1. Purpose

The purpose of this document is to provide specifications and relevant technical details for the laser source electrical subsystem.

2. Scope

This document provides an overview of the complete Gen 2 measurement system, Laser source module subsystem functional blocks and signal interconnect, critical component information, diode laser driver requirements and signaling, Tapered amplifier driver requirements and signaling laser safety and support components.

3. Governing Safety Standards and Component References

Document No.	Document Title

All references to specific policies, procedures, or work instructions in this document are to the latest revision of that document unless otherwise noted. All references to personnel in this document are to that person or his/her designated representative unless otherwise stated.

4. Definitions and Acronyms

4.1. Acronyms used in this Document

ASSY – Assembly
BOM – Bill of Materials
DWG – Drawing
FAB – Fabrication
OTS – Off the Shelf
PCA – Printed Circuit Assembly
PCB – Printed Circuit Board

5. Generation 2 Laser Measurement System

5.1. **System Overview** – Measurement system is divided into seven sybsystems:

- Laser Source Module
- RVP--TDA4Vx Instrument Controller
- Isolation Interface Module
- Patient--Applied--Part
- Power Distribution/Regulator Module
- Trigger/Timing Module
- Laser Distribution and Control

Figure 5.1 illustrates the overall system architecture with relevant signals and interconnects shown, color coded by function.

