TECH NOTE

Thermal Resistance of the LRS-9550-4442B C-Mount Fixture

PURPOSE

This technical note describes the thermal resistance of the LRS-9550-4442B C-Mount Fixture. Thermal resistance was characterized across all device locations and with different device loading patterns.

BACKGROUND

The LRS-9550-4442B fixture is designed for high power C-mount devices with drive currents up to 20A and is compatible with the LRS-9550 High Power Laser Diode Test System. Depending on the application and system configuration, the C-mount fixture can be loaded with either 8 or 16 C-mount laser diodes. Devices are arranged in two rows on either side of the fixture and are electrically connected in series. Figure 1 illustrates arrangement and numbering of devices.

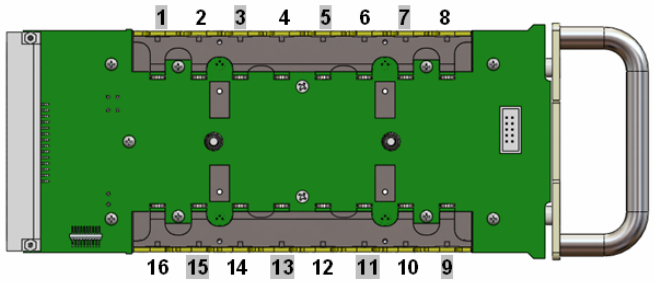

Figure 1. Device locations (8 device loading pattern highlighted in grey)

The fixture is designed to have minimal thermal resistance between the temperature-controlled fixture base and the laser diode chips. The fixture thermal resistance, R_f, is defined as follows for a given device location:

$$R_f = (T_c - T_b)/(V*I*(1-E)) \quad (°C/W)$$

where,

T_c = laser diode chip temperature
T_b = fixture base temperature (as measured in ReliaTest software)
V = voltage drop across laser diode
I = laser diode current
E = laser diode optical efficiency

Because the devices are powered in series, the devices must be electrically isolated from one another while still maintaining good thermal contact to the fixture base. The LRS-9550-4442B C-Mount fixture utilizes aluminum nitride ceramic inserts at each device location to provide electrical isolation and excellent heat transfer. Additionally, the aluminum fixture base geometry has been optimized using finite element analysis to provide good uniformity of thermal resistance across all device locations.

EQUIPMENT AND METHODS

The testing was performed with a standard LRS-9550-4442B fixture in an LRS-9550 test system. Laser diode wavelength was measured using an LRS-9550-6012 Spectral Probe and an external optical spectrum analyzer.

Laser diode chip temperature was calculated using the wavelength shift technique (as described in Application Note #30, “Measuring High Power Laser Diode Junction Temperature and Package Thermal Impedance”). A single C-Mount laser diode (see table 1 for parameters) was characterized for chip temperature versus wavelength using the wavelength shift method.

Table 1. Parameters of Laser Diode used in Test

Package	C-Mount
Wavelength	975 nm, multi-mode
Chip	200µm single emitter
Operating Power	6 W

The characterized laser was loaded into the desired fixture device location and the remaining locations were populated with non-lasing C-mount lasers to act as thermal loads. The 2-56 device mounting screw was tightened to 0.5 in-lbs. The fixture was inserted into the system and configured to run at 6A and 25°C base temperature. Once the fixture temperature was stable, the wavelength of the characterized laser was measured. This test was repeated for all positions on one side of the fixture[1] with both 8 and 16 device loading patterns.

[1] Only one side was tested due to the symmetry of the fixture base.

RESULTS AND CONCLUSIONS

The thermal resistances at each device location for 8 device loading are displayed in table 2. The average thermal resistance was 3.25 °C/W.

Table 2. 8 Device Loading Pattern

Device Location	R_f (°C/W)	Chip Temp (°C)	Base Temp (°C)
16			25
15	3.31	54.0	
14			
13	3.59	55.6	
12			25
11	2.72	48.2	
10			
9	3.40	54.4	
Average:	**3.25**		

The thermal resistances at each device location for 16 device loading are displayed in table 3. The average thermal resistance was 3.24 °C/W.

Table 3. 16 Device Loading Pattern

Device Location	R_f (°C/W)	Chip Temp (°C)	Base Temp (°C)
16	3.75	57.4	25
15	3.03	52.5	
14	3.57	55.8	
13	3.49	55.6	
12	3.32	55.0	25
11	2.61	48.1	
10	3.13	52.2	
9	3.05	52.2	
Average:	**3.24**		

The LRS-9550-4442B C-mount fixture was found to have a thermal resistance of approximately 3.25°C/W as measured from the laser diode chip to the fixture base. Thermal resistance did not differ between the 8 and 16 device loading patterns. Thermal resistance with this particular test laser was well within the specification of <5°C/W.