HL1561A/AC/BF

InGaAsP LD

T-41-07

Description

The HL1561A/AC/BF are 1.55 µm band InGaAsP λ/4 phase-shifted distributed-feedback (DFB) laser diodes with a buried heterostructure.

Fiber Specifications (HL1561BF only)

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	: More than 500 mm

Features

- Long-wavelength light output: 1530 to 1570 nm
- 5 mW (CW) operation at room temperature (HL1561A/AC)
- High output power: P_f = 1.0 mW (CW or pulsed) (HL1561BF) operation
- Dynamic single longitudinal mode: side-mode suppression S_r = 38 dB Typ. (HL1561A/AC/BF)
- Fast pulse response: t_r = 0.15 ns; t_f = 0.2 ns Typ.

Absolute Maximum Ratings (T_C = 25°C)

Item		Symbol	Rated Value	Units
Optical output power	HL1561A/AC	P_O	5	mW
Fiber optical output power	HL1561BF	P_f	1.0	mW
Reverse voltage	HL1561A/AC	V_R	2	V
LD reverse voltage	HL1561BF	$V_{R\,(LD)}$	2	V
PD reverse voltage		$V_{R\,(PD)}$	15	V
PD forward voltage		$I_{P\,(PD)}$	1	mA
Cooler current		I_C	1.4	A
Operating temperature		T_{opr}	0 to +60	°C
Storage temperature	HL1561A/AC	T_{stg}	0 to +80	°C
	HL1561BF		–40 to +70	

Optical and Electrical Characteristics (T_C = 25°C)

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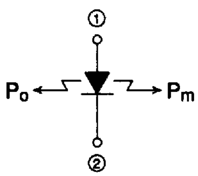
Item		Symbol	Min	Typ	Max	Units	Test Conditions
Optical output power	HL1561A/AC	P_O	5	—	—	mW	Kink free
			1.5	—	—		$I_F = I_{th} + 20$ mA
Fiber optical output power	HL1561BF	P_f	1.0	—	—	mW	Kink free
			0.3	—	—		$I_F = I_{th} + 20$ mA
Threshold current		I_{th}	—	25	50	mA	
Monitor optical output power	HL1561A/AC	P_m	0.6	—	—	mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	HL1561A/AC	λ_P	1530	1550	1570	nm	P_O = 3 mW
	HL1561BF		1530	1550	1570		P_f = 0.5 mW
Side-mode suppression ratio	HL1561A/AC	S_r	30	38	—	dB	P_O = 3 mW
	HL1561BF		30	35	—		P_f = 0.5 mW
Beam divergence (parallel)	HL1561A/AC	$\theta_{//}$	—	30	—	deg.	P_O = 3 mW, FWHM
Beam divergence (perpendicular)		$\theta_{\perp}$	—	40	—		P_O = 3 mW, FWHM
Rise time	HL1561A/AC	t_r	—	0.15	—	ns	$I_{bias} = I_{th}$, 10 to 90%
	HL1561BF		—	0.2	—		$I_{bias} = I_{th}$, 10 to 90%
Fall time	HL1561A/AC	t_f	—	0.2	—	ns	$I_{bias} = I_{th}$, 90 to 10%
	HL1561BF		—	0.3	—		$I_{bias} = I_{th}$, 90 to 10%
PD dark current	HL1561BF	I_{DARK}	—	—	350	nA	$V_{R\,(PD)}$ = 5 V
Monitor current		I_S	100	—	—	µA	$V_{R\,(PD)}$ = 5 V, P_f = 0.5 mW
PD capacitance		C_t	—	10	20	pF	$V_{R\,(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage		$V_{R\,(S)}$	—	—	2	V	
Cooling capacity		ΔT	40	—	—	°C	P_f = 0.5 mW, T_C = 60°C
Cooler current		I_O	—	—	1.4	A	ΔT = 40°C
Cooler voltage		V_C	—	—	1.8	V	ΔT = 40°C
Thermistor resistance		R_{TM}	—	10	—	KΩ	

Internal Circuit

Package Type
- HL1561A: A1
- HL1561AC: AC



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Pin Connection (Bottom View) (HL1561BF)