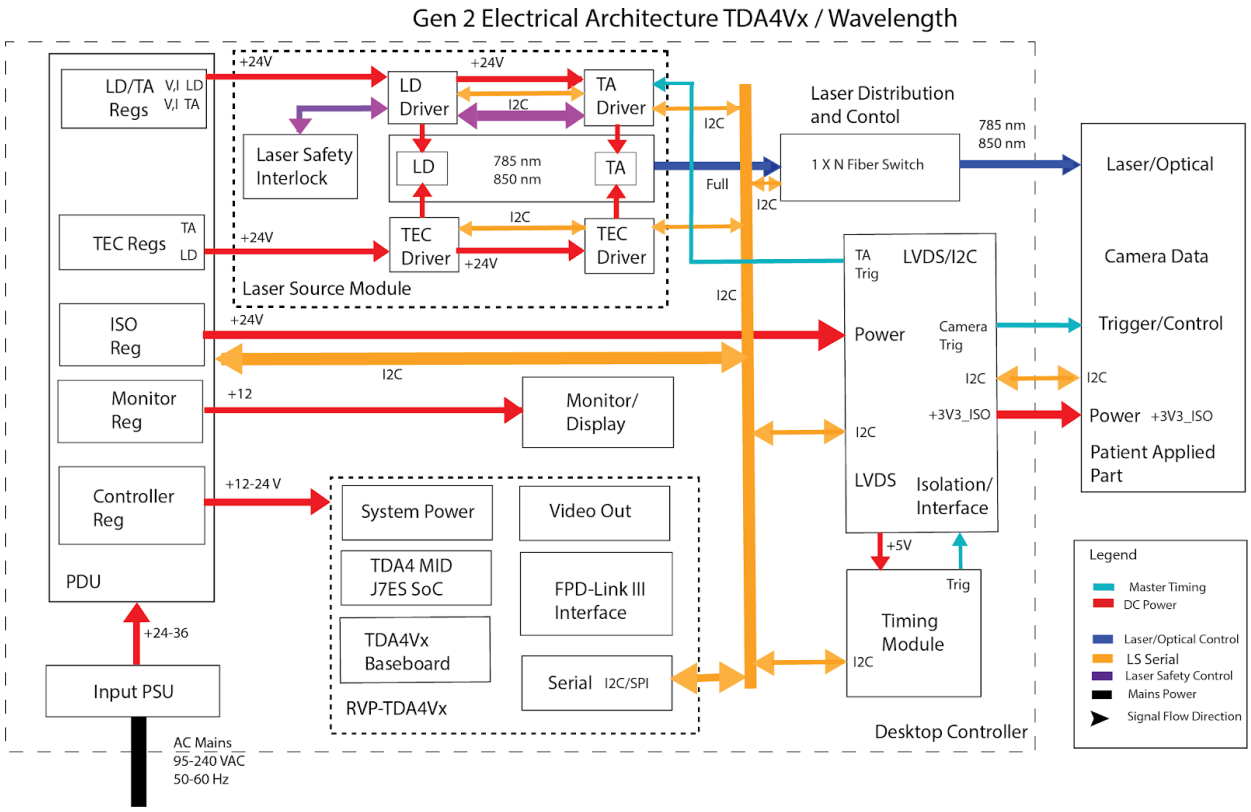


Figure 5.1 System Architecture

Laser Source Module-- Optical system used to deliver optical energy to patient. Contains two OTS semiconductor laser devices, detailed in the critical components section of this document.

RVP--TDA4Vx Instrument Controller-- Computational platform used for system control, signal and data processing and patient applied part interface.

Isolation/Interface Module-- Patient--applied--part power, interface and control

Patient--Applied--Part-- Device containing multiple camera sensors, control electronics, laser distribution optics and data pathway electronics

Power Distribution/Regulator Module--Instrument subsystem power distribution, monitoring and control

Trigger/Timing Module--Instrument system master timing module. Provides timing and synchronization signals to laser source, patient applied part and instrument controller

Laser Distribution and Control-- Commercial, serially controlled 1 x 8 Fiber optic switch

5.2. **Laser Source Module Subsystem Detail** – Diode Laser and Tapered Amplifier devices are both driven by low noise, voltage controlled current sources. Input power to these devices is supplied by discrete, individually regulated supplies from the power distribution unit. In addition to device drivers, this subsystem also provides TEC drivers for each semiconductor laser to ensure that the device operates at a constant, well defined temperature. Figure 5.2 illustrates the device driver arrangement and relationship to the power distribution unit.

