

Reliability

IRED Power Dissipation Consideration

IRED power output (P_o) increases with forward current (I_f). Increasing the forward current also increases power dissipation (P_d) and chip junction temperature (T_j), resulting in decreased optical power output and device operating lifetime.

Data sheets for IRED products specify optical power output as a function of both forward current and maximum operating ambient temperature. Maximum power dissipation limits are specified to maintain chip junction temperature below some maximum value. Typically, IRED data sheets specify maximum power dissipation at 25°C, and include a power dissipation derating factor (mW/°C) for operation at temperature above 25°C ambient.

The relationship of chip junction temperature to operating conditions is:

$$T_j = T_A + \Theta_{th} P_d$$

Where

- T_j = Chip junction temperature (°C)
- T_A = Ambient operating temperature (°C)
- Θ_{th} = Package thermal resistance junction to ambient (°C/W)
- P_d = Power dissipation (W)

Maximum chip junction temperature limits for Honeywell IRED products range from 125°C to 150°C. Maximum package ambient operating temperatures range from 85°C to 125°C. Package thermal resistance is used to calculate maximum allowable power dissipation for any particular application. Honeywell IRED has made these calculations for several IRED products. Table 1 summarizes the results for products used at maximum ambient temperature. Power dissipation deratings for ambient temperatures between 25°C and T_{max} may be calculated using the power dissipation values given on the product data sheet. The junction and ambient temperature limits are selected to prevent both catastrophic package material deterioration and excessive IRED power output degradation. The thermal resistance values of Table 1, are those representing device operation without heatsinking. They are worst-case values and can be made considerably lower by the use of heatsinking techniques.

Pulsed mode operation requires the use of additional criteria to determine proper design operating conditions. Pulsed operation at low drive currents (below the maximum dc drive limits) effectively extends the IRED operating lifetime beyond the DC operation lifetime by a factor equal to the inverse of the duty cycle.

Operation of an IRED device in the pulsed mode is limited by the peak chip junction temperature, not the average junction temperature. Junction temperature increases in a complex non-exponential manner with a characteristic thermal time of 10 to 100 microseconds when operated in the pulsed mode. By operating an IRED with short pulse widths relative to the thermal time constant, pulsed currents much greater than the maximum allowable dc operating current may be used without causing a reduction in IRED operating lifetime. To preserve operating equivalent to that of DC conditions, the duty cycle of the pulsed condition must also be considered; the average pulsed power dissipation must not exceed the average DC maximum power dissipation.

Fig. 1 shows the acceptable pulsed current operating conditions to achieve IRED operating lifetimes equivalent to those at maximum DC operating conditions and temperatures. Two parameters constrain peak current: duty cycle and pulse width.

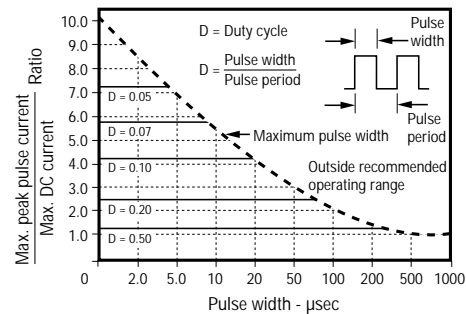


Figure 1: Maximum pulsed current conditions for GaAs: Si and AlGaAs: Si

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Table 1: IRED Product power dissipation limits for DC operation

PACKAGE TYPE	PRODUCT NUMBER	THERMAL RESISTANCE (°C/W)	MAXIMUM AMBIENT OPERATING TEMPERATURE	MAXIMUM JUNCTION TEMPERATURE	MAXIMUM POWER DISSIPATION FOR T _A = MAX
Hermetic pigtail	SE1450 SE1470	785°C/W (no heat sink)	125°C	150°C	32 mW
Hermetic TO-46	SE3453/5453 SE3455/5455 SE34705470	370°C/W (no heat sink)	125°C	150°C	68 mW
Plastic	SEP8505 SEP8705	670°C/W (no heat sink)	85°C	125°C	37 mW
Plastic sidelooker	SEP8506 SEP8706	750°C/W (no heat sink)	85°C	125°C	35 mW

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