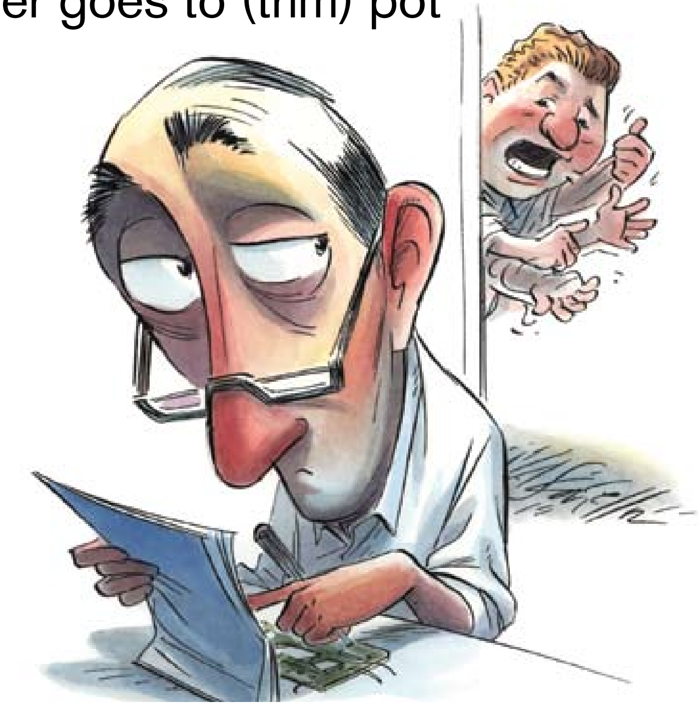
TALES FROM THE CUBE BY GLEN CHENIER • TEETER TOTTER TREE STUFF

Laser goes to (trim) pot



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We had finished final tests on a transponder whose function was to take in a SONET (synchronous-optical-network) data stream at a 1310-nm wavelength and retransmit the data at 1550 nm for use in bidirectional coarse-wave-length-division multiplexing on a single optical fiber. The product had to withstand outdoor environmental ambient-temperature variations of −40 to +65°C and did not have the power budget to allow laser heating or cooling to a constant temperature. We installed various 1550-nm-laser types on the basic PCB (printed-circuit board) for the power and distance options. When cold, a laser requires small current drive. When hot, the laser requires the current drive to rise to maintain lasing threshold and sufficient modulation depth. Turning the laser completely off during modulation minimums would cause a start-up delay that would shorten the next pulse width. Thus, we had to keep the laser alive at all times with at least 10 dB between minimum threshold and maximum pulse-power levels.

We used a self-training technique that placed one-board-fits-all production units with their various laser types into an environmental chamber, where we ramped the temperature from −40 to +65°C. During training, the control processor used analog-to-digital conversion and EEPROM data storage to record the individual laser's temperature-dependent drive requirements at all operational temperatures.

A feedback loop from the laser's rear-facet photodiode controlled the laser's average power as set by a mechanical trim pot and followed temperature variations to maintain constant average optical power. The ADC and processor monitored this average current as an indirect temperature measurement; the processor also used a DAC to search for the required laser current for a 10-dB power increase at each temperature. The resulting training data was stored in an EEPROM and retrieved during normal operation, again using the ADC and DAC functions.

During the initial lab tests of a 1-mW laser, I noticed that the trim-pot setting was close to the end of its range, and the resulting coarse mechanical response was difficult to adjust. I changed the trim pot from the 10 kΩ for the low-power lasers to 1 kΩ for the high-power laser. This change placed the trim-pot wiper close to the center of its range for easier adjustment.

A customer later wanted a sample of the high-power, long-reach version, so our production technician took a pretested, low-power unit from stock, swapped out the laser, and tweaked the trim pot for 0 dBm, as required. He did not swap out the original 10-kΩ trim pot. During the training-temperature ramp, all looked good until the temperature reached about −5°C. Then, the laser power became erratic, and we had to quickly find and fix the problem. We first replaced the laser to no avail. In the third trial temperature ramp, the laser power had not yet started bouncing up and down when I suddenly remembered the 10-kΩ trim pot and its coarse-setting difficulty. Sure enough, the trim pot was still the 10-kΩ value set close to the end of its range and in this position was mechanically sensitive to temperature variations. I changed the trim pot to 1 kΩ, retweaked for 0 dBm near the thermally benign wiper center, and restarted the training-temperature ramp. This time, there were no erratic power fluctuations, and the recorded modulation level data was nicely monotonic.

The incident resulted in a procedure for better written communication. A "traveler" sheet containing the unit's history already accompanied each production unit. All we had to do was place a note on the sheet stating that, if you replaced the standard laser with a high-power one, you needed to change the trim pot, too. **EDN**

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