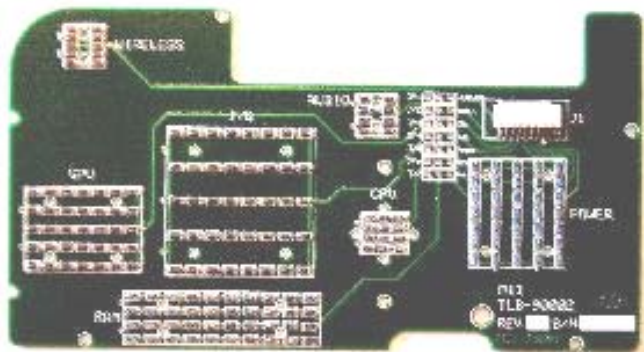


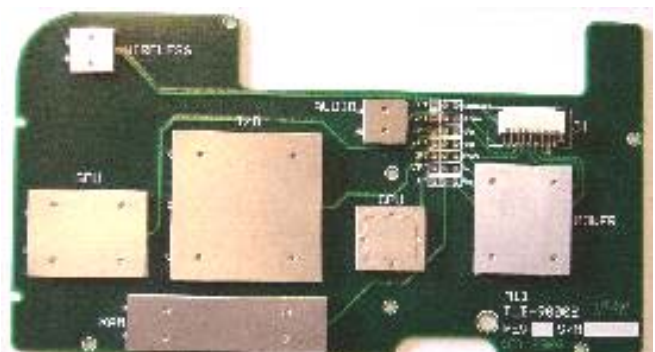
A common problem in the design and development of complex heat-producing electronic assemblies and systems is how to anticipate thermal management issues before all the components, especially state-of-the-art and/or custom integrated circuits, are available and the final electrical and mechanical design are completed. Thermal simulation models provide one insight into the thermal issues but assembly and system designers also need an empirical view of the thermal issues. Thus, the thermal management solution designer needs another tool to help increase the confidence in the thermal design.

That tool is the Thermal Load Board (TLB). The TLB is used to simulate an application printed circuit assembly (PCA) either before all the heat-producing components are available for mounting on the application PCA or if the heat-producing components require complex electronic circuitry to create heat within the components. The board is typically designed to be as mechanically and thermally equivalent to the application PCA as reasonably possible, and usually offers a way to vary the power dissipation of the elements that simulate the heat-producing components. The latter capability is necessary for validating a simulation model over some heat generation dynamic range.

The photos below show a typical TLB. The image on the left shows the basic board with all the heat-producing components simulated with groups of resistors. The image on the right is the same board with metal plates over the resistor groups to simulate uniform heating over each group. The plates are machined to a precise thickness so that the completed TLB can be used with the already-designed thermal management solution. Further, for those devices having an exposed chip for direct attachment purposes, the metal plate can have a plateau machined to exactly match the chip size and orientation. Jumper eyelets on the TLB allow for various powering options – either a single power supply for all the resistor groups connected in parallel or various combinations for multiple power supplies so that the dynamic range of the thermal management solution can be verified.



Basic TLB showing resistor heaters



Metal Plates added to provide uniform heat generation

The TLB can also be used in the study of thermal transients at the assembly or system level. Those heat sources that are time variant can be driven by time- and power-programmable supplies while the non-time-variant heat sources can be driven by static power supplies.



Thermal Load Boards

Heat sources are simulated with either chip resistors, power surface mount resistors or transistors, and/or semiconductor Thermal Test Vehicles (TTVs). The latter are sometimes available from the semiconductor manufacturer that will be supply the devices that will be mounted on the final board; TEA may also be able to supply a suitable TTV. A given TLB design may incorporate any combination of these different heat sources.

Connection to the TLB is highly dependent on the Customer's specific application environment. If required, the board can be designed to plug into systems or enclosures to make use of existing power supplies. Alternatively, the board can be designed for either flying leads, TLB-mounted connectors or an edge finger extension, or any combination thereof. The latter is useful when the TLB is housed in a tight fitting enclosure that requires minimal side wall access cutouts.

The TLB development process consists of the following steps --

- a) Project Definition – size, shape and power topology for the TLB, heat source type and power level, electrical requirements, etc.
- b) Electrical and Mechanical Location review – TEA provides electrical schematic showing heat sources and connection circuitry and board outline with heat source placement; Customer reviews and approves design and layout.
- c) TLB Design and Layout – TEA completes the board layout, working with the customer to resolve any layout issues as they come up.
- d) TLB Layout review – TEA provides layout in pdf, dxf, or Gerber format for the Customer review and approval.
- e) TLB Board Fabrication – TEA has one of several qualified pcb fabrication facilities make the boards.
- f) TLB Component Acquisition – TEA purchases standard components and orders mechanical pieces (i.e., heat spreaders, etc.).
- g) TLB Documentation – TEA completes the assembly and application documentation.
- h) TLB Assembly – TEA generates assembly kit (includes board, components, documentation, etc.) and transports the kit to a qualified board assembly vendor.
- i) TLB Checkout and Final Test – TEA checks all aspects of the finished TLB and companion items (i.e., connectors, application documentation, etc.)
- j) TLB Delivery – TEA ships TLB and companion items.

Depending on the board size and complexity, the design review and approval process, and the delivery urgency, a custom-designed TLB can typically be delivered in 5 to 8 weeks ARO range.

The cost of TLB design, layout and fabrication is also highly dependent on board size and complexity, power dissipation levels, interface requirements, the design review and approval process, and the delivery urgency. The cost is typically in the \$12,000 to \$45,000 range. Due to the custom development nature of TLB projects, a customer deposit is required with order placement to initiate project work.

Thermal Load Boards are very application specific and must be designed and developed in close cooperation between the Customer and TEA. TEA would welcome the opportunity to discuss your specific requirements.