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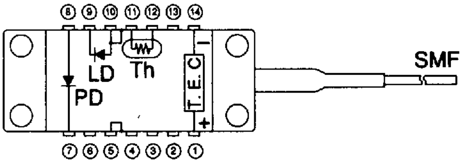

LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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
- HL1561BF: BF

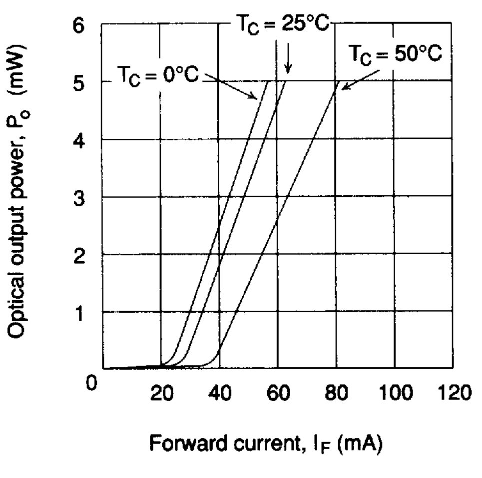

Figure 1 Optical Output Power vs. Forward Current (HL1561A/AC)

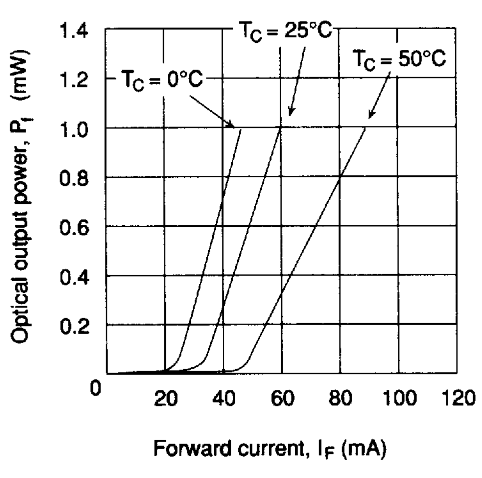

Figure 2 Optical Output Power vs. Forward Current (HL1561BF)

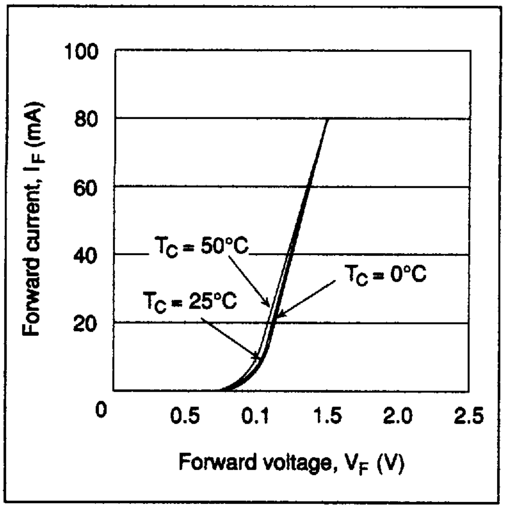

Figure 3 Forward Current vs. Forward Voltage (HL1561A/AC)

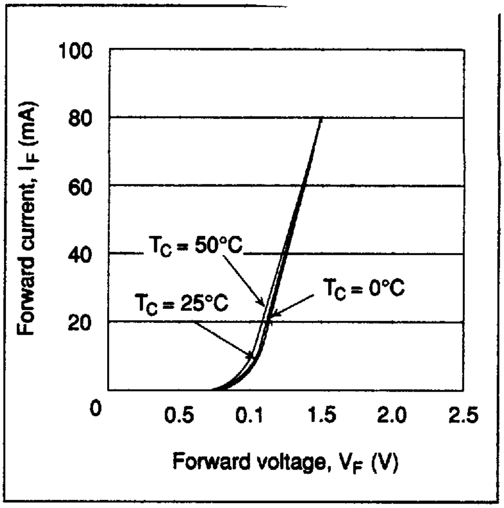

Figure 4 Forward Current vs. Forward Voltage (HL1561BF)

