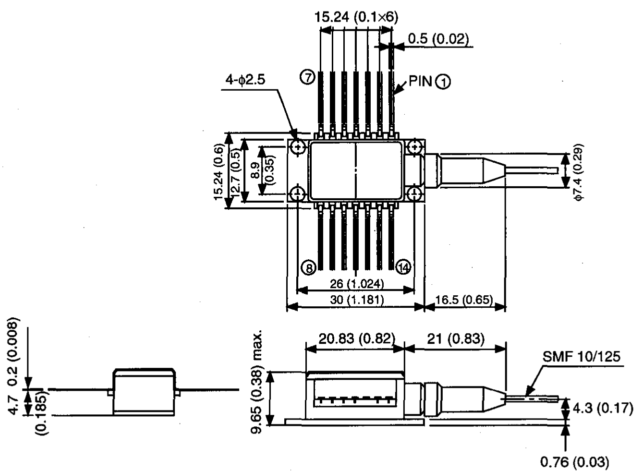
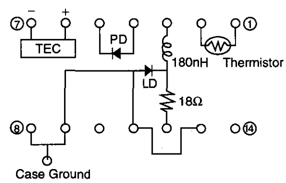
Optical Characteristics (T_{LD} = 25°C)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	—	25	40	mA	CW
LD forward voltage	V_F	—	—	1.5	V	I_F = Ith + 20 mA
Fiber output power	P_f	1.0	1.5	—	mW	I_F = Ith + 20 mA
Tracking error	ΔP_f	—	±0.2	±0.5	dB	T_C = –20 to 65°C, APC, ATC
Optical rise time	t_r	—	—	100	ps	Note 1, 10 to 90%
Optical fall time	t_f	—	—	200	ns	Note 1, 10 to 90%
Peak wavelength	λ_p	1290	1310	1330	nm	Note 1
Spectral width	$\Delta\lambda$	—	0.45	0.8	nm	Note 1
Side mode suppression ratio	S_r	30	40	—	dB	Note 1
Monitor current	I_m	100		1500	μA	CW, $V_{R\,(PD)}$ = 4 V, $I_F = I_{th}$ + 20 mA
PD dark current	I_{DARK}	—		0.5	μA	$V_{R\,(PD)}$ = 10 V
Thermistor resistance	R_{th}	9.5	10	10.5	kΩ	
Cooling current	I_C	—	—	1.2	A	ΔT = 40K, $I_F = I_{th}$ + 20 mA
Cooling voltage	V_C	—	—	1.4	V	ΔT = 40K, $I_F = I_{th}$ + 20 mA
Optical isolation	—	30	—	—	dB	
Input impedance	Z_{in}	—	25	—	Ω	

Note 1 : 2.5Gb/s, NRZ, PRBS: $2^{23} - 1$, Mark ratio 50%
P_{peak} = 2 mW, $I_B = I_{th}$, rise/fall time of LD driver is less than 120 ps

Outline Drawings and Pin Descriptions





Pin	Description
1:	Themistor
2:	Themistor
3:	LD Cathode (DC Bias)
4:	PD Anode
5:	PD Cathode
6:	TE Cooler (+)
7:	TE Cooler (–)
8:	Case Ground
9:	Case Ground
10:	NC
11:	LD Anode, Case Ground
12:	LD Cathode (RF Signal)
13:	Case Ground
14:	NC

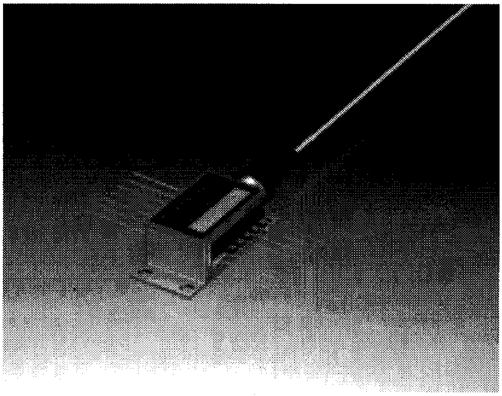
Dimension: mm (inch)

LB7374

Description

The LB7374 is a single longitudinal mode laser diode module..

