HL1541A/AC/FG/BF/DL/DM

InGaAsP LD

T-41-05

Description

The HL1541A/AC/FG/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 HL1541FG has a built-in photodiode and can type packaging.
- 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 – 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)

Absolute Maximum Ratings (T_C = 25°C)

Item		Symbol	Rated Value	Units
Optical output power	HL1541A/AC/FG	P_O	5	mW
Fiber optical output power	HL1541BF/DL	P_f	1.0	mW
	HL1541DM		1.2	
Reverse voltage		V_R	2	V
PD reverse voltage	HL1541FG/BF/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 FG/BF/DL	T_{opr}	0 to +60	°C
	HL1541DM		0 to +50	
Storage temperature	HL1541A/AC	T_{stg}	0 to +80	°C
	HL1541FG		–40 to +80	
	HL1541BF/DL		–40 to +70	
	HL1541DM		–40 to +60	

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Optical and Electrical Characteristics (T_C = 25°C)

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Item		Symbol	Min	Typ	Max	Units	Test Conditions
Threshold current		I_{th}	—	25	50	mA	
Optical power output	HL1541A/AC	P_O	5	—	—	mW	Kink free
			1.5	—	—		$I_F = I_{th}$ + 20 mA
	HL1541FG		5	—	—		Kink free
			1.5	3.0	—		$I_F = I_{th}$ + 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 wavelength	HL1541A/AC/FG	λ_p	1530	1550	1570	nm	P_O = 3 mW
	HL1541BF/DL/DM		1530	1550	1570		P_f = 0.5 mW
Spectral width	HL1541A/AC/FG	S_r	30	35	—	dB	P_O = 3 mW
	HL1541BF/DL/DM		30	35	—		P_f = 0.5 mW
Beam divergence (horizontal)	HL1541A/AC/FG	$\theta_{//}$	—	30	—	deg.	P_O = 3 mW, FWHM
Beam divergence (vertical)		$\theta_{\perp}$	—	40	—	deg.	
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	HL1541FG/BF/DL/DM	I_{DARK}	—	—	350	nA	$V_{R\,(PD)}$ = 5 V
Monitor current	HL1541FG	I_S	50	—	—	µA	$V_{R\,(PD)}$ = 5 V, P_O = 3 mW
	HL1541BF/DL		300	—	—		$V_{R\,(PD)}$ = 5 V, P_f = 0.5 mW
	HL1541DM		150	—	—		
PD capacitance	HL1541FG/BF/DL/DM	C_t	—	10	20	pF	$V_{R\,(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation bias current	HL1541FG/BF/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	

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HL1541A/AC/FG/BF/DL/DM

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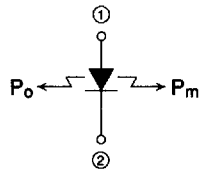
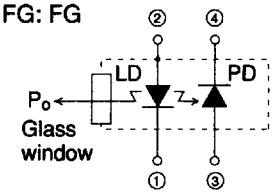
Internal Circuit

Package Type
- HL1541A: A1
- HL1541AC: AC



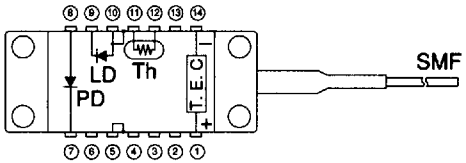
HL1541A/AC

Package Type
- HL1541FG: FG



HL1541FG/MF

Pin Connections (Bottom view)

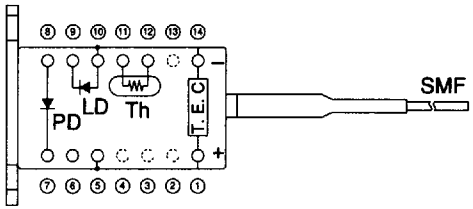


LD: Laser diode
PD: Photodiode
Th: Thermistor
T. E. C.: T. E. cooler
SMF: Single-mode fiber

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

Package Type
- HL1541BF: BF

HL1541BF



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

HL1541DL

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Pin Layout (Bottom View) HL1541DM

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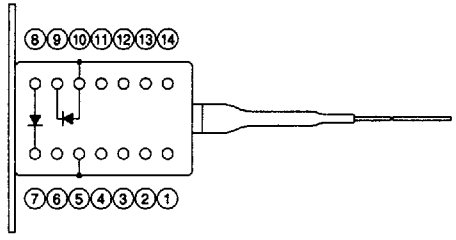
Package Type
- HL1541DM: DM



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.