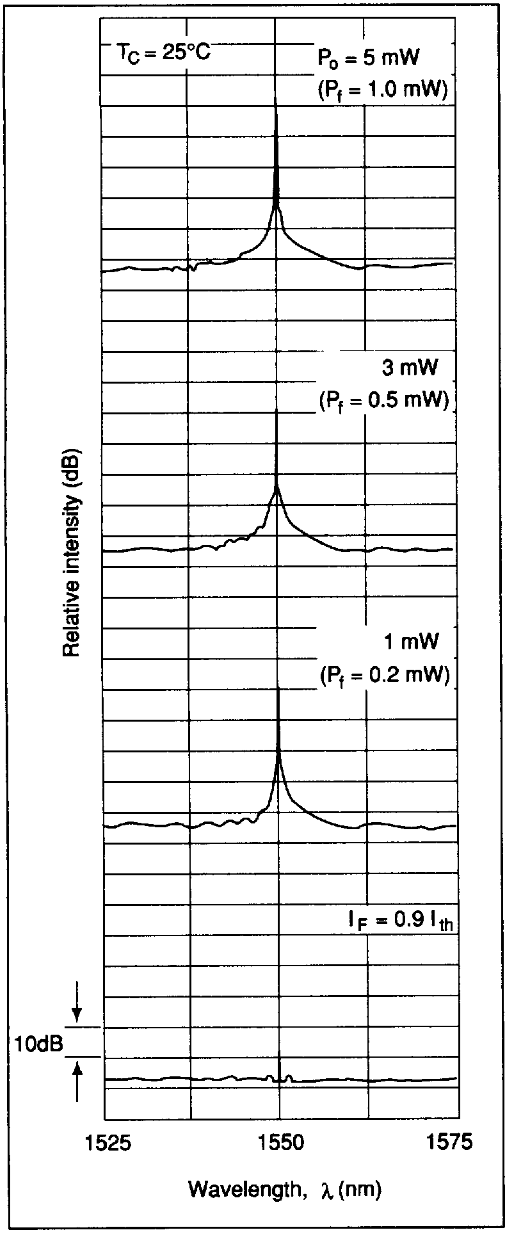

Figure 5 Optical Output Power Dependence of Lasing Spectrum (HL1561A/AC/BF)
( ): HL1561BF only

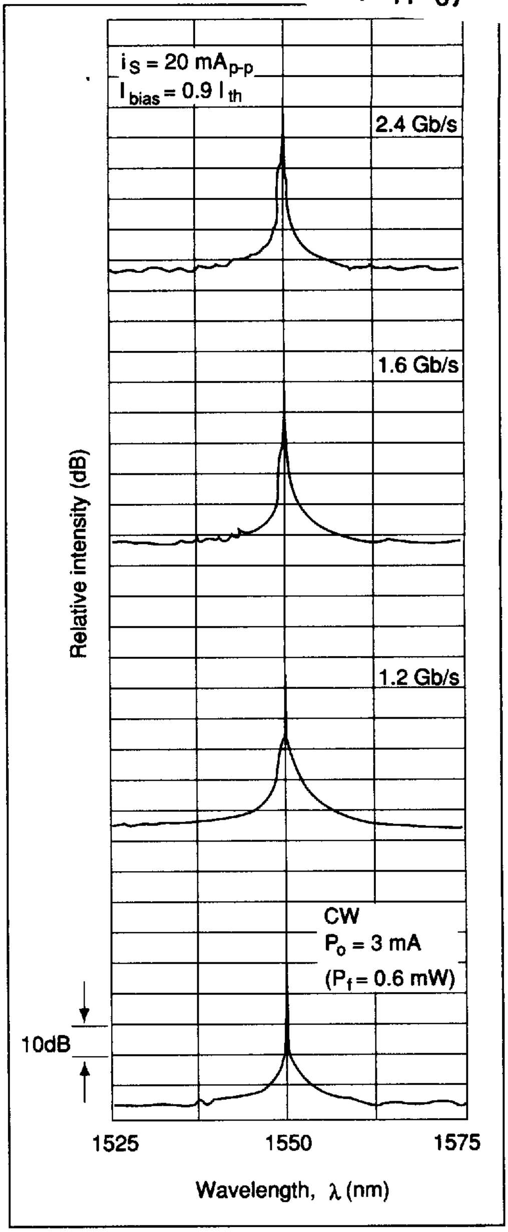

Figure 6 Frequency Dependence of Lasing Spectrum (HL1561A/AC/BF)
( ): HL1561BF only

