ENGINEERING WEEK

Two developments in the last nine months have resulted in a significant improvement in the ability of GE Tape Handlers to read marginal magnetic tapes. The first was the development of the "LUCK" data recovery circuit. This circuit was developed to solve a critical problem GE machines have had for a number of years; the inability to read marginal magnetic tape. The second work involved a quantitative study of the theory and philosophy of NRZI data encoding. It resulted in a data recovery system which has far superior ability to realize data signals out of overiding noise.

Three separate studies were made during the design of the "LUCK" circuit. First, Quality Control and Field Engineering personnel were consulted in an effort to determine exactly what the problems were. At this time a study was also made of all previously proposed solutions. An attempt was made to correlate the deficiencies of the system with the proposed solutions. At this point, it became clear that all "fixes" to date had been interim attempts to improve performance. No definitive solution was in sight. A laboratory study was then made of the deficient circuit itself. From this study, the causes of poor performance became evident. At this point, a new circuit was designed which incorporated several new techniques.

The main goal of the new design was to optimize performance, at the same time maintaining pin compatibility. However, it was also an ideal time to enhance the producibility of the circuit in the factory. In view of this, integrated circuits were used throughout, resulting in a component reduction of thirty four percent.

The results have been gratifying. Thre reading of marginal tapes when using the "LUCK" circuit has ceased to be a problem. In one instance, a tape generated by an IBM System at a Chrysler Corporation Site consistently generated ninety one permanent errors when read on a GE System. The tape was read error free in the same machine by replacing the old read circuits with the newly designed "LUCK" circuit.

The second design resulted in a completely new technique of recovering very weak data signals off noisy tape. The technique has been named "Curvature Detection" due to the fact that the circuit computes the radius of curvature of the signal during detection.

It had been suspected that the frequency spectrum of tape and system noise combined and data did not overlap significantly. A spectrum analysis of the amplified tape head output confirmed this to be true. This raised the possibility of devising a system which would accept only signals which fell into a specified frequency range.

Before the system could be designed, it was necessary to accurately determine the frequency spectrum of valid data. To inspect the tape head output while reading data with a spectrum analyzer would not be sufficient, in that this represents nominal conditions. The system must be designed to accept data under all conditions, including absolute worst case. In order to determine the spectrum under all signal conditions, a mathematical model of a valid data signal was designed. Photographs of actual data were then used to design the model. By varying parameters of the model, it is possible to accurately simulate all forms of data. From this study the frequency spectrum of data was determined. The results of this study are significant as they are a quantitative expression of what frequencies are necessary in any read circuit which is required to read NRZI data.

At this point a circuit was designed which would perform the required function. The circuit then was modelled mathematically. Slightly more than 8000 words were used on the 600 Line Computer in the program. It was then possible to simulate the entire data recovery process in the computer - from the tape head output to the generation of a digital signal at the circuit output. By changing the parameters of the input signal it was possible to observe the performance of the circuit under all signal conditions. Circuit performance was optimized by means of computer orientated design. The final circuit, when breadboarded in the laboratory, operated quite closely with the predicted performance.

Due to the extensive use of the computer throughout the development of the recovery system, the time required from the inception to completion of the engineering prototype was only three and a half months.

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