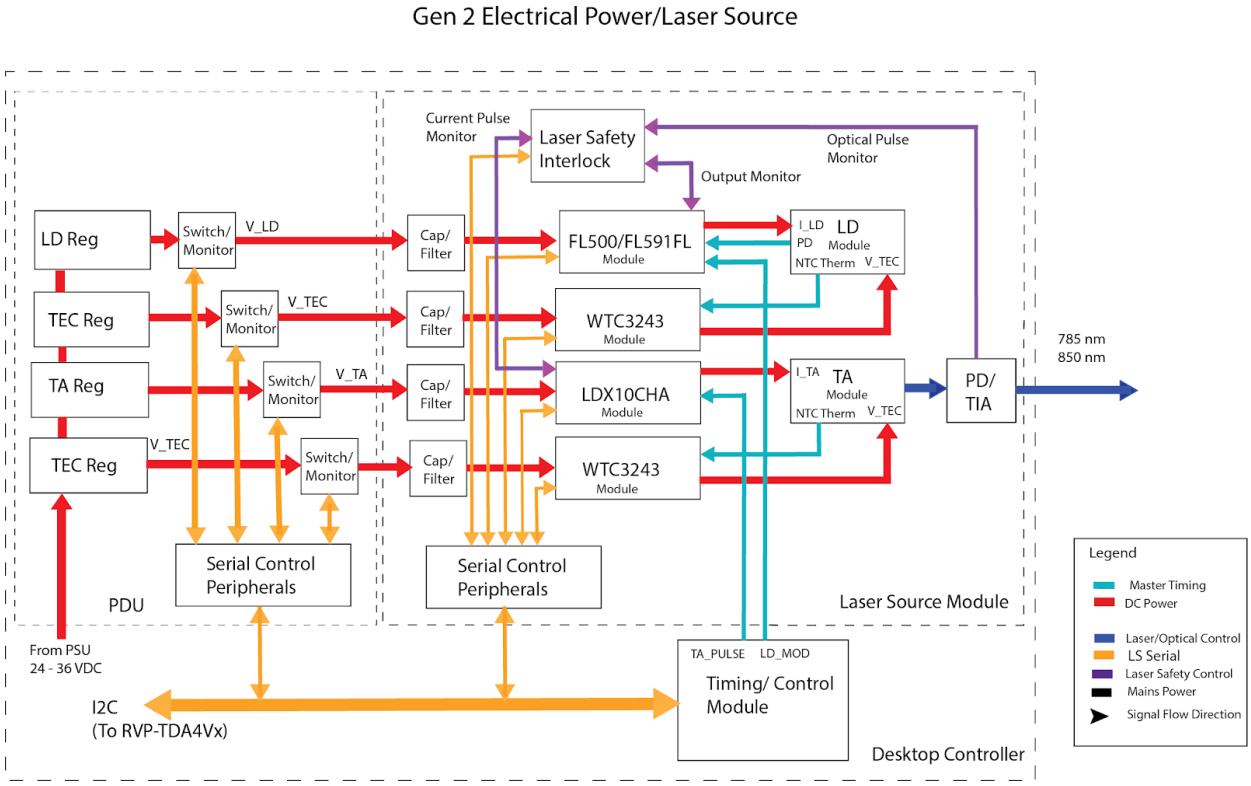


Figure 5.2 Laser Driver Subsystem

Architecture provides a switched, monitored low noise power supply to each of the driver modules shown in this system. Also included in this is a set of monitor and control peripherals, connected to one of the I2C networks in the system serial control backbone. Also illustrated in this diagram is the trigger/timing signals supplied to each device. Section 5.3 describes the laser diode driver in detail, and section 5.4 describes the tapered amplifier system in detail.

5.3. **Laser Diode Driver** – Laser diode module is a commercially sourced, single frequency diode laser module in a dual, inline butterfly type package. Figure 5.3 illustrates the device and critical specifications.

Gen 2 Laser Diode Data/Specifications

Diode Laser Specifications

Device Parameter	Typical
Center Wavelength	780 nm
Operating Mode	CW, Continuous
Operating Current	100 - 250 mA
Power Output	50 mW
Case Temperature	25 C +/- 0.1
Case Enviroment Range	15 - 30 C
TEC Current Range	0.15 mA - 1.4 A
TEC Voltage Range	0.35 - 6 V
NTC Thermistor Resistance	10.0 kOhm

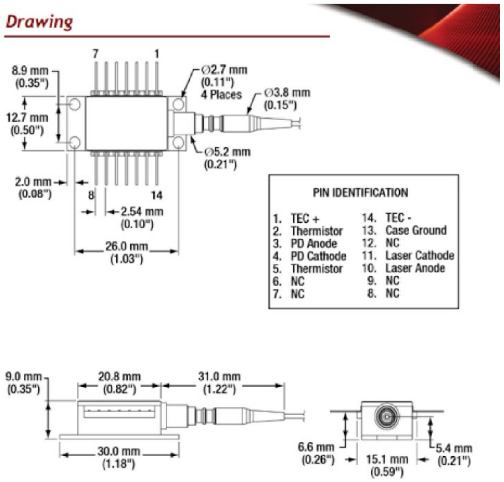


Figure 5.3 Laser Diode Specification

Items to note: Device is operated CW, fiber coupled, and has an integrated TEC, and NTC thermistor for temperature control. Active device is isolated from the case and the current intention is to attach the case to a defined ground potential, consistent with safety and EMC testing requirements. Temperature regulation is 25 C +/-- 0.1.

The diode laser driver contains a constant current driver, control and monitor electronics and is implemented using a set of commercial OTS components from Wavelength Electronics. Figure 5.4 illustrates the driver architecture and relevant Wavelength components. Note that the driver should provide support for a small signal modulation input, in addition to the CW current level. Back facet device monitor is not used in driver operation, but is used in conjunction with the Laser Safety Interlock.