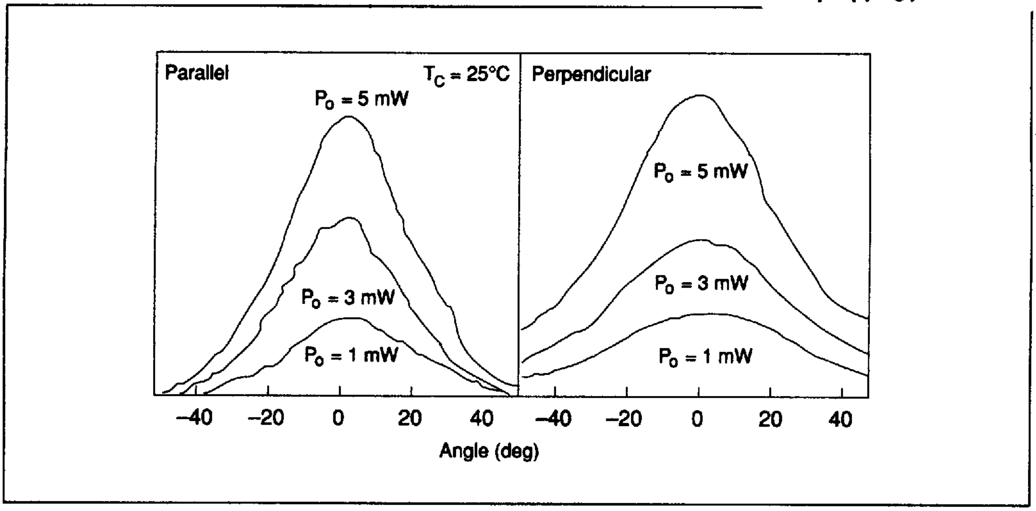

Figure 7 Far Field Pattern (HL1561A/AC)

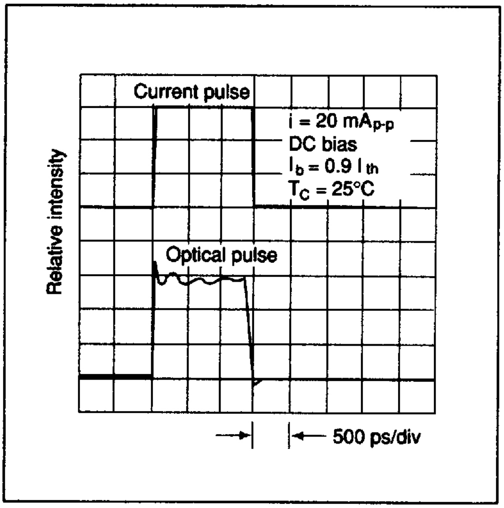

Figure 8 Pulse Response of Laser Diode (HL1561A/AC/BF)

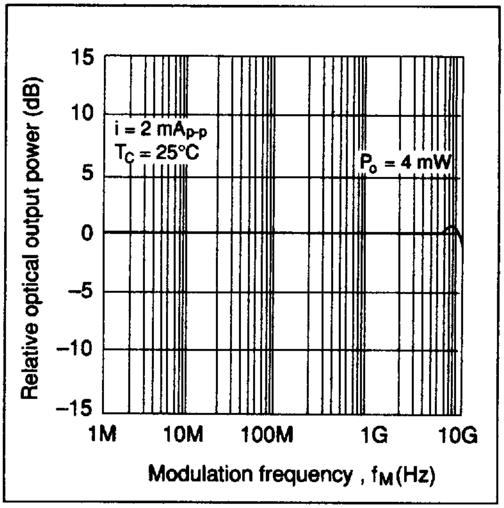

Figure 9 Frequency Response of Laser Diode (HL1561A/AC)