Fiber Specifications
(HL1541BF/DL/DM)

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

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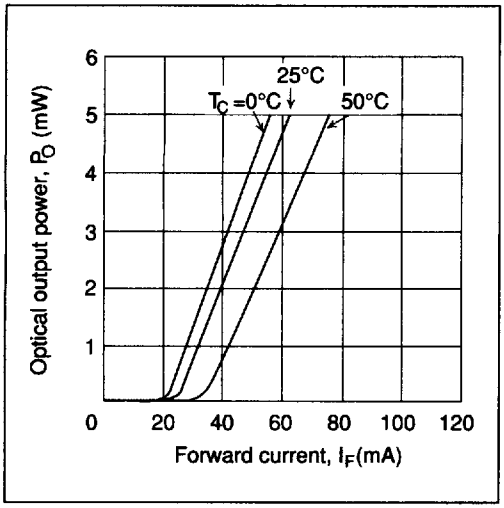

Figure 1 Optical Output Power vs. Forward Current (HL1541A/AC/FG)

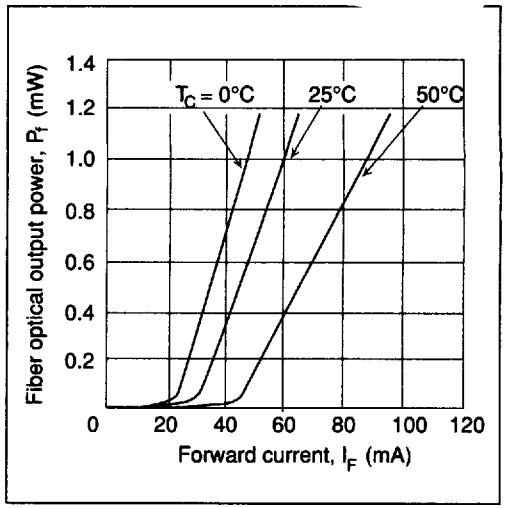

Figure 2 Optical Output Power vs. Forward Current (HL1541BF/DL/DM)

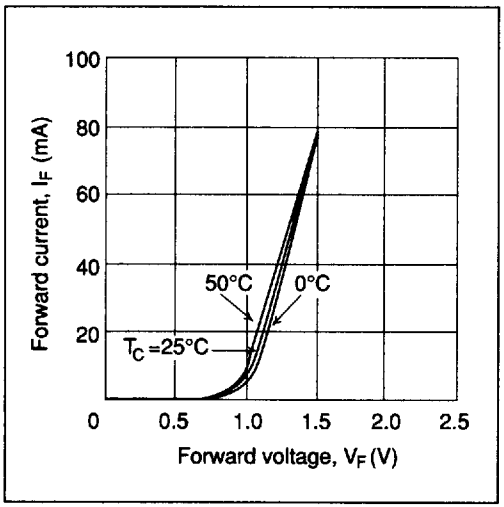

Figure 3 Forward Current vs. Forward Voltage

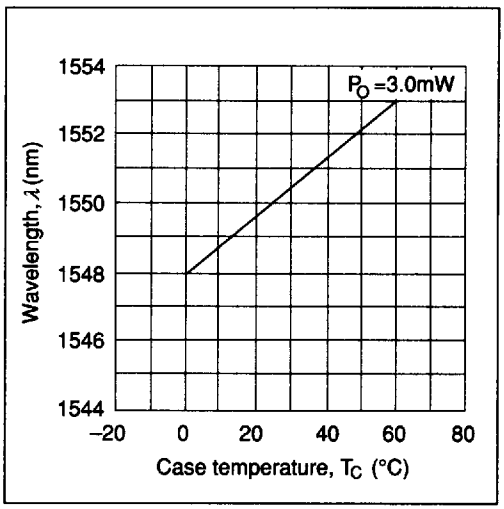

Figure 4 Lasing Wavelength Temperature Dependence

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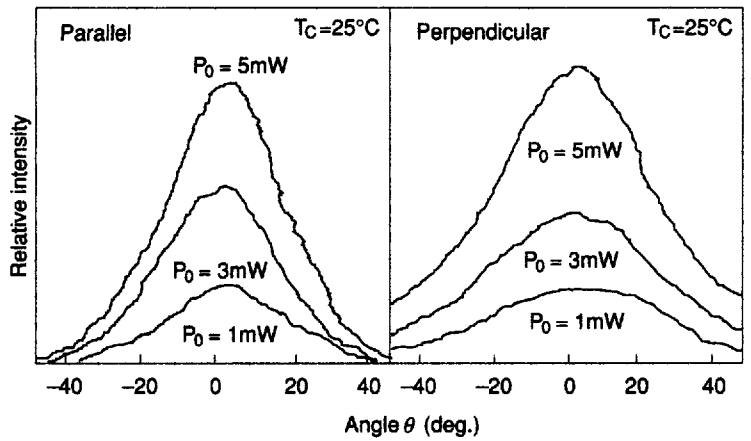

Figure 5 Far Field Pattern (HL1541A/AC/FG)

