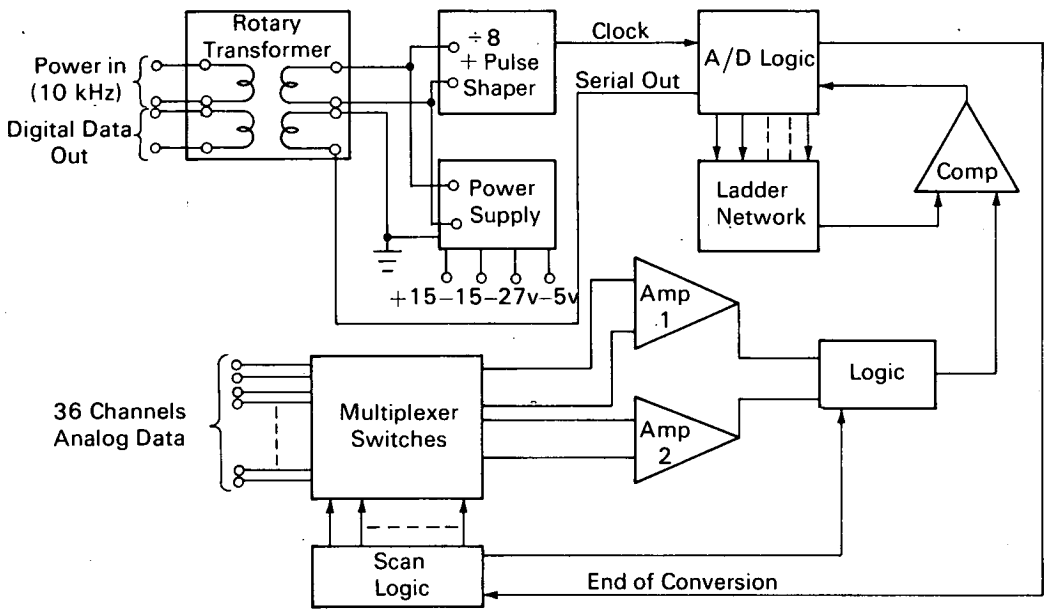
NASA TECH BRIEF

Data Acquisition from High-Speed Rotating Shafts



Rotating Shaft Data System

The problem:

In the testing of rotating equipment, transferring data taken on the rotating portion to a stationary data system is a common problem. Electrical signals representing temperature, pressure, torque, strain, etc., are transferred in most cases by slip rings. However, slip rings often have limited lives and generate considerable electrical noise, particularly at high rotational speeds.

The solution:

A system has been developed which, when used with a rotary transformer, results in greatly increased life, negligible noise, and the capability for a large number of data channels. This data system mounts on the end of a high-speed shaft and rotates with it. The system is constructed almost entirely of available commercial microelectronics. It is used to multiplex many channels of analog transducer output data, and to convert this multiplexed signal into a binary digital output. Power for the electronics is transferred onto the shaft via a rotary transformer. The digital data are transferred from the shaft via a separate winding on the same transformer. A block diagram of a 36-channel version of the system is shown. A 72-channel system has also been built.

How it's done:

The 10 kHz power fed to the system through the transformer is conditioned to supply the required

(continued overleaf)

dc voltage levels and is also counted down to provide the clock signal. This provides sychronization with external equipment.

All logic and switching consists of MOSFET (metal oxide semiconductor field effect transistor) microcircuits. The analog-to-digital converter logic is a single, medium scale integrated MOSFET circuit. The amplifiers and comparator are integrated operational amplifiers with some discrete components added. The ladder network is a precision thin film resistor circuit.

The amplifiers used after the multiplexer raise the voltage level to 5 V for the analog-to-digital converter. Two amplifiers are used to allow two different full scale voltage level transducer groups to be handled: one is at 50 mV full scale (for thermocouples); the other at 1 V full scale.

All electronics are packaged on four printed circuit boards 8.9 cm in diameter. This system has been tested at temperatures from 25° to 70° C, and at 15,000 rpm. The maximum stress on the components was about 10,000 G's. Accuracy was ± 0.3% of full scale.

Notes:

1. Many variations of this system are possible to handle the general problem of transferring many channels of data from rotating portions of machinery to stationary equipment; the problems encountered with slip rings can be eliminated.
2. The following documentation may be obtained from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-TN-D-5678 (N70-18982), A Shaft Mounted Microelectronic Data System for Rotating Measurements
3. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B70-10043

Patent status:

No patent action is contemplated by NASA.

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