NASA TECH BRIEF

Ames Research Center

Heart-Rate Pulse-Shift Detector

Advances in the state of the art of biotelemetry suggest that a single telemeter implanted in a small animal can be used to monitor not only body temperature but also animal movement and heart rate. In a program of research involving the design of electronic circuitry and a data-processing system to monitor simultaneously the three circadian periods, a heart-rate detector circuit was developed which accurately separates and counts phase-shift pulses over a wide range of basic pulse-rate frequency, and also provides a reasonable representation of the full repetitive EKG waveform.

As indicated by the block diagram of the heart-rate detector (figure 1), telemeter pulse inputs in the range of 200 to 1000 pps, with phase-shifted heart-rate information, are first directed to a count-rate meter circuit which controls a variable-width monostable multivibrator; then the included EKG waveform is reconstructed. Circuit characteristics are selected to give a pulse width of about 90% of the basic pulse period over the required frequency range. At each input pulse, the multivibrator is triggered for 90% of the basic frequency; any small deviation in frequency becomes a more significant deviation in the time preceding the next pulse and eventually the deviation is converted to usable heart-rate data. Ignoring the first 90% of each pulse period substantially reduces output noise arising from spurious pulses.

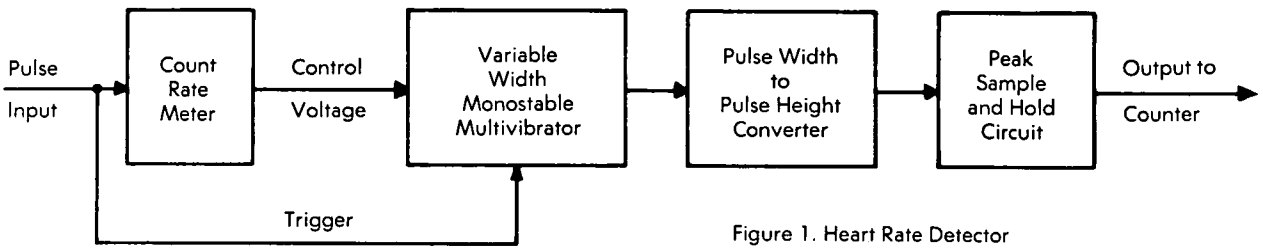

Figure 1. Heart Rate Detector

The source of input to the heart-rate detector is indicated in the block diagram of the system for monitoring several small animals (figure 2). The implanted biotelemeter is basically a relaxation oscillator which operates in the low-frequency rf band. The pulse repetition frequency is a calibrated function of animal body temperature, and is further phase-modulated by animal heart beats. The modulated rf signals are received by three orthogonally-oriented loop antennas, then separately amplified and directed to broadly-tuned AM detectors. The amplifiers employ dual-gate FET's with circuit gain suitable for subsequent signal processing. Diode switching then selects the strongest detected signal for further distribution to demodulators for separation of temperature-dependent pulse frequency, periodic heart-beat pulse shift, and signal strength indications which are indicative of animal activity.

(continued overleaf)

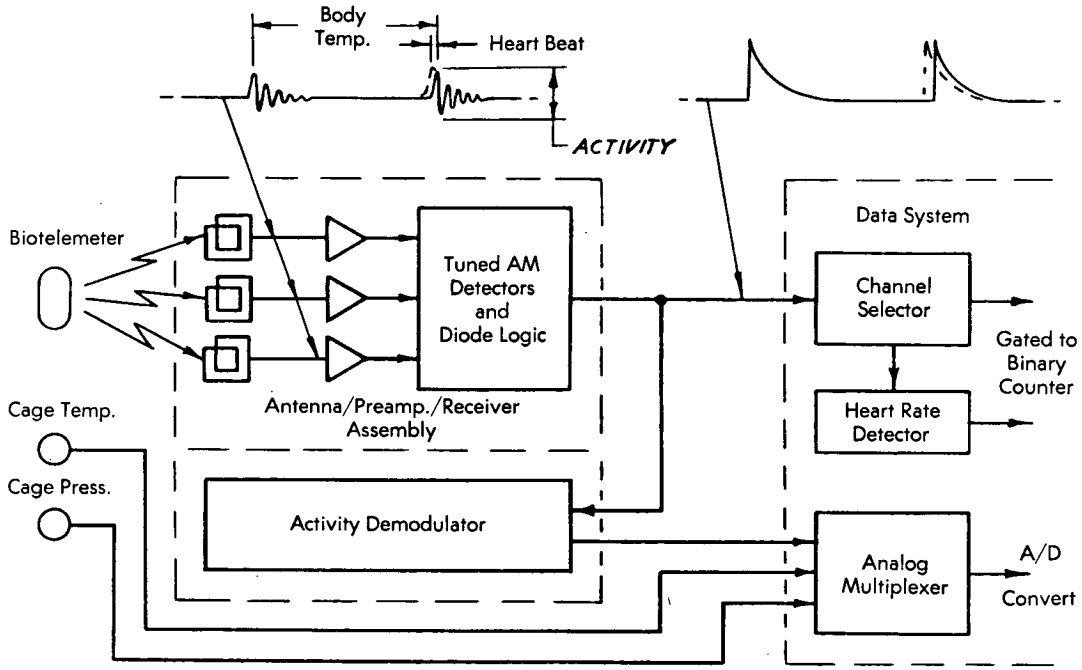

Figure 2. Monitor System

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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Moffett Field, California 94035
Reference: TSP 74-10196

Patent status:

NASA has decided not to apply for a patent.

Source: Mark Anderson of
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