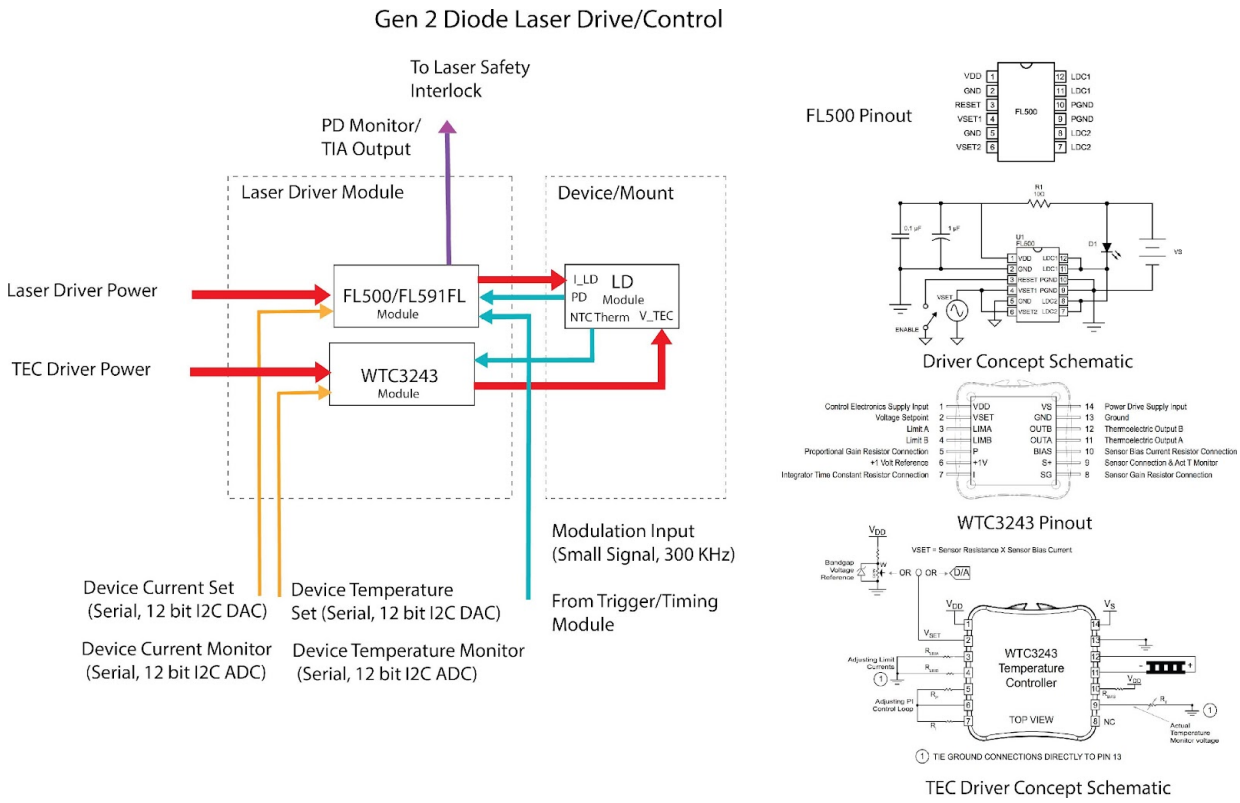


Figure 5.4 Laser Driver Module Details

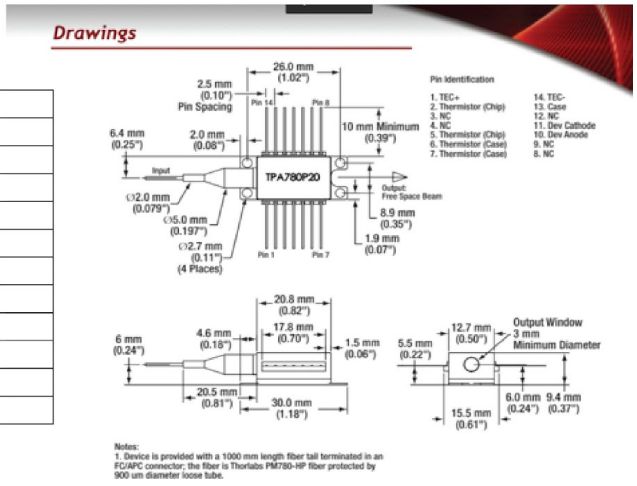
5.4. **Tapered Amplifier Driver--** Tapered Amplifier module is a commercially sourced, narrow bandwidth semiconductor laser module in a dual, inline butterfly type package. Figure 5.5 illustrates the device and critical specifications. Items to note: Device is operated QCW mode, fiber coupled, and has an integrated TEC, and NTC thermistor for temperature control. Active device is isolated from the case and the current intention is to attach the case to a defined ground potential, consistent with safety and EMC testing requirements. Temperature regulation is 25 C +/-- 0.1.