Features



- 1.55 µm multi-quantum well (MQW) DFB laser diode with marrow spectral line width
- High speed modulation (up to 2.5Gb/s)
- Long distance transmission with no external modulator (up to 80 km)
- Built-in 30dB optical isolator
- Internal monitor photodiode, thermistor and thermo-electric cooler
- Hermetically sealed, 14-pin low-profile butterfly package

Absolute Maximum Ratings (T_C = 25°C)

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–20 to 65	°C
Storage case temperature	T_{stg}	–40 to 70	°C
LD forward current (CW)	I_F	150	mA
LD reverse voltage	$V_{R\,(LD)}$	2	V
PD reverse voltage	$V_{R\,(PD)}$	15	V
Thermistor current	I_T	0.2	mA
Cooling current	I_C	1.4	A
Lead soldering temperature	T_s	260	°C
Lead soldering time	—	10	sec

Fiber Pigtail Specifications

Item	Rated Value	Units
Core diameter	10±1	µm
Cladding diameter	125±3	µm
Jacket diameter	0.9±0.1	mm
Cutoff wavelength	≤1270	nm
Fiber length	≥2000	mm

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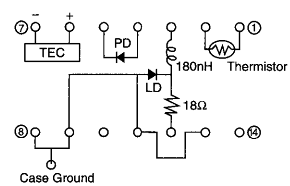
Optical Characteristics (T_{LD}' = 25°C)

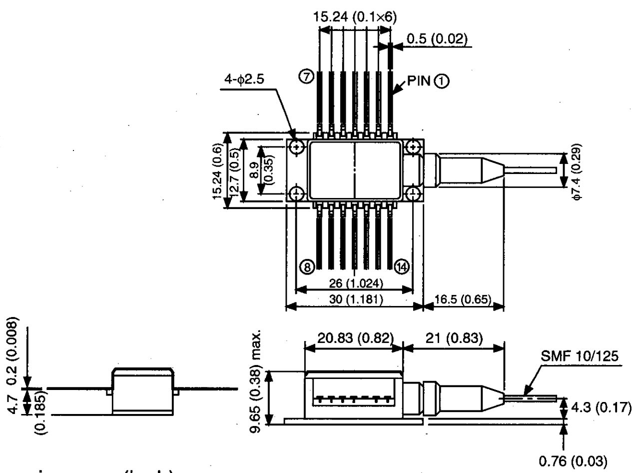
Item	Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current	I_{th}	—	25	40	mA	CW
LD forward voltage	V_F	—	—	1.5	V	I_F = Ith + 20 mA
Fiber output power	P_f	0.5	1.0	—	mW	I_F = Ith + 20 mA
Tracking error	ΔP_f	—	±0.2	±0.5	dB	T_C = –20 to 65°C, APC, ATC
Optical rise time	t_r	—	—	100	ps	Note 1, 10 to 90%
Optical fall time	t_f	—	—	200	ns	Note 1, 10 to 90%
Peak wavelength	λ_p	1525	1550	1575	nm	Note 1
Spectral width	$\Delta\lambda$	—	0.4	0.6	nm	Note 1
Side mode suppression ratio	S_r	30	40	—	dB	Note 1
Monitor current	I_m	100		1500	µA	CW, $V_{R\ (PD)}$ = 4 V, $I_F = I_{th}$ + 20 mA
PD dark current	I_{DARK}	—		0.5	µA	$V_{R\ (PD)}$ = 10 V
Thermistor resistance	R_{th}	9.5	10	10.5	kΩ	
Cooling current	I_C	—	—	1.2	A	ΔT = 40K, $I_F = I_{th}$ + 20 mA
Cooling voltage	V_C	—	—	1.4	V	ΔT = 40K, $I_F = I_{th}$ + 20 mA
Optical isolation	—	30	—	—	dB	
Input impedance	Z_{in}	—	25	—	Ω	

Note 1 : 2.5Gb/s, NRZ, PRBS: $2^{23} - 1$, Mark ratio 50%
P_{peak} = 2 mW, $I_B \geq I_{th}$, rise/fall time of LD driver is less than 120 ps

Outline Drawings and Pin Descriptions



Pin	Description
1:	Themistor
2:	Themistor
3:	LD Cathode (DC Bias)
4:	PD Anode
5:	PD Cathode
6:	TE Cooler (+)
7:	TE Cooler (–)
8:	Case Ground
9:	Case Ground
10:	NC
11:	LD Anode, Case Ground
12:	LD Cathode (RF Signal)
13:	Case Ground
14:	NC



Dimension: mm (inch)

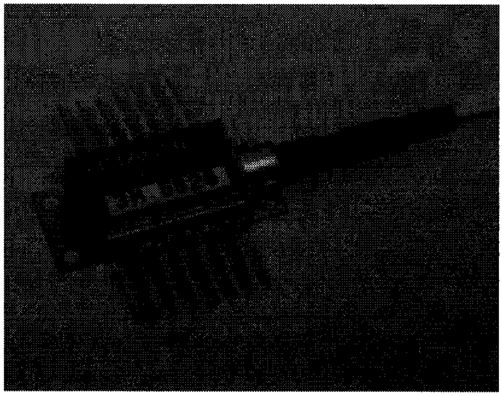
Front-end Receiver

2

Description

The PS5931 is a front-end receiver.

