NASA TECH BRIEF

New Passive Telemetry System

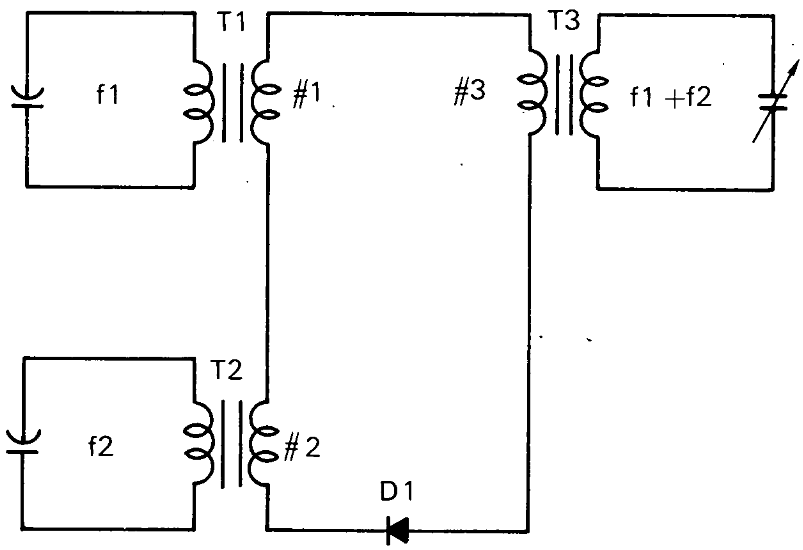

Fig. 1
Basic Implant Schematic

A conceptual design of a new passive telemetry system has been described which enables the monitoring of vital biological functions from living organisms. This system concept has particular merit for applications in numerous areas such as permanent monitor of physiological variables without attached wires, medical research tool for studying animal life, and remote monitoring of stress or strain as in machinery, production processes or material studies.

This passive telemetry system offers a new approach for extracting information from a body without external connections or power sources. Electromagnetic energy from externally located transmitters is imparted to a specially designed circuit module implanted in the body. The implanted module utilizes the propagated energy to produce an rf carrier for reradiation which is modulated (either AM or FM) by parametric changes within the sensor.

The basic operating principle of the passive telemetry system may be understood by referring to the implant schematic shown in Figure 1. T1, T2 and T3 are miniature transformers wound on open-ended bobbins of ferrite materials. T1 and T2 are pretuned to separate frequencies of external transmitters. The common secondary loop, composed of T1, T2, T3 and D1, is a mixing circuit where sum, difference and harmonic frequencies f1 and f2 are generated. The secondary of T3 is tuned to the sum frequency $f_1 + f_2$ which is amplitude and phase modulated by the parametric reactance of the sensor element. An

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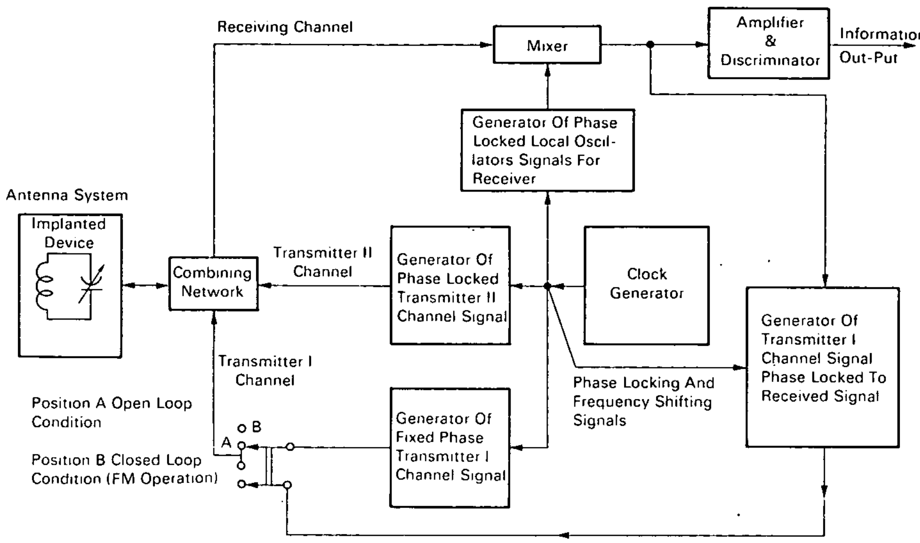

Fig. 2
Phase Locked Loop Telemetry System

external receiver-antenna tuned to the sum frequency picks up the reradiated signal which contains the information to be telemetered.

Initial development efforts utilized an amplitude modulated system but the highly distance-dependent characteristics requiring complex automatic gain controls resulted in an investigation of a frequency modulation system. The FM system has several inherent advantages. The information frequency is nonharmonically related to the powering frequencies by using a phase locked loop technique. There is a virtual elimination of single frequency "cross talk" between power transmitter and information receiver in a passive telemetry system utilizing a completely passive circuit implant. Accurate calibration is possible due to the fact that the system is independent of amplitude variations and noise such as that normally encountered in AM systems. Also, an improved signal-to-noise ratio can be obtained using frequency modulation.

The logic for the various modes of operation of the passive telemetry system is illustrated in the block diagram of Figure 2. In the AM version the information is contained in amplitude modulations of the reradiated sum frequency where f_1 and f_2 remain fixed and signal fluctuations result from the drifting off-resonance of the tuned circuit as the sensor parameter changes.

In the FM concept, only one of the two transmitter frequencies (f_1 and f_2) is fixed. The other is caused to track the instantaneous resonant frequency of the sensor circuit so that the sum frequency is always equal to this resonant frequency. This tracking is accomplished by means of a phase locked loop which is closed through the implant. Changes in phase in the reradiated sum frequency of the implant module are fed back to the frequency control circuits which cause one of the transmitter power frequencies to vary in such a direction as to keep the phase of the received signal constant. The system concept has been developed to a breadboard stage where phase modulation has been demonstrated.

Note:

Documentation is available from:
Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151
Price $3.00
Reference: TSP69-10312

Patent status:

No patent action is contemplated by NASA.

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