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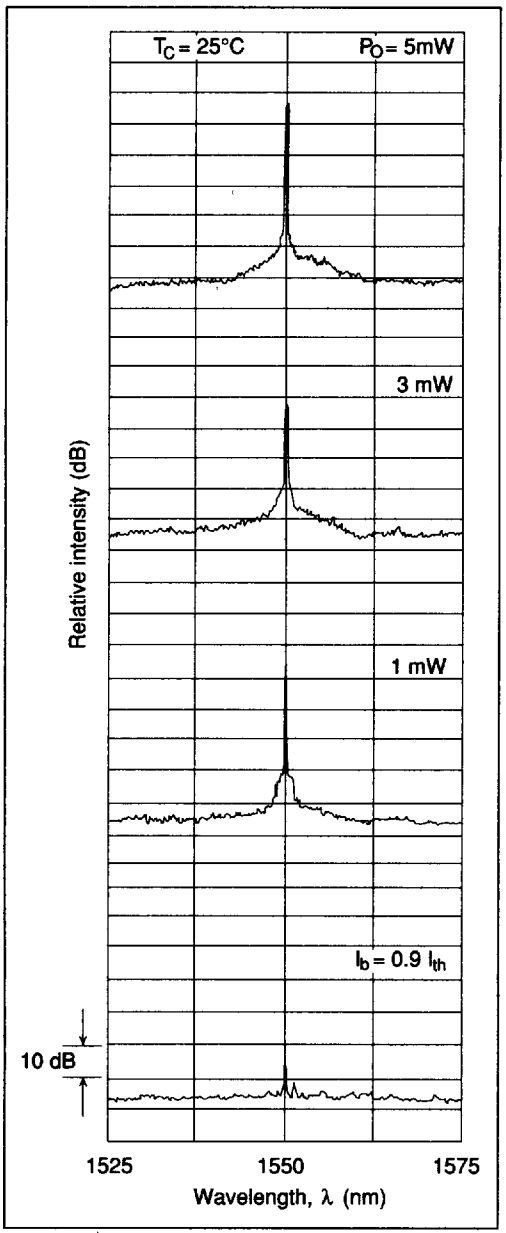

Figure 6 Output Wavelength (HL1541A/AC/FG)

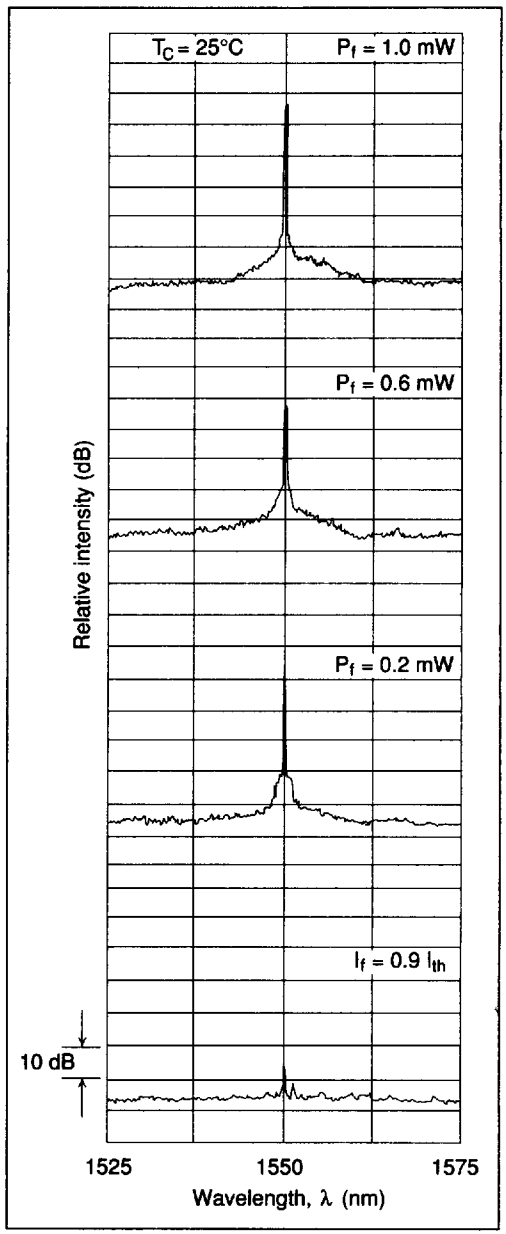

Figure 7 Output Wavelength (HL1541BF/DL/DM)

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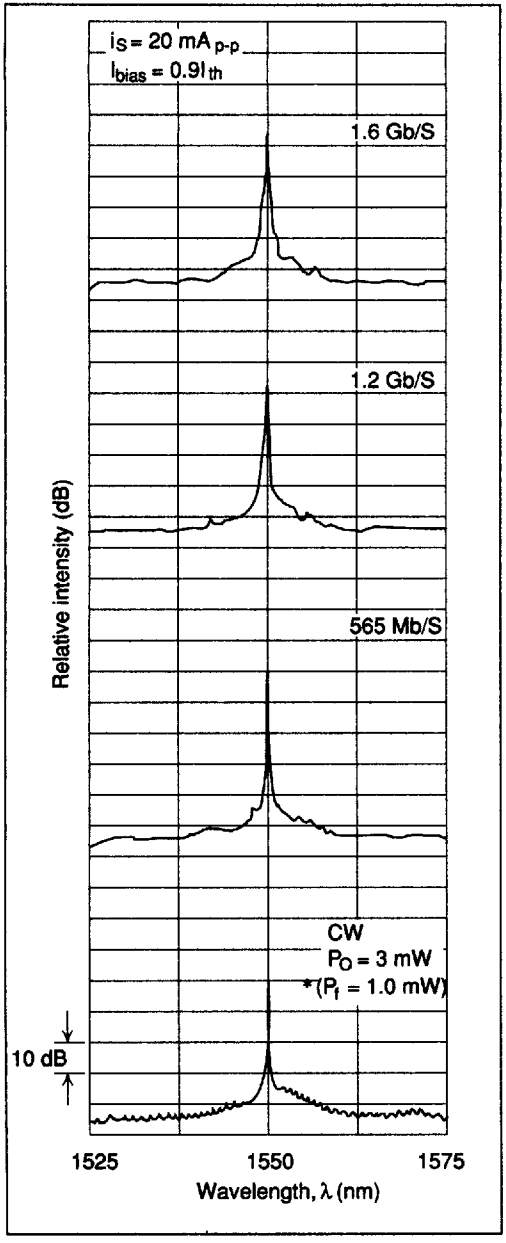