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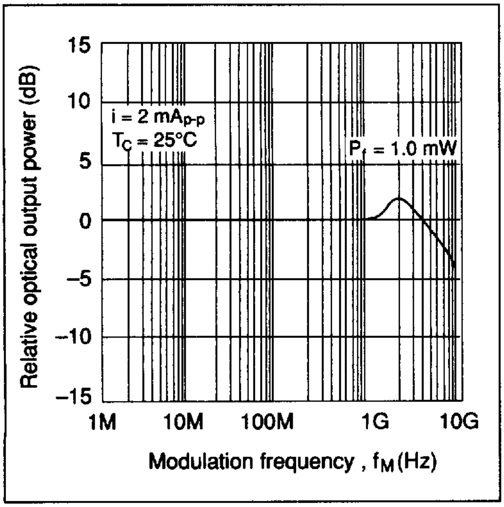

Figure 10 **Frequency Response of Laser Diode (HL1561BF)**

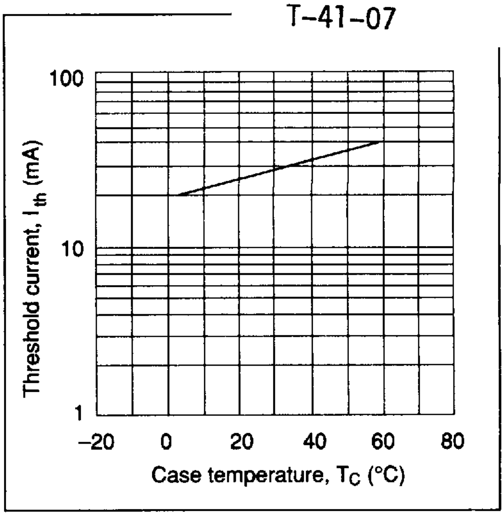

Figure 11 **Threshold Current vs. Case Temperature (HL1561A/AC/BF)**

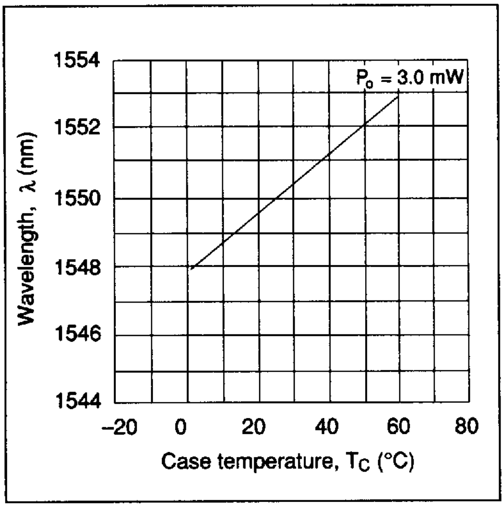

Figure 12 **Temperature Dependence of Lasing Wavelength (HL1561A/AC)**

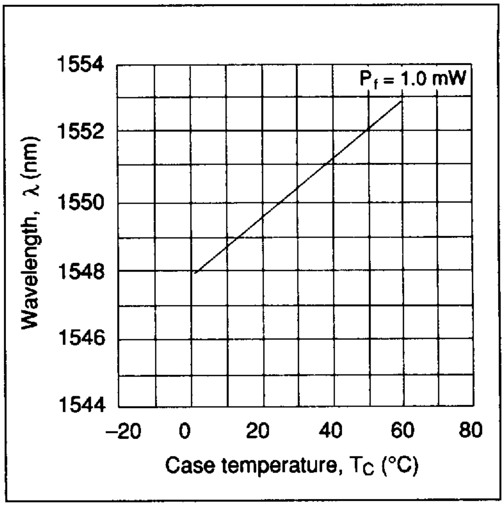

Figure 13 **Temperature Dependence of Lasing Wavelength (HL1561BF)**

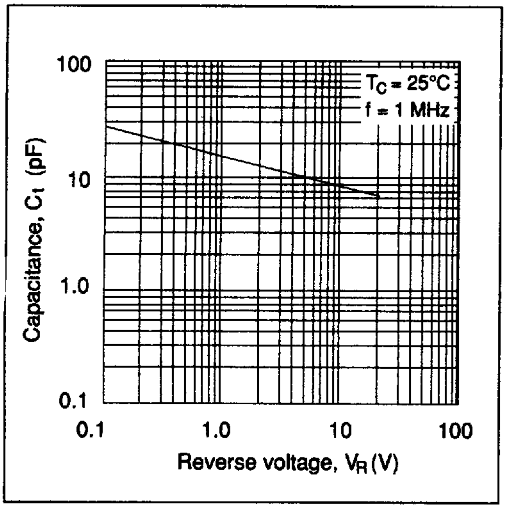

Figure 14 Capacitance vs. Reverse Voltage of Photodiode (HL1561BF)

