IF IT AIN'T BROKE FIX IT

Yes, you read it correctly. Believe it or not, it can make economic sense to throw away all the relays on a printed circuit board even if none have failed. The economic justification depends on the cost of the individual relays, how many there are on the board, the expected life of the relays, and what it costs to find and replace a failed part.

Consider an Automated Testing Equipment (ATE) channel card with sixteen relays, each having an expected life of one billion cycles. This is typical for Coto's ATE-grade relays. The board can be regarded as a system that fails if any individual relay fails. Coto determines expected relay life by electrical load testing over billions of switching cycles, followed by Weibull statistical analysis. This produces two statistics: the mean cycles before failure (MCBF) and the Weibull slope, typically about 2 for a good quality reed relay. A board with sixteen relays has one quarter the MCBF of an individual relay, in this case giving an estimated board MCBF of 250 million cycles.

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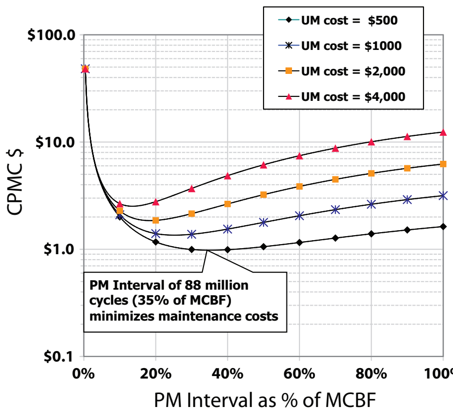
Our customers say the cost of unscheduled maintenance (UM) to repair a board is more than a hundred times the cost of an individual relay. This multiplier can be even higher if downtime is included at typical ATE running costs of $2/minute. If the average UM cost is known, it's possible to figure if preventive maintenance (PM) is cheaper than waiting for a relay to break and then going out to fix it, and how much money that PM strategy can save. A good indicator of the potential cost saving is the average cost per million board switching cycles (CPMC), which usually shows a minimum at a certain PM interval. Figure 1 shows the CPMC vs. the PM interval for the board described above. Individual relays are assumed to cost $3, and the estimated UM cost is $500. In this case, a CPMC minimum of $0.98/million cycles is found if PM is conducted every 88 million cycles (35% of the board MCBF), with all the relays being replaced whether they have failed or not. Compare this to the alternative, doing a UM repair to find and fix one relay on a board, and the economics become clear. The relay board has an MCBF of 250 million cycles, so the unscheduled CPMC is $500/250 = $2 per million cycles. This is twice as expensive as the PM strategy described above. The CPMC's for other UM cost estimates are also shown in Figure 1. For example, if UM repairs cost $2000 instead of $500, the optimum PM interval is 46 million cycles, and the cost per million board switching cycles is $1.86.

This is a simplified model. It assumes all the relays on a board are the same type and wear out at the same rate, and it also assumes PM costs are folded into other field support activities. However, it clearly illustrates the potential cost advantages of preventive over unscheduled maintenance.



For a full description of the methods used to calculate the Weibull statistics and the CPMC minimization algorithm, take a look at a White Paper called "Testing Reed Switches and Relays for Reliability," available on the Coto Website.

Coto Technology can help with your PM planning. Tell us how many Coto relays are on your board, their type, and their approximate switching load. We'll estimate the Weibull parameters, tell you if a PM strategy makes sense, and recommend the optimum period between PM events to minimize your maintenance costs. In other words, whether to fix the boards even if they "Ain't Broke."

To find out how Coto can aid you in your design efforts, please contact us at the web address below.

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