Figure 8 Spectral Frequency Dependence (*:HL1541BF/DL/DM)

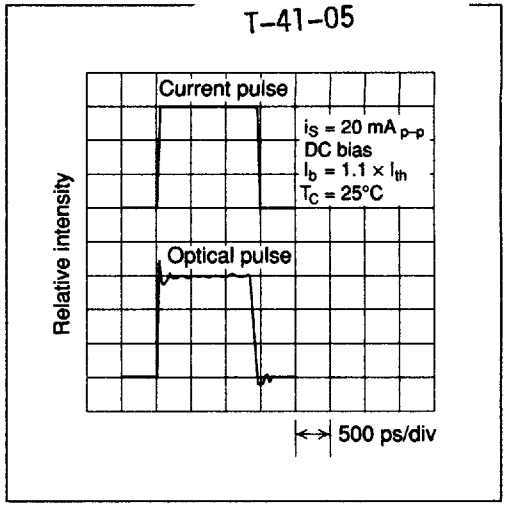

Figure 9 Pulse Response Characteristics

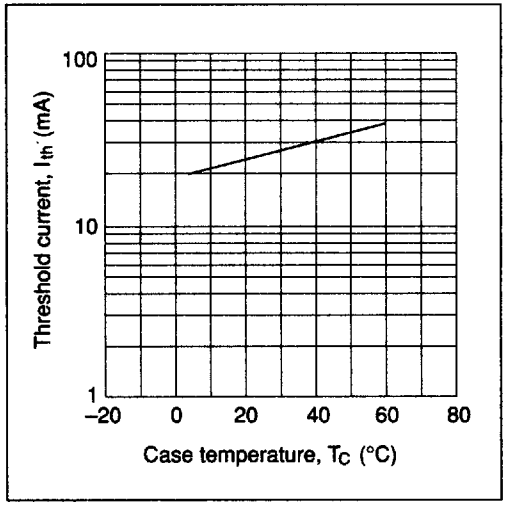

Figure 10 Threshold Current vs. Case Temperature

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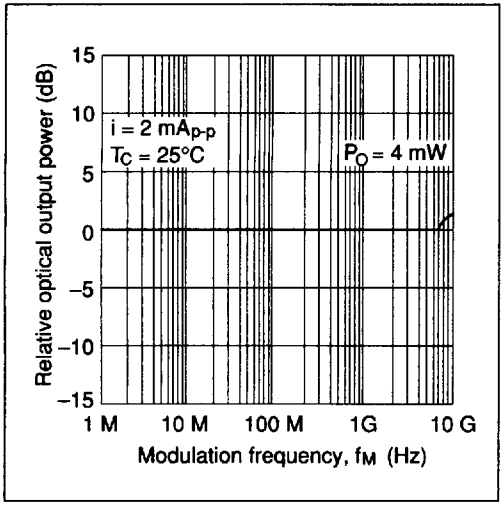

Figure 11 Frequency Response Characteristics (HL1541A/AC/FG)

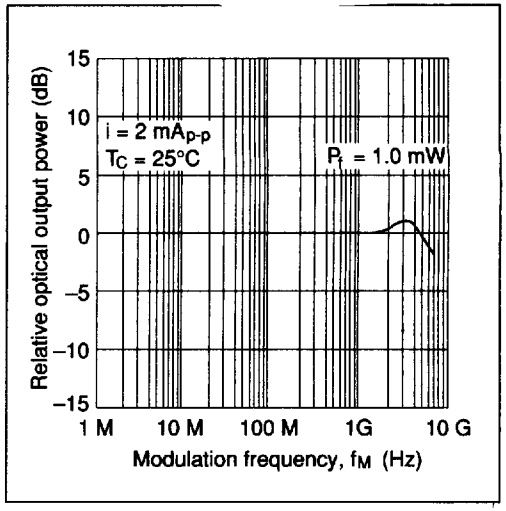

Figure 12 Frequency Response Characteristics (HL1541BF)