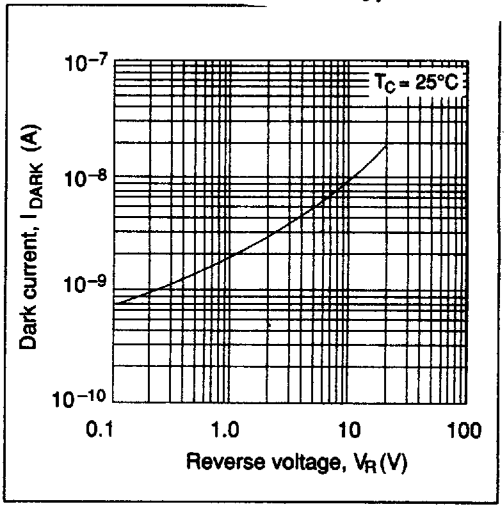

Figure 15 Dark Current vs. Reverse Voltage of Photodiode (HL1561BF)

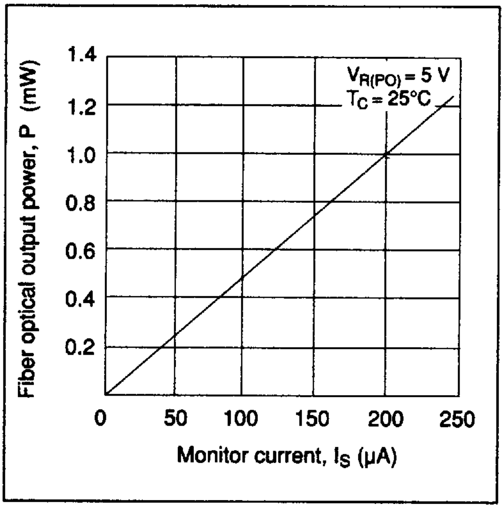

Figure 16 Fiber Optical Output Power vs. Monitor Current (HL1561BF)

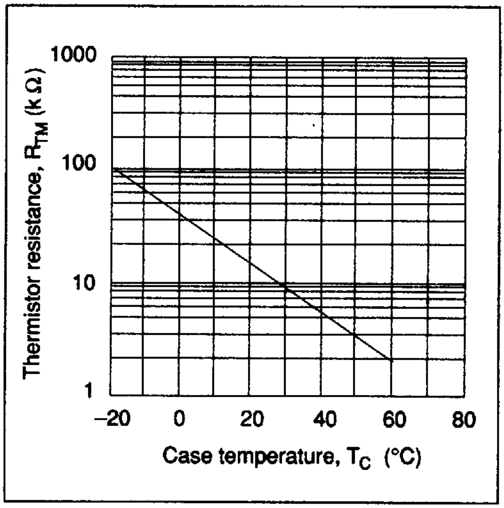

Figure 17 Temperature Dependence of Thermistor Resistance (HL1561BF)

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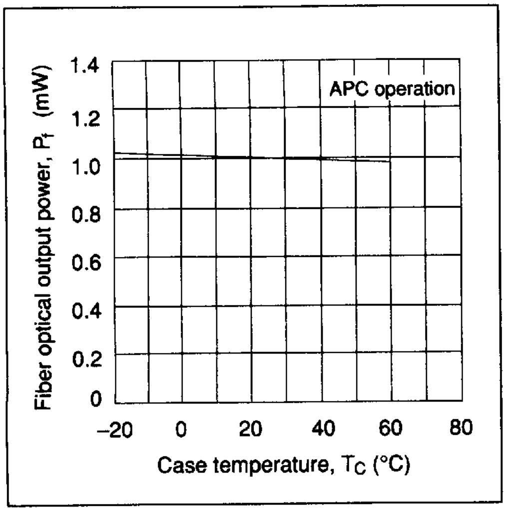

Figure 18 Tracking Characteristics (HL1561BF)

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Section 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.