The Tapered Amplifier driver control and monitor electronics and is implemented using a set of commercial OTS components from Wavelength Electronics. Figure 5.6 illustrates the driver architecture and relevant Wavelength components. Note that the driver should provide support for CW operation at a lower current level than specified in the QCW peak specification

Gen 2 Tapered Amplfier Data/Specifications

Tapered Amplifier Specifications

Device Parameter	Typical
Center Wavelength	780 nm
Operating Mode	QCW, 20 -800 μS
Operating Current	7 A pulsed mode
Energy Output	300 μJoules/pulse
Case Temperature	25 C +/- 0.1
Case Environment Range	15 - 40 C
TEC Current	2 A
TEC Voltage Range	3 V
NTC Thermistor Resistance	10.0 kOhm



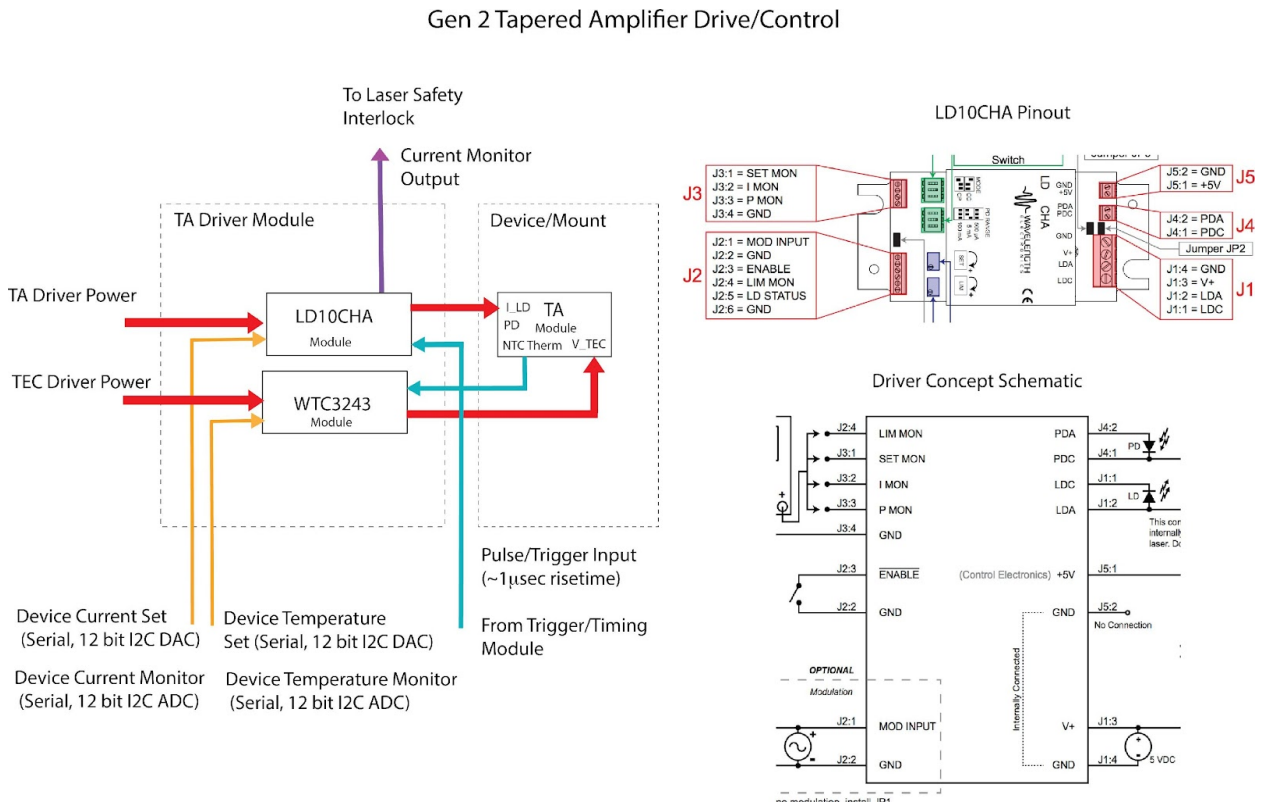


Figure 5.6 Tapered Amplifier Details

5.5. **Laser Safety Interlock** – Laser source operation uses an interlock circuit that monitors the laser for proper operation. Circuit monitors both single pulse energy and multiple pulse energy. Both electrical and optical monitors are employed for measurements and serve to provide redundant monitoring, consistent with IEC 60825.

In addition to laser output monitoring, the interlock system also provides protection against device failure. An essential part of the monitoring system checks for Diode Laser input and proper operation of the device. Operating the Tapered Amplifier without a Diode Laser (Seed) input will lead to irreversible damage to the Tapered Amplifier. Figure 5.7 illustrates the logical schematic of the Laser Safety Interlock with some technical details.