Features



- High speed operation (up to 2.5Gb/s)
- Hermetically sealed, 14-pin low profile butterfly package
- Internal GaAs pre-amplifier IC
- Transimpedance 600 to 1000Ω
- Internally AC coupled
- Output impedance 50Ω
- Wide Dynamic Range: 25dB

Absolute Maximum Ratings

Item	Symbol	Rated Value	Units
Operating case temperature	T_{opr}	–10 to 70	°C
Storage case temperature	T_{stg}	–40 to 70	°C
Supply voltage	V_{DD}	5.8	V
	V_{SS}	–5.8	
Lead soldering temperature	T_s	250	°C
Lead soldering time	—	10	sec

Fiber Pigtail Specifications

Item	Rated Value	Units
Core diameter	10±1	μm
Cladding diameter	125±3	μm
Jacket diameter	0.9±0.1	mm
Cutoff wavelength	≤1270	nm
Fiber length	≥1000	mm

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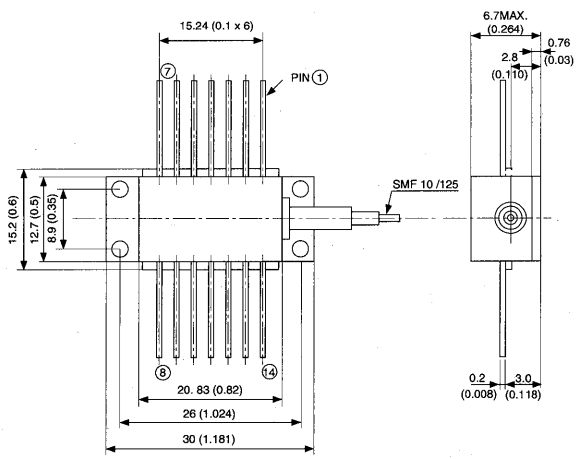
Optical and Electrical Characteristics ($T_a = 25°C$)

Item	Symbol	Min	Typ	Max	Units	Test Conditions
Received wavelength	λ	1280	1310	1335	nm	
		1480	1550	1580		
Responsivity	R	0.75	—	—	A/W	λ = 1.31 μm
APD breakdown voltage	V_B	40	60	80	V	I_{DARK} = 10 μA
Temperature coefficient of V_B	—	0.16	—	0.28	%/°C	T_a = 0 to 65 °C
APD dark current	I_{DARK}	—	10	50	nA	$V_{APD} = 0.9\ V_B$
Equivalent input noise	I_n	—	3	10	pA/√Hz	f = 500MHz
Transimpedance	Z_t	600	—	1000	Ω	f = 500MHz
Output return loss	S_{22}	14	—	—	dB	f = 300k to 1.7GHz
Output signal amplitude	—	8	—	—	mV_{pp}	P_r = –31dBm, M = 12
O/E transfer function 3dB bandwidth	f_{3dB}	1.7	—	—	GHz	AC-coupled, from 10MHz, M = 12
Sensitivity	P_{rmin}	—	—	–31	dBm	2.5Gb/s, $2^{23} - 1$ NRZ, 10^{-10} BER
Overload limit	P_{rmax}	–7	—	—	dBm	2.5Gb/s, $2^{23} - 1$ NRZ, 10^{-10} BER
Logic sense	—	light "On" --- logic "Low" —				
DC power supply	V_{DD}	4.75	5.0	5.25	V	
	I_{DD}	—	15	20	mA	
	V_{SS}	–5.46	–5.2	–4.94	V	
	I_{SS}	—	15	20	mA	
Power consumption	—	—	—	0.25	W	

Outline Drawings and Pin Descriptions



Pin	Description
1:	V_{APD} (+60V TYP)
2:	GROUND
3:	V_{SS} (–5.2V TYP)
4:	GROUND
5:	No Connection
6:	No Connection
7:	GROUND
8:	GROUND
9:	OUTPUT
10:	GROUND
11:	No Connection
12:	GROUND
13:	V_{DD} (+5.0V TYP)
14:	No Connection

Dimension: mm (inch)

2

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