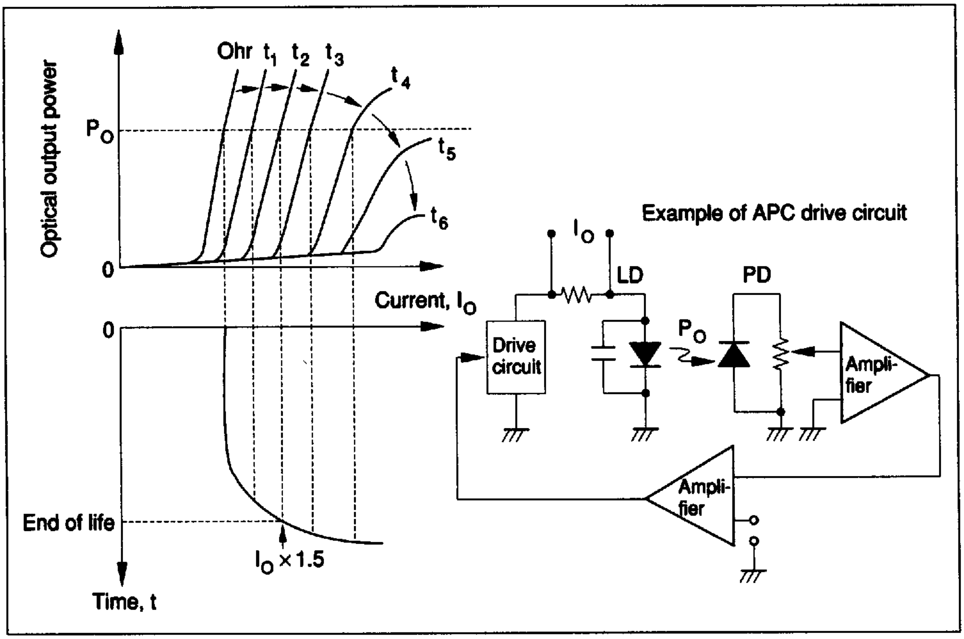

Figure 6-1 Example of Drift in LD Optical Output Power vs. Current Characteristic

6.2 Derating

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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.

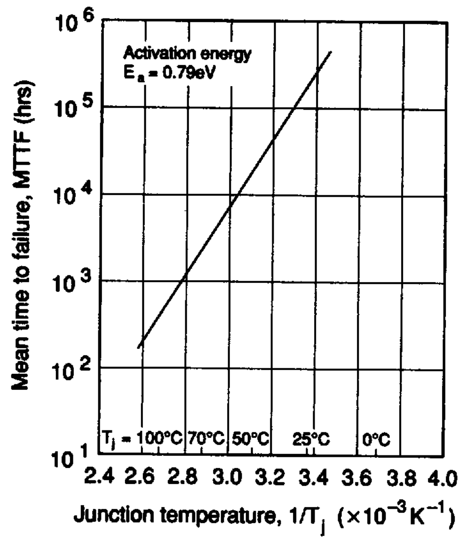

Figure 6-2 LD Mean Time to Failure vs. Junction Temperature (Example)

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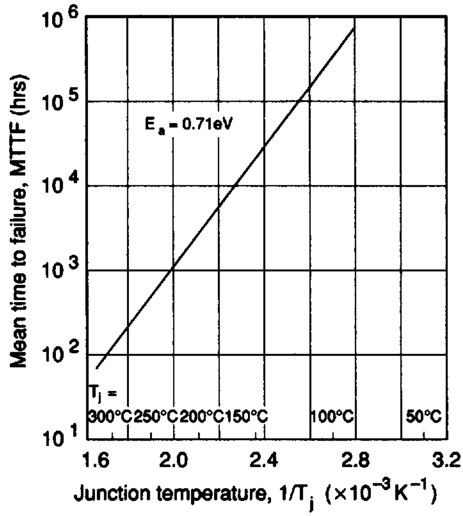