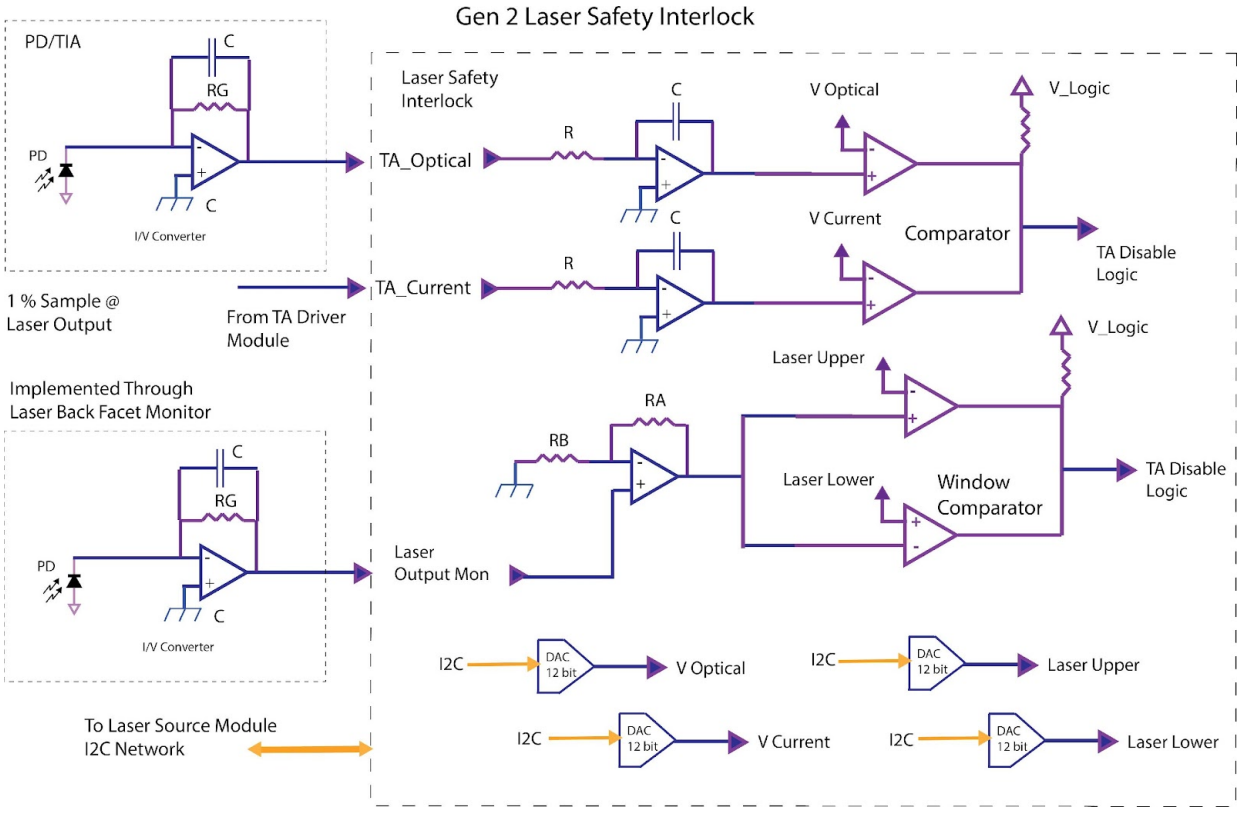


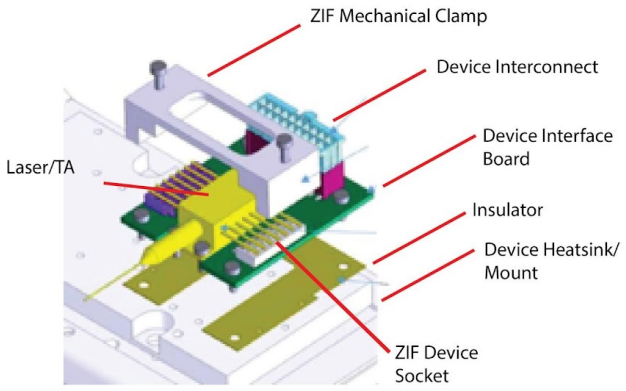
Figure 5.7 Tapered Amplifier Details

6. MECHANICAL CONSIDERATIONS

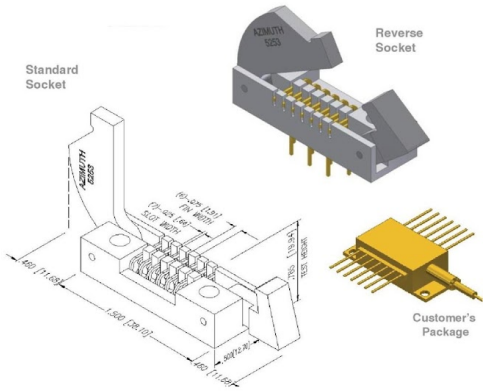
6.1. **General Comments--** Each active device is mounted on a thermally conductive heat sink. Device electrical connections are made through a ZIF type socket attached to a PCA adjacent to the device.

The PCA system also provides connections to the respective drivers through a short multiconductor cable. Interconnect is set up to minimize crosstalk between systems. Laser and Tapered Amplifier components are degraded by electrical noise from power supply elements and the TEC drivers.
Module design should be consistent with best practices in low noise electronic system design. Figure 6.1 illustrates the general concept of device mounting and a proposed ZIF socket from Azimuth.

Gen 2 Device General Mounting Arrangement



Device socket secured with additional clamp for use in portable/mobile environment



Azimuth Zero Insertion Force Socket 5253-100-7R,S

Figure 6.1 Device Electrical Socket and Mechanical Arrangement

In order to preserve flexibility, all pins should be carried from the device and board to the driver, to permit use of packaged devices that may have an alternative pinout.

6.2. **PCA Considerations--** Physical architecture is based on two PCAs per device:

- Device PCA-- provides electrical interconnect to the active device, and provide electrical interconnect to the device driver module, as described in this specification. PCA should also provide mounting holes for attachment to heat sink/thermal system
- Driver PCA-- Active device driver, TEC module, support and monitor electronics and interconnect to PDU. PCA should also include mounting holes for attachment to the rest of the system .

Where possible, OTS or otherwise commercial components are acceptable and should be used in lieu of custom designed parts

6.3. PCA Mechanical Outlines--

6.4. **Units**:

6.4.1. Dimensions and Tolerances shall be specified in metric units of measure unless otherwise

specified.

6.4.2. Tolerances should be specified for x, 0.x, and 0.xx.

6.5. Drawing Notes

6.6. **Critical dimensions (if needed)**:

6.7. Part Labeling

6.7.1. PCB

- Part number and revision level on silkscreen layer as board size permits.

6.7.2. PCA

- PCA part number, revision level and serial number in human readable text and barcode (QR preferred) on permanent tamper--proof label as board size permits or directive to see labeling instruction with appropriate document number.
- Part number and revision level on ESD packaging. (May be specified on part in Agile)

7. TBD

8. Quality Records

9. Appendix

End of Document