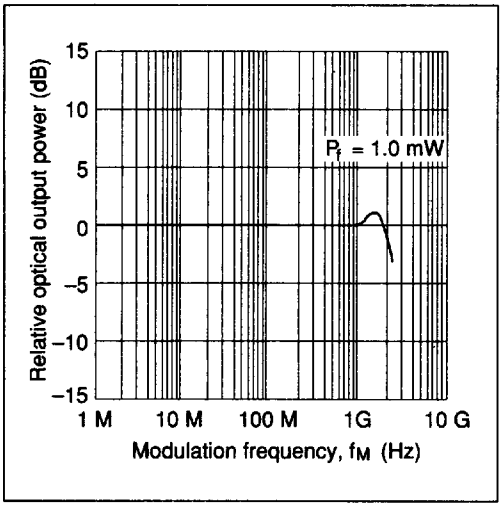

Figure 13 Frequency Response Characteristics (HL1541DL)

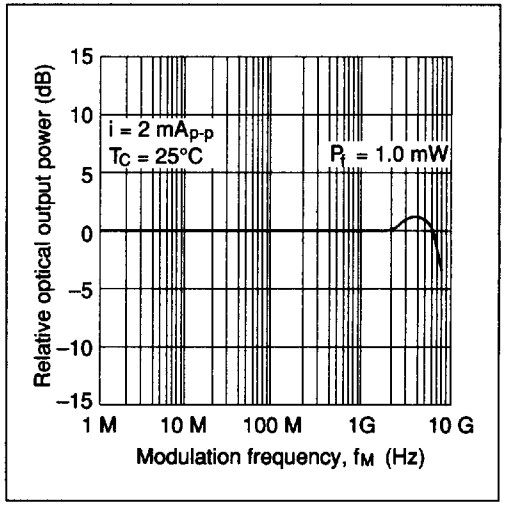

Figure 14 Frequency Response Characteristics (HL1541DM)

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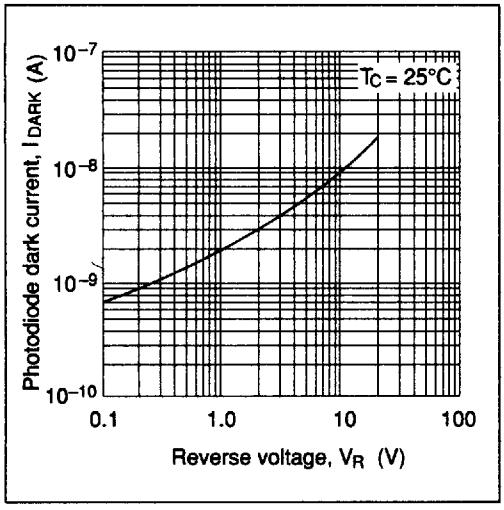

Figure 15 Dark Current vs. Reverse Voltage (HL1541FG/BF/DL/DM)

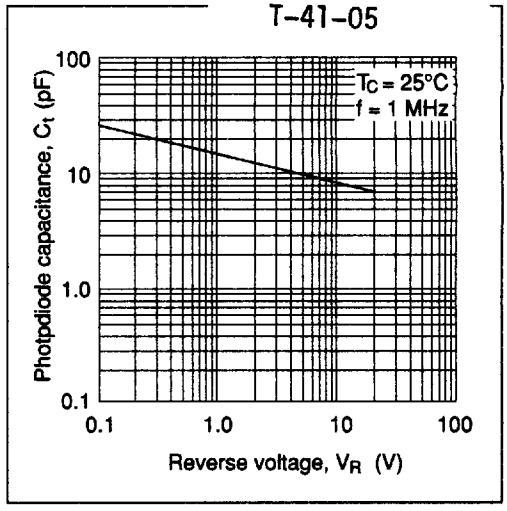

Figure 16 Capacitance vs. Reverse Voltage (HL1541FG/BF/DL/DM)

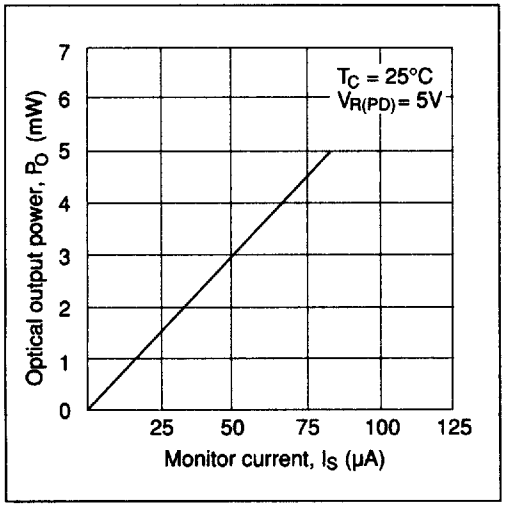

Figure 17 Optical Output Power vs. Monitor Current (HL1541FG)

