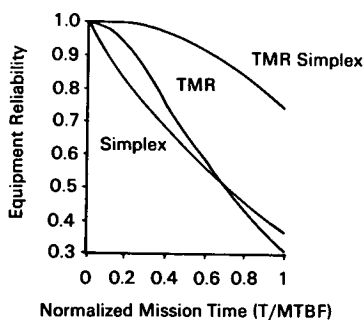


NASA TECH BRIEF

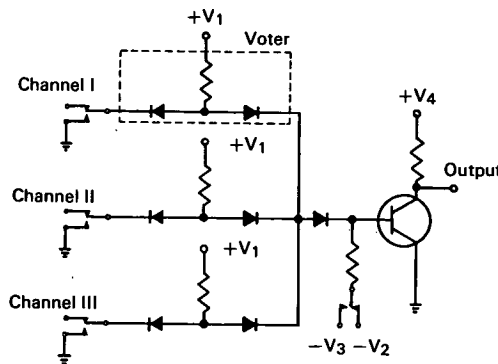


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Triple Modular Redundancy (TMR) Computer Operation Improved



AVAILABILITY COMPARISONS



TMR TO SIMPLEX SWITCHING

The problem:

In conventional triple modular redundancy (TMR) machines, failed elements are masked by the voting function, but remain active. An additional failure in the same logical function will result in a system failure. The logic function containing the failed element is now less reliable than an equivalent simplex configuration. This condition exists because there are twice as many components as the simplex configuration and the failure of any one will cause the unit to fail. As failed elements accumulate in the machine, the TMR reliability curve is forced down and eventually crosses the equivalent simplex curve at somewhat less than the mean time before failure (MTBF) of the equivalent simplex configuration.

The solution:

By switching off the failed element plus one of the remaining good elements, the reliability curve will

never cross the simplex curve and a substantial reliability increase will be obtained.

How it's done:

One method of switching from TMR to simplex is to control the bias of the voters. The voltage level is set for a threshold level of two units of current from the current summing network (-V₂). Upon sensing a failure, the bias is cut off from the failed channel voter and one of the remaining good channels. The remaining good channel is then set for a threshold level of one unit of current (-V₃).

Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
 Manned Spacecraft Center
 Houston, Texas 77058
 Reference: B67-10085

(continued overleaf)

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: M. Ball and F. H. Hardie
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