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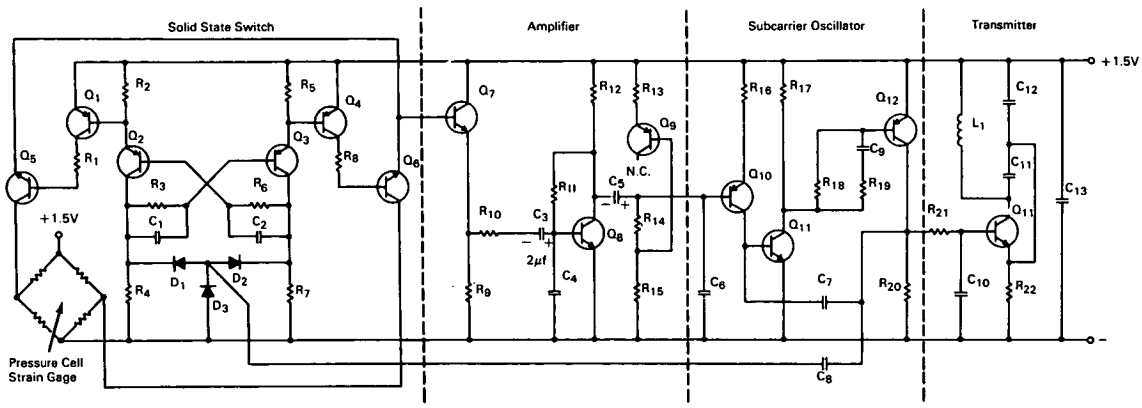
Brief 66-10624

NASA TECH BRIEF

Miniature Telemetry System Accurately Measures Pressure



The problem:

To design a telemetry system to accurately measure pressure with a small implantable pressure cell and transmitter. The system must operate with low power consumption.

The solution:

A miniature, low power, telemetry system that can be used with any of a number of commercially available strain gage pressure transducers. A small, solid state, strain gage pressure cell, designed for implanted physiological applications, is used with the new circuitry to provide a complete, implantable pressure transducing system.

How it's done:

The electronic circuit uses a pulse code modulation similar to ones previously used for temperature and biopotential monitoring. The subcarrier modulation technique allows accurate transmission of the low output level of the pressure cell from an implanted location to a remote radio receiver. The small strain gage signal (approx. 15 mv for 250 mm of Hg) is chopped by means of a solid-state switch (Q_1, Q_2, Q_3, Q_4, Q_5, Q_6) and amplified by an ac amplifier Q_7 and Q_8 (gain approximately 5). After amplification the signal controls the period of an astable multivibrator (Q_9, Q_{10}, Q_{11}, Q_{12}) operating at approximately 1 kHz. The pulse derived from the astable multivibrator is applied through C_8 to obtain synchronous operation of the solid-state switch, thereby causing the period of the multivibrator to be controlled alternately by the voltage derived from Q_5 and Q_6. The difference between successive periods then is proportional to the bridge unbalance signal and hence the pressure. The interval between pulses at bridge balance would be identical, but in order to avoid ambiguity the bridge is initially unbalanced in such a manner that one period remains smaller than the other over the

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entire operating pressure range. A typical modulation of ±20 percent of the mean period is obtained for a pressure change of 250 mm of Hg.

The short pulse developed by the astable multivibrator (approx. 20 microsecond long) is used to turn on the rf oscillator, Q_{13}. L_1 is used both as a tank circuit inductor and as a transmitting antenna. Since the information is derived from the time period between rf pulses, amplitude and frequency changes in the rf link do not affect the accuracy. After the pulses are received on a commercial FM receiver (88–108 MHz) a suitable demodulator is used to obtain an analog signal.

The telemetry system is shown with a protective coating of elasticized silicone rubber applied. In this condition, the system is ready for implantation.

Notes:

1. The system has been used to date only with pressure transducers, but the circuit is equally applicable to any measurement using a strain gage sensor. The pressure transducer is commercially available.
2. The transducer used is 6.5 mm in diameter and 1 mm thick. The lead-in wires terminate on the back of the transducer in a package that is 3.5 mm in diameter by 4.5 mm long.
3. The compensated temperature range of the transducer is from 77°F to 113°F. The telemetering electronics are suitable for temperatures to 150°F.
4. The battery lifetime of 500 hours is associated with a transmission distance of 3 to 5 feet. Increased transmission distance will be accompanied by increased power consumption with a reduced battery life. It is estimated that the battery life would be reduced to 125 hours for a transmission distance of about 100 feet.
5. Similar applications are described in Tech Brief 64-10171 for biopotential monitoring and Tech Brief 66-10057 for temperature monitoring.
6. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B66-10624

Patent status:

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

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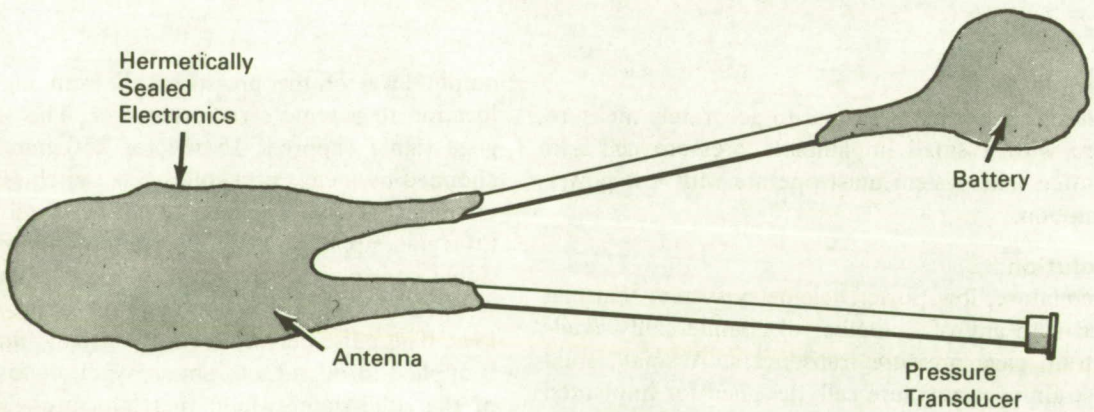

Miniature Telemetry System
Ready for Implantation