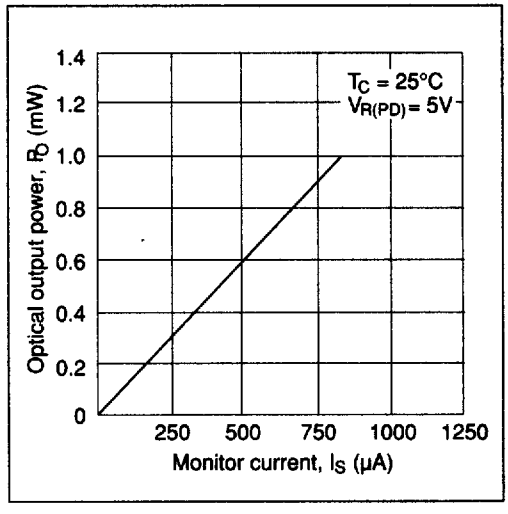

Figure 18 Optical Output Power vs. Monitor Current (HL1541BF/DL/DM)

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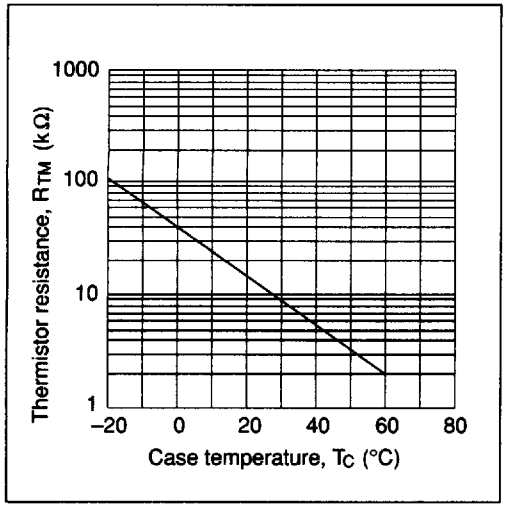

Figure 19 Thermistor Resistance vs. Case Temperature (HL1541BF/DL)

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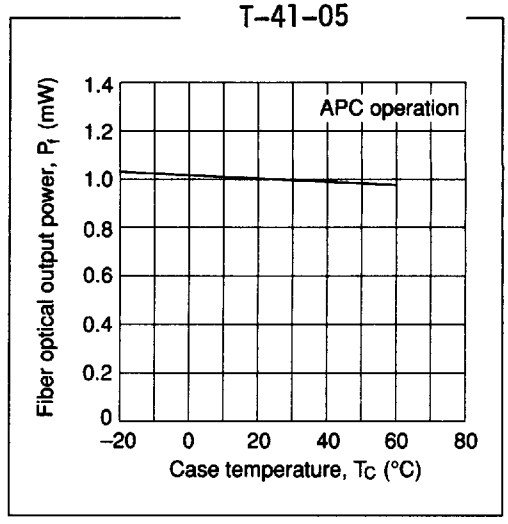

Figure 20 Tracking Characteristics (HL1541BF/DL)

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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.

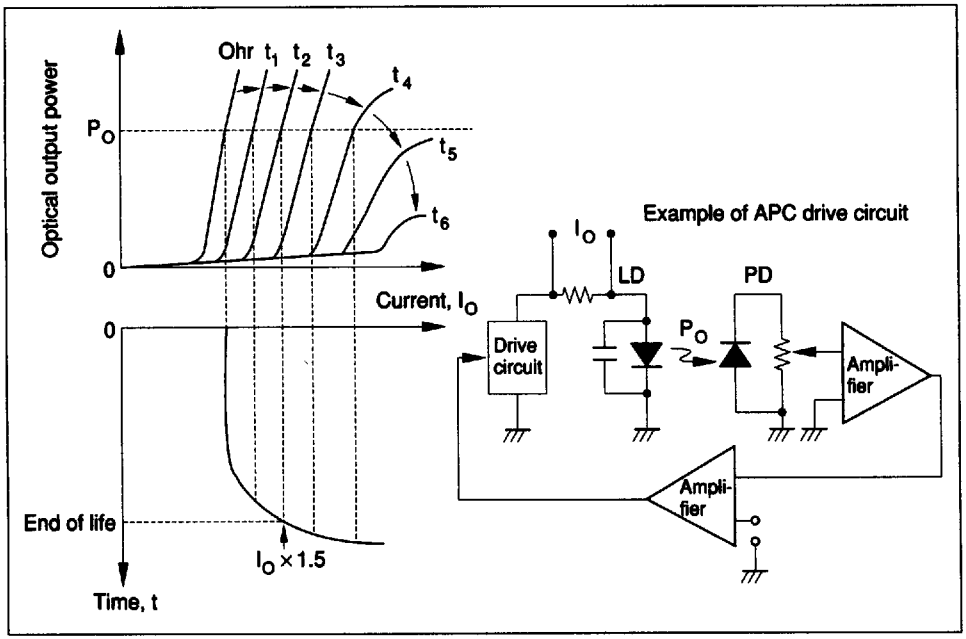

Figure 6-1 Example of Drift in LD Optical Output Power vs. Current Characteristic

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6.2 Derating

T-90-40

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.

