

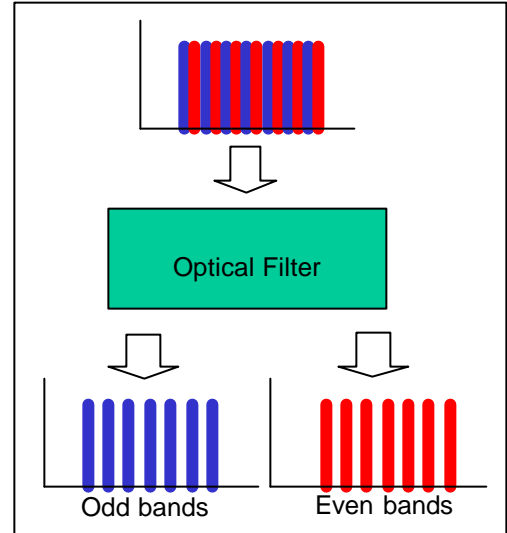
## Precise Temperature Control of Optical Communication Device

### Objective

An optical communication device for dense wavelength division multiplexing (DWDM) applications is extremely sensitive to operating temperature. The communications traffic going through this module each day is in millions of dollars. Therefore reliability and availability are the prime requirements.

The module needs to be heated to a steady higher temperature than ambient and controlled within a very narrow margin under all environmental and operational conditions. The objective was to develop a control system that can:

- ?? Achieve fully redundant and fault tolerant operation
- ?? Withstand transients in power supply voltage change
- ?? Compensate for ambient temperature fluctuations
- ?? Accommodate hot insertion of control modules
- ?? Offer better than 99.999% availability.

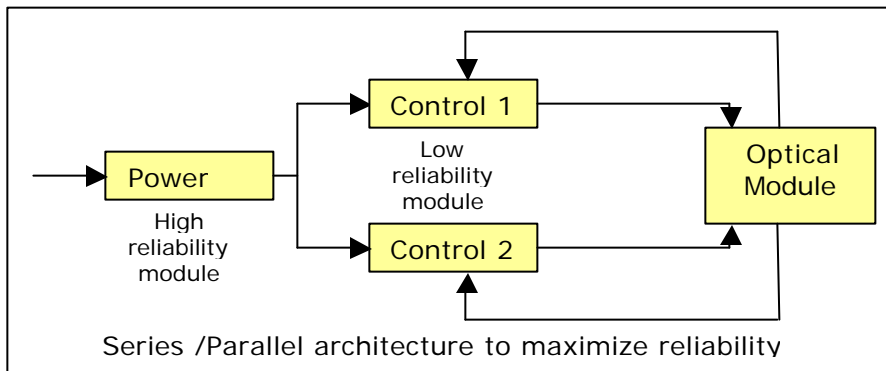


### Background

The optical comb filter device in a “long haul” optical network system requires precise temperature for reliable operation. This device splits the incoming signals at tightly packed frequency bands into even and odd bands. Since the bands are narrow, the ambient temperature of the module significantly affects the filtering quality. Since the ambient temperature can vary from 0-55°C, a higher temperature of 75°C ± 0.1°C was chosen for operation. The device has a built-in heater and an RTD based temperature sensor.

The architecture of controller system should have:

- ?? Multiple operational paths such that any failure at any node will not affect the operation of the product
- ?? Failure detection and reporting mechanism to request service
- ?? Modularized architecture for easy field service.



FIT (Failure In Time) study of the proposed architecture showed sections with varying reliability. These sections were split into different modules. Modules with lower FIT numbers were duplicated. Control and recovery mechanisms were built into the system for high performance and

reliability.

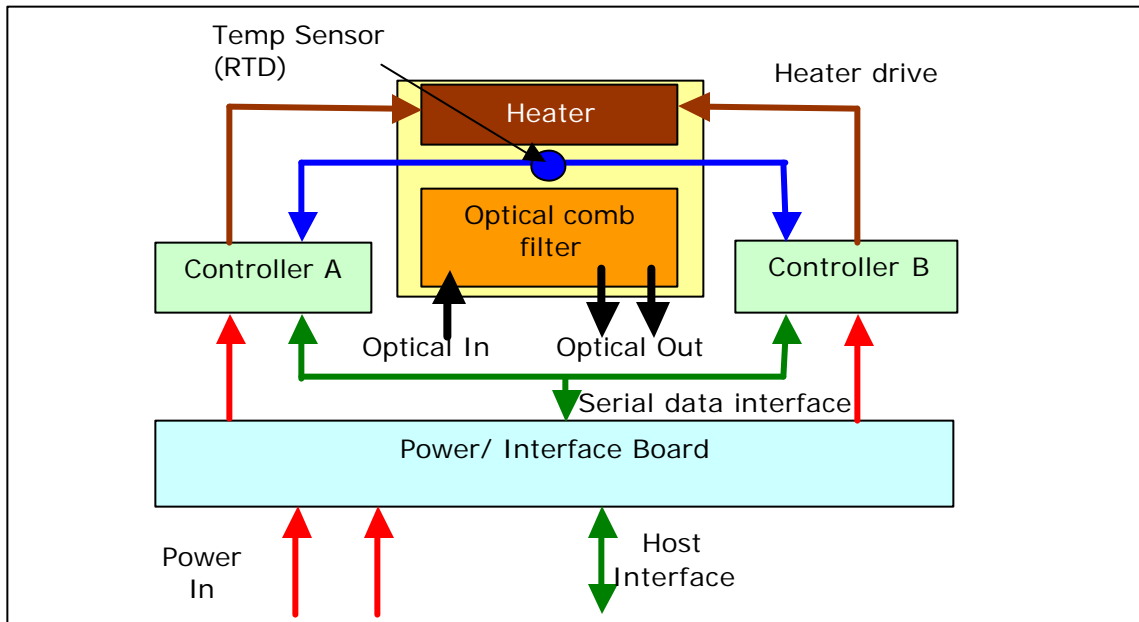
The series-parallel model to analyze and maximize reliability extended from module to component level.

## Architecture

The thermal control system for the optical module was designed with four modules:

- ?? Optical device module; This unit housed the optical device, dual temperature sensing circuit and OR'ing circuit power
- ?? Two microprocessor based controller modules with built-in heater power switcher
- ?? Power interface board accepts two -48V power inputs and generates alarm signals.
- ?? Chassis module with backplane and mounting mechanism.

A special control algorithm was developed to handle both continuous and discontinuous operational conditions.



## Final Product

The thermal controller assembly was developed and tested for precise temperature control under extreme conditions such as:

- ?? Ambient temperature cycling
- ?? Supply voltage cycling and
- ?? Frequent insertion and removal of controller module.

This product is currently in operation in the field successfully for over three years.

