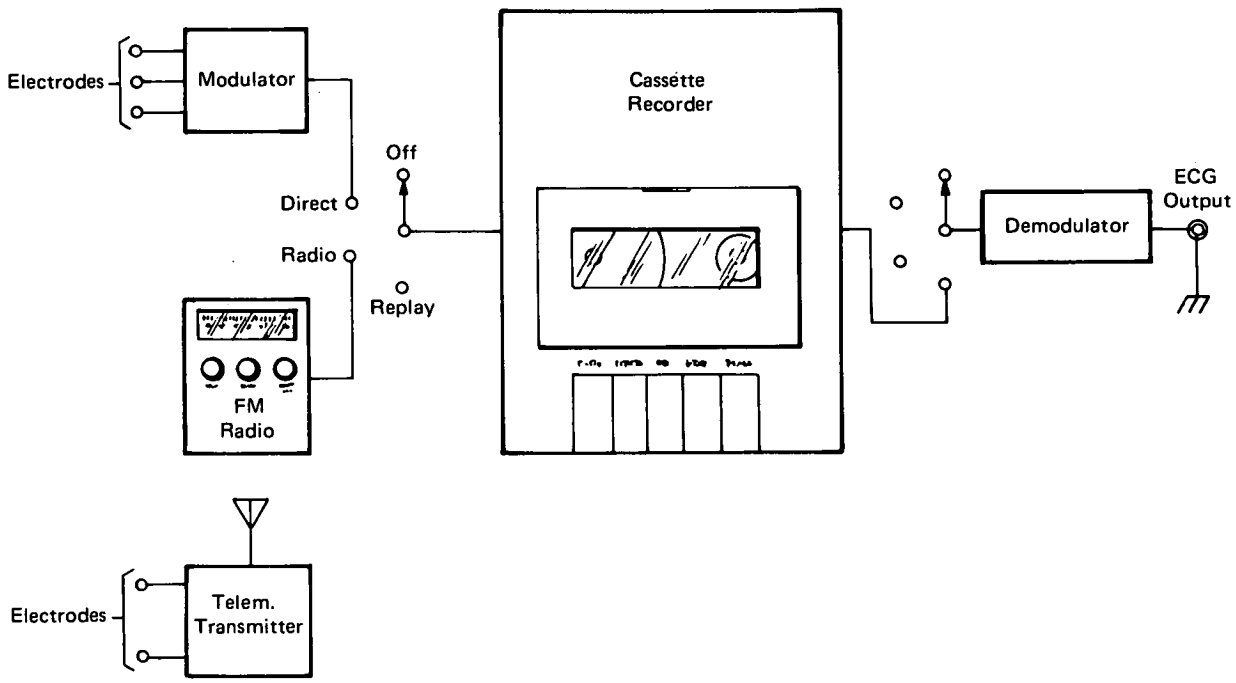
NASA TECH BRIEF

Marshall Space Flight Center

Biopotential Monitoring With Inexpensive Office-Type Cassette Recorders



Biopotential Monitor, Block Diagram

The problem:

Automatic monitoring of vital signs of hospital and ambulatory patients is becoming more common as new, sophisticated medical treatments become available. However, medical personnel handling large numbers of cardiac outpatients through clinics or home or office routines need new methods to acquire, store, and analyze the medical data. One method is to place the data on magnetic tape. Medical-grade recording systems exist to hard-wire-record biopotential signals, but they are so expensive that they price themselves outside most physicians' means. An inexpensive alternative, office tape cassettes, are not currently used because their low frequency limit is higher than the frequency of biomedical signals such as ECG's

The solution:

A low-cost, modified cassette is part of a system that accepts biomedical data for storage. The system accepts a wide range of data and is compactly packaged for portability.

How it's done:

The system, as shown in the illustration, includes three subsystems:

1. A signal conditioner – modulator/transmitter.
2. A cassette recorder – FM receiver.
3. A demodulator.

The signal conditioner amplifies the biomedical signal from the electrodes. It is pulse-rate modulated at a center frequency best suited for the particular recorder

(continued overleaf)

used. To amplify the low-level biopotential signals, a micropower programmable amplifier is used. It has a large open-loop gain, high input impedance, high common-mode rejection, low offset current and voltage, and a very low power consumption.

The amplifier/modulator raises the low-frequency signals by 2 to 5 kHz. This rejects AM noise and allows FM broadcast of the signal with a minimum of circuitry.

A standard office recorder with automatic level control, multiple inputs, AM-FM radio, and battery operation is used for the recording stage. These are available at a very reasonable price and offer a substantial savings over conventional medical systems.

The demodulator accepts any pulse-rate modulated signal on the tape. It consists of a zero-crossing detector/one-shot multivibrator and an integrator. An output signal from the tape recorder is sampled by the zero-crossing detector and provides a sharp transition for each zero crossing. Negative triggers into the multivibrator produce positive output pulses which are smoothed by the integrator to reproduce the original signal.

Because this type of demodulator is not locked to the modulator, it is independent of the modulating frequency and battery voltage fluctuations. Therefore, accurate time measurements are not assured. If accurate time measurements are needed, a phase-locked loop demodulator must be used.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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