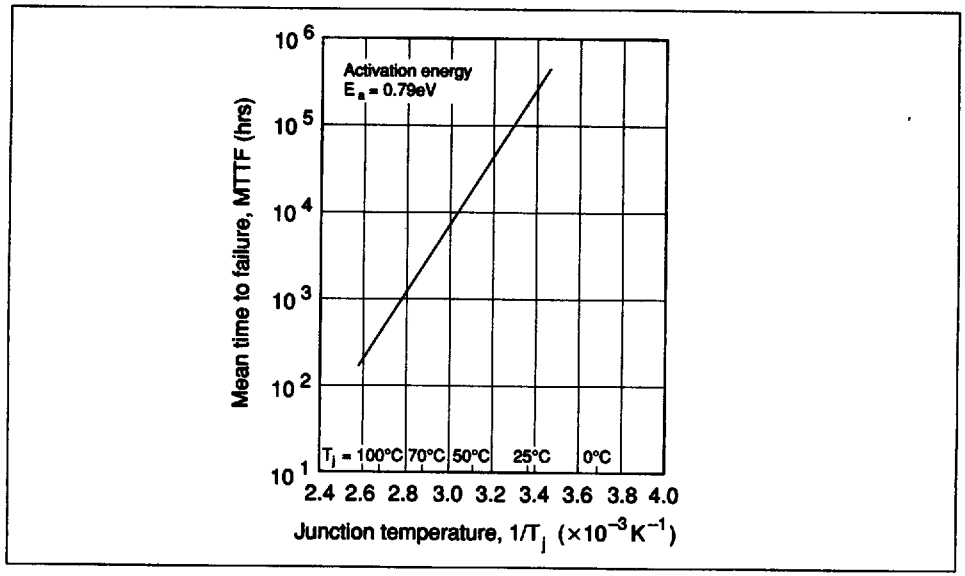

Figure 6-2 LD Mean Time to Failure vs. Junction Temperature (Example)

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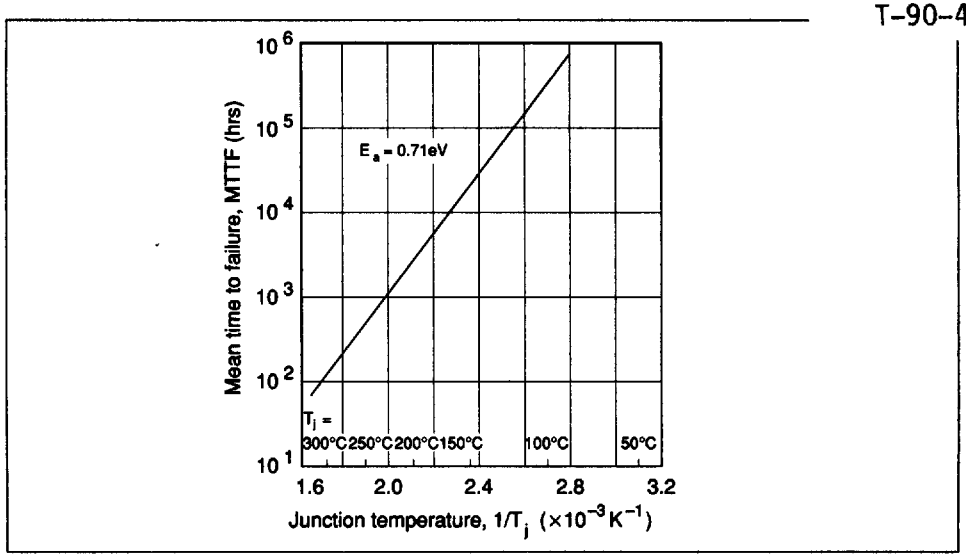

Figure 6-3 IRED Mean Time to Failure vs. Junction Temperature (Example)