Figure 6-3 IRED Mean Time to Failure vs. Junction Temperature (Example)

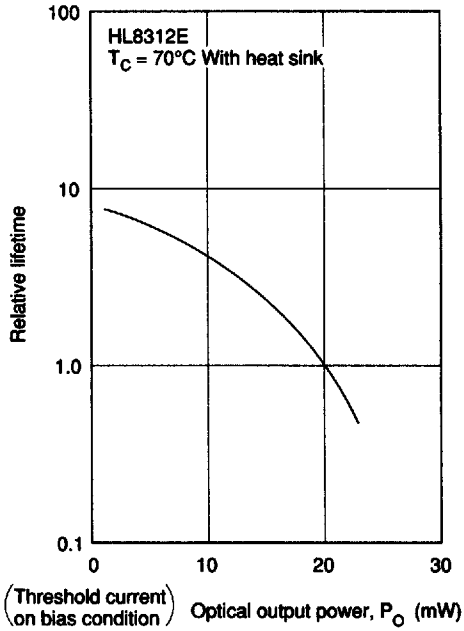

Figure 6-4 LD Operating Life vs. Optical Output Power (Example)

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.

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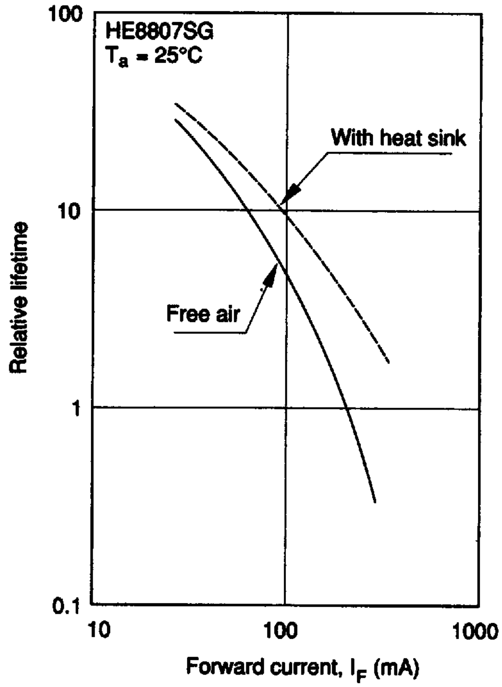

Figure 6-5 IRED Operating Life vs. Forward Current (Example)

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.

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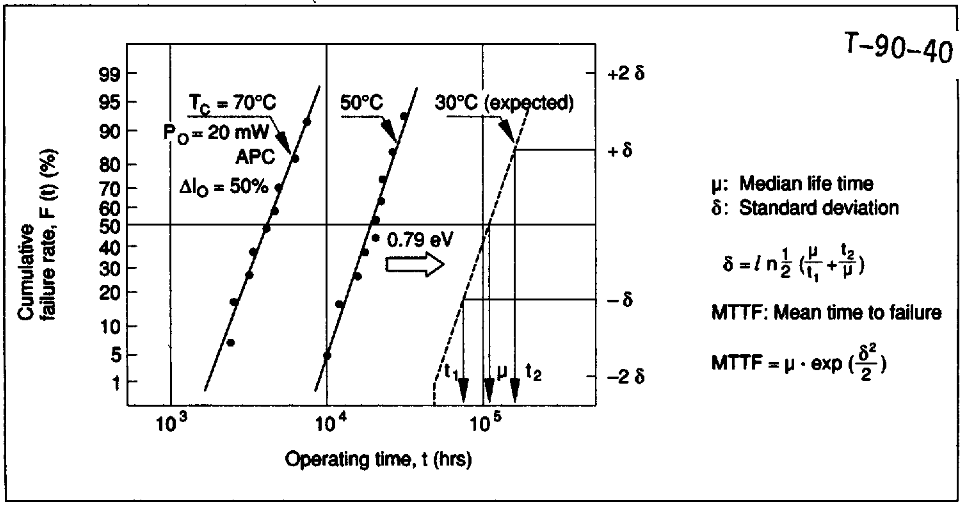

Figure 6-6 Distribution of Expected LD Life (Example)

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, HE1301 series