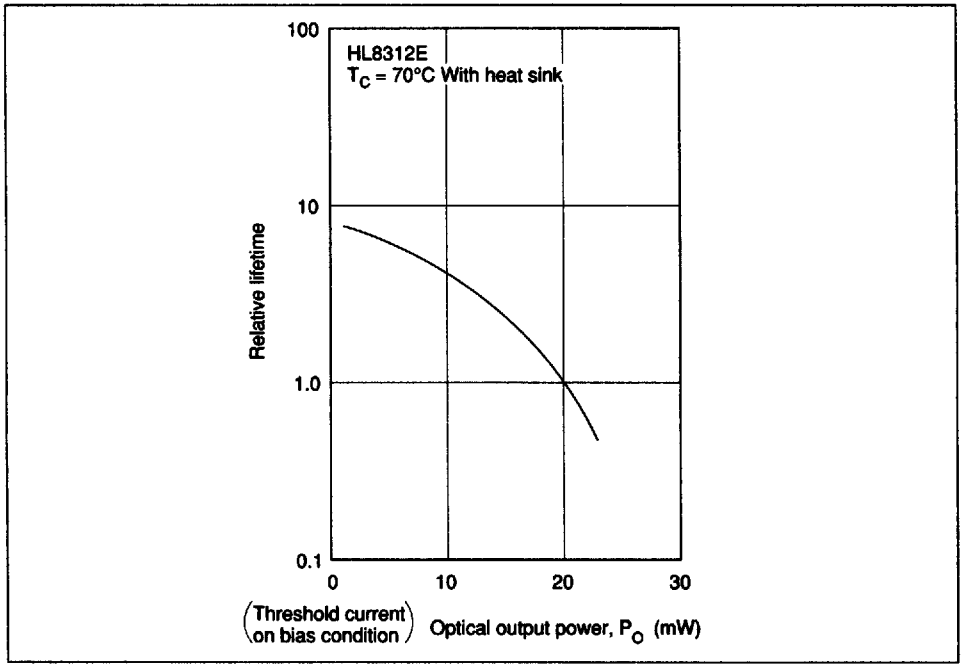

Figure 6-4 LD Operating Life vs. Optical Output Power (Example)

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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.

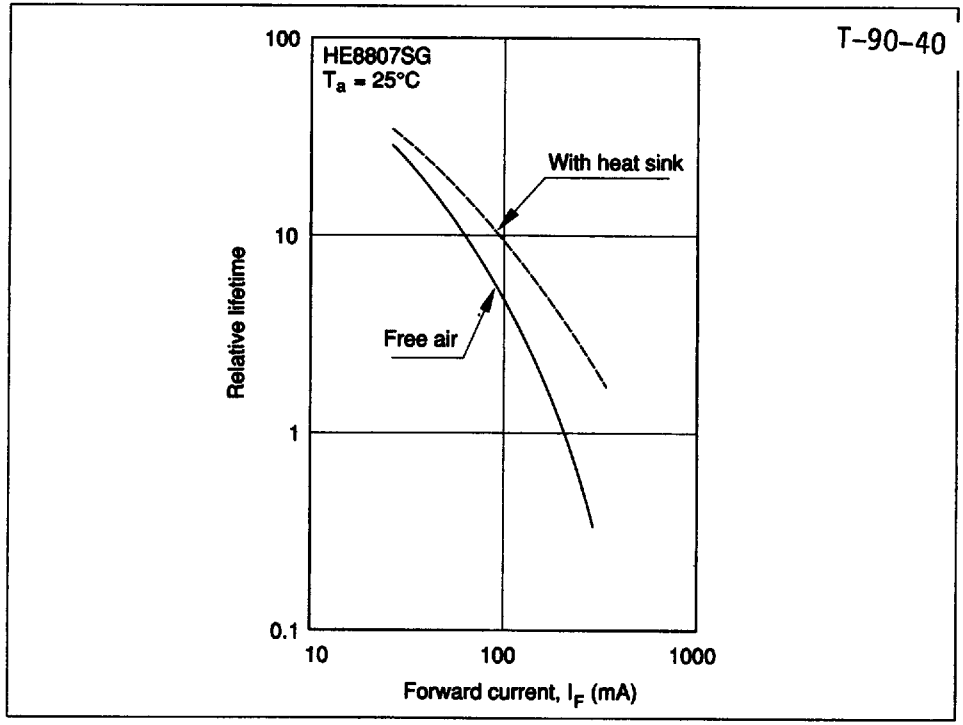

Figure 6-5 IRED Operating Life vs. Forward Current (Example)

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.

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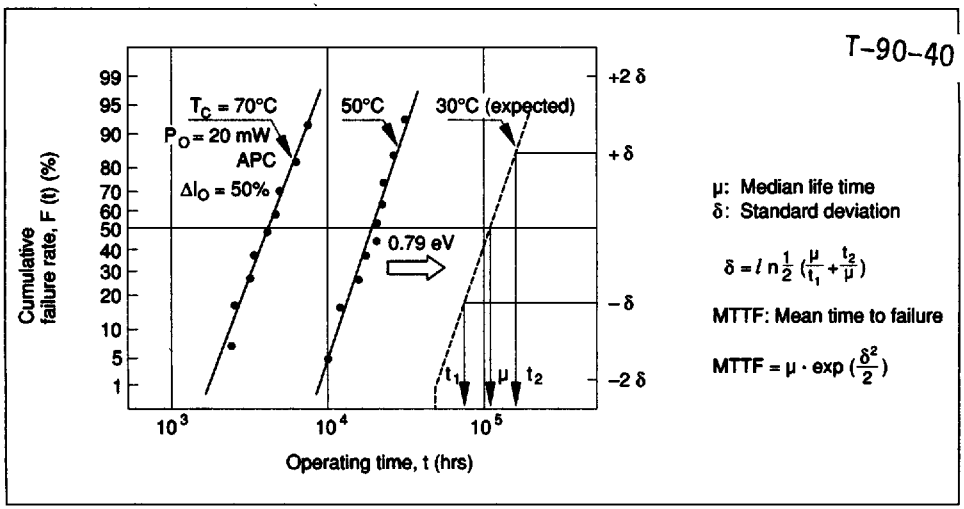

Figure 6-6 Distribution of Expected LD Life (Example)

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

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